INVESTIGATING THE MODULATORS OF HEALTH BEHAVIOUR CHANGE USING THE NOVEL AUT STROKE RISKOMETER APPLICATION

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Abstract

Stroke is a leading cause of death and disability in New Zealand (NZ) with nine out of ten events attributed to modifiable risk factors, including lifestyle behaviours. Conventional, primary stroke prevention paradigms heavily rely on awareness and education to promote changes in lifestyle risk factors (preventative health behaviour changes (PHBCs)) (Brouwer-Goossensen et al., 2016). The Stroke Riskometer™ (SR) mobile application is based on such a strategy, providing users with their 5- and 10-year risk for a stroke to motivate PHBCs (Parmar et al., 2015). However, the effectiveness of such methods in promoting long-term PHBCs, particularly among unmotivated individuals, is limited (Kelly & Barker, 2016). The following research examined the influences of: (1) health beliefs, (2) socioeconomic deprivation and (3) psychosocial stress in initiating and maintaining PHBCs for stroke risk reduction among NZ-based users of the SR and study advertisement responders.

In Study 1 of this three-part research, qualitative interviews based on the constructs of the Health Belief Model were performed with 37 participants. Data analysis revealed that a high perceived risk of a stroke did not motivate PHBCs among study 1 participants. Instead, other health priorities and role-modelling were more powerful promoters of change while social norms and habits were barriers for PHBC. Execution of PHBCs required robust self-regulation and clarity on how to implement PHBCs. Self-regulation was also critical to prevent relapse while significance of the original motivator and acquired PHBC-related benefits strengthened resolve to maintain changes.

Study 2 aimed to investigate the food choice motivations of 179, Auckland-based participants with low and high individual and community-level socioeconomic deprivation. Participants completed questionnaires on overall diet quality (including stroke-risk-increasing foods (e.g., processed foods) and risk-reducing foods (e.g., fruits and vegetables)), food choice motivations and nutritional knowledge. Overall diet quality and intake of risk-reducing foods was significantly lower in the high individual and community-level deprivation groups.

Conversely, risk-increasing food intake was proportionately higher in the latter group. Food prices were considered an important food choice motivation for participants with high individual-level deprivation. However, nutrition knowledge did not vary significantly by the degree of deprivation.

Study 3 investigated the impact of chronic psychosocial stress in 19 participants using a mixed methodology approach. The Trier Inventory for Chronic Stress questionnaire was employed to identify chronic stressors while qualitative interviews explored their impact on the ability to maintain PHBCs and coping techniques used. Chronic stress originated from both work/study-related demands and social issues, initiating both acute and chronic physiological/psychological responses. Participants adopted adaptive or maladaptive techniques for rest and reward or to divert their attention from the stressor. The method adopted was based on their self-regulatory capacity and whether participants valued immediate rewards or future benefits.

The overall research illustrated how an individual transitions from a state of readiness to implementing and maintaining PHBCs long-term. Insights were provided on how an individual's health beliefs, psychosocial stress and deprivation status play a critical role in the success of each stage. Therefore, client-centred strategies accounting for such factors needs to be developed for optimising long-term PHBCs.

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Attestation of authorship

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.

Shwetha Ann George

Signature: Date: 17 January 2021

Transcription conventions

Descriptor	Meaning
Italicised	Stressing or emphasising a point
…	Gap within participant quote indicating non-relevant text (Study 1 and 3)
[ ]	Researcher addition within participant quotes (Study 1 and 3)

Chapter 1 Introduction

Annually, 17 million individuals are affected by stroke with devastating personal, social and economic ramifications (Feigin et al., 2014). Approximately 100 million disability-adjusted life years (DALYs) are lost as a result of the disease (Feigin & Norrving, 2014; Katnelson et al., 2012). In New Zealand (NZ), the stroke burden is greatest among Māori and Pasifika and those with high socioeconomic deprivation (SEDep), slowing the decline in stroke incidence evident in the overall population in the last decade (Dyall et al., 2008; Fink, 2016; Heeley et al., 2011; Marshall et al., 2015). Lifestyle-related risk factors account for approximately 74% of stroke/cardiovascular disease (CVD) incidence (Feigin, Norrving, et al., 2016; Katnelson et al., 2012; Kulshreshtha et al., 2013). Clinically meaningful reductions in stroke risk of up to 80% can be conferred by long-term changes in lifestyle risk factors (a process referred to from now on as preventative health behaviour changes, abbreviated as PHBC). PHBC within the context of this research is defined as the cessation of stroke risk-inducing behaviours (e.g., smoking) or adoption of stroke risk-reducing behaviours (e.g., physical activity).

Mitigating the growing burden of stroke can be achieved by effective community and individual primary prevention approaches (Feigin, Norrving, et al., 2016; Katnelson et al., 2012). Nonetheless, despite global implementation of such measures, prevention strategies still fall short in effecting long-lasting PHBCs (Feigin, Norrving, et al., 2016). Initiating or maintaining PHBC requires motivation, which can be difficult to achieve in those disinclined to PHBCs (Hardcastle et al., 2015). This three-part research study critically evaluated three key moderators that could impact PHBC engagement or its continued preservation (Figure *1.1)*.

Firstly, the role of an individual's health beliefs (e.g., risk perceptions, benefits/barriers of behavioural changes) in facilitating PHBC was explored in Study 1. Behavioural theorists have long explored what determines an individual's health-related choices, resulting in a myriad of Social Cognition Models (Jones et al., 2014).

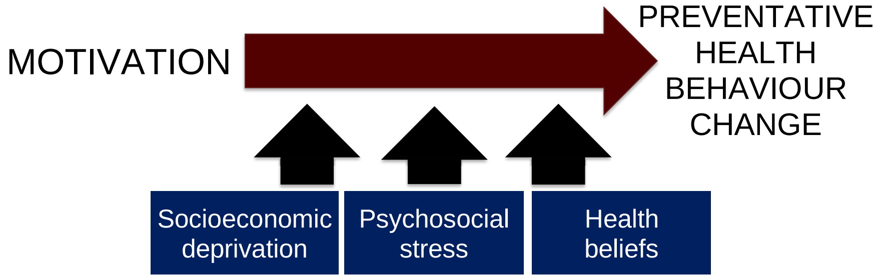

Figure 1.1 SEDep, stress and health beliefs were hypothesised as impacting an individual's motivation for PHBC.

Of these, the Health Belief Model (HBM) is the oldest and most utilised framework for examining behavioural changes associated with disease prevention. The model incorporates three core perceptions including: (1) susceptibility to developing an illness, (2) severity/consequences of the illness, and (3) benefits and barriers of undertaking behaviours that counteract the risk (Sullivan et al., 2010; Sullivan & Waugh, 2007). Situational cues and self-efficacy[1] were also incorporated into the model for determining PHBC likelihood. Utilising the HBM to explore participants' PHBC motivations was based on: (1) its widespread use as the basis of PHBC-based interventions and (2) limited understanding about how health beliefs impact PHBCs in healthy individuals.

The second arm of the research (Study 2) explored how study participants' aptitude for performing diet-related PHBCs were influenced by socioeconomic restrictions. Both internationally and in NZ, stroke onset has been independently predicted by increasing individual and community SEDep (P. Brown et al., 2005; Carter et al., 2008; Grimaud et al., 2011; Weir et al., 2005). SEDep is classified as observable and demonstrable disadvantage, relative to the norms of their local community or wider society, in material resources (goods, resources, amenities, physical environment) and social resources (roles, functions, rights and responsibilities) (Salmond & Crampton, 2000, 2001). Current national and international evidence suggest a negative association between SEDep and dietary intake (Benjamin et al., 2017; Darmon & Drewnowski, 2015; Ministry of Health, 2008; Statistics New Zealand & Ministry of Pacific Island Affairs, 2011; Wong et al., 2017). An unhealthy diet (low in fresh

[1] See glossary

fruits and vegetables and high in processed food, fats, sugar and salt) is classified as the fourth most important risk factor for stroke (Melaku et al., 2018; O'Donnell et al., 2016). Prior research suggest that deprived populations reported food cost concerns, have limited access to healthy dietary options and insufficient knowledge of food nutrition (C. Black et al., 2014; Pearce, Day, et al., 2008; Pearce, Hiscock, et al., 2008; Thornton et al., 2011; Turrell & Giskes, 2008).

The final arm of the study (Study 3) explored the impact of psychosocial stress in hindering motivation for PHBC using a mixed methodology study design. Many scholars hold the view that psychosocial stress has a positive correlation to stroke-induced morbidity and mortality (Booth et al., 2015; Henderson et al., 2012; Kotlęga et al., 2016; O'Donnell et al., 2016). Maladaptive coping[2] efforts to reduce stress such as increases in smoking or consuming high-calorie diets may play a key role in facilitating or exacerbating this association (Holton et al., 2016; Kotlęga et al., 2016).

In summary, the overarching goal of this doctoral work was to explore how readiness, implementation and maintenance of PHBC for primary stroke risk prevention in NZ participants was affected by: (1) an individual's health beliefs (i.e., stroke risk perceptions, benefits/barriers of behavioural changes), and (2) external pressures (e.g., psychosocial stress and socioeconomic deprivation). The layout of this thesis is outlined in Figure *1.2*.

1.1 RESEARCH BACKGROUND AND RATIONALE

PHBCs have profound implications on primary prevention efforts for reducing the risk of stroke and mitigating young onset strokes and the growing stroke burden among NZ's minority groups (Feigin, Roth, et al., 2016; Goldstein & Sacco, 2016; Katnelson et al., 2012; Kulshreshtha et al., 2013; Norrving et al., 2015). A wealth of research exists on the impact of interventions based on education and awareness and their PHBC outcomes upon individuals at a high risk of a stroke.

[2] See glossary

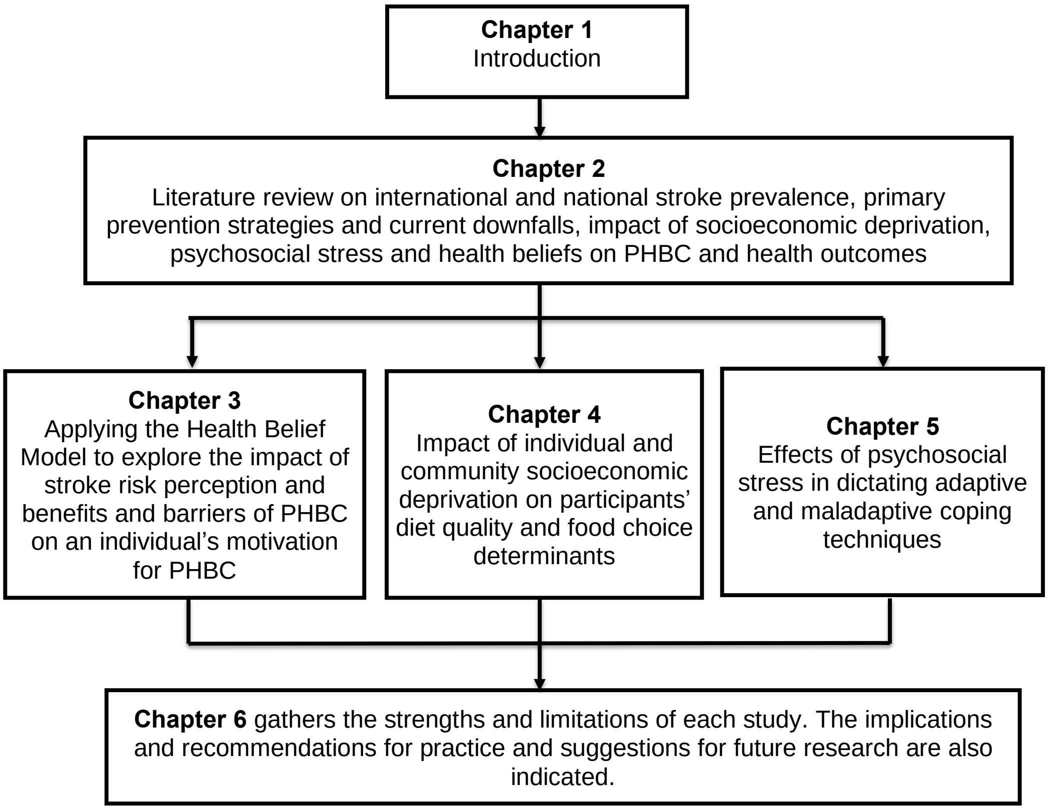

Figure 1.2 Study design and structure of thesis

The precedence of such strategies to deliver advice on the proximal determinants of disease (such as obesity or smoking) (Egger et al., 2017; Kelly & Barker, 2016). Delivery of health information are also entering a new technological era, venturing into the field of smartphone technologies and health apps (see Section 2.7 for a full discussion of current research and findings). There is an increasing use of digital communication technologies to disseminate health information quickly to the general public and healthcare providers alike, improving clinical decision-making and access to health services (Dubey et al., 2014; Nam et al., 2013; Takao et al., 2012; Yan et al., 2016). 2014 saw a surge of health-related mobile applications (mHealth apps) available for download on both iPhone and Android platforms (J. Zhao et al., 2016). Developed by AUT researchers in collaboration with national and international stroke experts, non-governmental organisations and Māori/Pasifika researchers, the *Stroke Riskometer*^{TM} (SR) mobile application is such a technology aimed at empowering self-management of stroke risk in a population-wide approach (Clary et al., 2017; Dubey et al., 2014; Feigin, Norrving, et al., 2017b; Parmar et al., 2015). The technology is endorsed by a number of international organisations including the World Stroke Organization (2019), World

Federation of Neurology and International Association on Neurology and Epidemiology (Feigin, Norrving, et al., 2017b; Parmar et al., 2015). To date, the SR is the only app which: (1) allows users to compute their projected risk for developing a stroke, (2) defines stroke symptoms and risk factors, and (3) provides evidence-based recommendations for risk factor self-management (Parmar et al., 2015; M. Zhang & Ho, 2017).

The proposal for this doctoral project was shaped by the researcher's interactions with participants in a 6-month pilot study that aimed to determine whether the SR motivated community-based participants to modify their lifestyle risk factors (Krishnamurthi et al., 2019). In preliminary conversations with the researcher during the follow up assessments, participants who did not modify risk factors revealed comparable knowledge to those who did regarding their: (1) future risk of a stroke, (2) risk factor prevalence and (3) benefits of a healthy lifestyle. Instead, the fundamental and often uncontrollable circumstances that limited their ability to adopt health promoting lifestyle choices were highlighted. Concerns around the cost of healthy eating, recurrence of stress and its management, restrictions of time and effort were reasons that emerged often. Moreover, early literature searches revealed research committed to understanding these PHBC limitations for the primary prevention of stroke within a NZ context is next to none. The impetus from these observations guided the researcher's rationale to gain valuable insight into factors other than poor awareness which dictated the likelihood of PHBCs (or lack of). Motivation for change is a complex phenomenon. Balancing a multitude of commitments and expectations and limitations exerted by one's circumstances are daily challenges for making PHBCs possible. Current prevention paradigms do not sufficiently account for such distal determinants of chronic disease and the vested interests for those disinclined to change are characterized by such determinants (Kelly & Barker, 2016) (Section 2.8).

In summary, four key factors offered a clear rational and significance for this doctoral research. Firstly, the challenges that limit PHBCs and extend beyond poor risk awareness and understanding have not been well understood in current research. The research sought to potentially clarify why traditional prevention strategies based on education and advice giving has, at best, short-term success but certainly very limited long-term effectiveness. Secondly, the alignment of one's values/priorities with the need for PHBCs has implications on motivation for implementing and maintaining PHBCs. Thirdly, there is a paucity of NZ-based research committed to understanding food choice motivations that may explain SEDep-related dietary inequalities. Such investigations are critical considering that NZ's most stroke-susceptible populations, Māori and Pasifika, typically reside in the most deprived areas and generally follow an unhealthy dietary pattern (elaborated in Section 2.8.2.1). Lastly, while stressors and coping responses linked to stroke risk has been well characterised, the intent and motivations that drive different coping methods have been sparsely explored within a NZ context.

This research provided an original and unique opportunity for inquiry with an often-silent group; i.e., the exploration of stories, perspectives and lived experiences of New Zealanders who struggle to make positive lifestyle choices or simply choose not to, regardless of having the resources and opportunities to. The current research adds to an evidence base that investigates and builds an understanding of these significant factors and could transpose to meaningful, practical outcomes. Knowledge from this research could optimise effective, long term PHBCs through the delivery of recommendations that are informed by the patients' capabilities, limitations, needs and goals.

The next chapter is a comprehensive literature review that first defines what constitutes a stroke, followed by the national and global burden of stroke, and its health and economic implications. Known risk factors for stroke which may become the target of preventative efforts are also identified. Where available, information on the NZ context is provided. Secondly, an overview of evidence-based recommendations for primary prevention is outlined. Existing gaps in current prevention strategies and behaviour change interventions that impede their effectiveness in generating long-lasting PHBCs are discussed. In this regard, existing literature evidence validating the critical role of motivation in PHBC implementation and maintenance is presented. The section concludes with a discussion on the current evidence illustrating the moderating influences of individual health beliefs, SEDep and psychosocial stress upon PHBCs.

Chapter 2 Literature Review

2.1 INTRODUCTION

A literature review was undertaken to provide context and identify the gaps in current knowledge to necessitate the rationale for performing this research. The scope of the review summarized and evaluated several research areas including: (1) the current burden of stroke, both in NZ and globally, and risk factor prevalence, (2) shortcomings of current primary stroke prevention paradigms and (3) the factors that potentially contribute towards these limitations and were the focus of the current research (i.e., health beliefs, SEDep and psychosocial stress).

2.2 METHOD

The steps for the literature review were performed as described by Snyder (2019). A narrative review approach was undertaken as the intent was to review and synthesise relevant research trends on a given research area (Snyder, 2019). Next, relevant literature was identified by developing a search strategy, creating the appropriate search terms, databases for searching and the inclusion exclusion criteria for selecting which articles to include in the review (Snyder, 2019). A comprehensive search index was achieved by searching for relevant literature through the AUT library's electronic databases, namely Scopus, Psych Info via OVID, Social Science Citation Index, PubMed, SpringerLink, Wiley Online Library, JSTOR, Web of Science, EBSCO Health and Medline. These databases were chosen as they provided a comprehensive source of up to date, peer reviewed articles on health and social research. Searches of a more informal nature using Google Scholar were also initiated. A variety of search terms ensured the review process was undertaken thoroughly to identify as many relevant articles as possible. Table 2.1 describes the search terms used to identify articles relevant to each research question. Alternative terms for each search term were linked with Boolean operators "OR" and combined with others using "AND". Search terms for research questions 1-4 were linked to "stroke" to obtain articles relevant to stroke research.

Table 2.1

Research questions and relevant search terms used in the literature review

Research question	Search terms
What is the pathophysiology of stroke?	Stroke pathology, cerebral haemorrhage, thrombosis, embolism, ischemia, haemorrhage, atherosclerosis, plaque, clot cerebral artery, subarachnoid cavity, intracerebral cavity
What is the current stroke burden both globally and in New Zealand?	Stroke, burden of stroke, stroke and New Zealand, stroke mortality, stroke incidence, stroke disability, stroke cost, stroke hospitalization, stroke rehabilitation, stroke fatality, first ever stroke, recurrent stroke, stroke and Māori, stroke and Pacific Islander, stroke and socioeconomic status
What is the impact of lifestyle risk factors upon stroke risk?	Stroke risk factors, modifiable risk factors, behavioural risk factors, stroke and smoking, stroke and alcohol, stroke and diet, stroke and exercise,
What are common primary stroke prevention strategies and what are its shortcomings?	Stroke primary prevention, stroke units, recombinant tissue plasminogen activator, population wide stroke prevention, tobacco control, risk estimation, high risk stroke prevention, digital technology, smartphone app, motivational population-wide prevention, health-related apps, Stroke Riskometer, Framingham Stroke Risk, QStroke prediction, education and awareness, advice,
What are the shortcomings of current prevention strategies and behavioural change interventions? (Health behaviour change included as a common search term)	Attrition rate, motivation, advice giving, prevention engagement, doctor-patient information transfer models, goal related behaviour change, social psychological theory, self-regulation, chronic disease hierarchy, unmotivated, disinclination,
How do health beliefs influence PHBCs? (Health behaviour change included as a common search term)	Models of social cognition, intentions, self-efficacy, health belief model, perceived risk of disease, perceived susceptibility of disease, readiness, situational cues, optimistic bias, benefits of behaviour change, barriers of behaviour change, health belief model and smoking, health belief model and alcohol, health belief model and exercise, health belief model and diet.
How does socioeconomic deprivation impact diet quality, food choice motivations and nutrition knowledge? (Diet included as a common search term)	Socioeconomic status (indicators such as income, education, occupation and deprivation) and stroke, socioeconomic status and diet (articles published in NZ and international), socioeconomic status and food choice, food cost, store access, low income area and food outlet, food environment, food desert, food swamp, deprived neighbourhood, takeaway, supermarket, fast food, time scarcity, food preparation, food convenience, food familiarity, food familiarity and social norms, food decision, reward based eating system, environmental friendly foods, natural content foods, nutritional claims, health-related claims, environmental sustainability, ecological cost of transportation, carbon trust labels, food sensory appeal, taste preference, processed foods, calorie dense foods, nutrition knowledge, nutritional information
How does stress impact PHBCs? (Health behaviour change included as a common search term)	Psychosocial stress, prolonged or cumulative stressors, chronic stress, maladaptive coping, adaptive coping, stress and exercise, stress and diet, stress and smoking, stress and alcoholism.

The review was conducted in stages, first by selecting articles based on their abstracts and then confirming whether they met the inclusion and exclusion criteria by reading the full-text articles. Title, abstracts and keywords of search results for each research question were screened against the inclusion criteria after duplicates were discarded. The formulated inclusion criteria included: (1) full text, peer reviewed journal articles, (2) articles published in English, (3) articles published within the last 10 years (except for original articles describing key theories utilized in the thesis). Articles were excluded if full texts were not available and if they were: (1) primarily focused on secondary stroke prevention or other cardiovascular disease, (2) studies that employed animal models, (3) discussed experimental treatment and (4) were phase 1-4 clinical trials. Another search strategy was to also review the references list in the selected articles to identify other potentially relevant publications that were not produced during the database search. Full text articles were imported into the researcher's Mendeley Library. Pertinent data from the retrieved articles were extracted and findings were systematically evaluated and synthesised.

2.3 DEFINITION OF STROKE AND ITS SUBTYPES

Stroke or cerebral ischemia is classically characterised as a manifestation of heterogeneously-different diseases including cerebral haemorrhages and several pathogenic subtypes of ischemic stroke (IS) (Sacco et al., 2013). Stroke is caused by a major disruption of blood flow to a part of the brain, resulting in an intricate pathophysiological response and acute, localised injury (P. George & Steinberg, 2015; Sacco et al., 2013; Soler & Ruiz, 2010). The two main pathological causes of stroke either include a thrombotic or embolic ischemia (compromised blood flow due to a block) or a haemorrhage (ruptured blood vessel and blood flow escape) (Auer, 2016; Gibson & Attwood, 2016; Sacco et al., 2013) (Figure *2.1*).

Around 80% of strokes are ischemic in nature, caused by narrowing or rupture of an atherosclerotic plaque (Aminde et al., 2017; Béjot et al., 2016; Gibson & Attwood, 2016). As a result, clots form in a major cerebral artery or thrombi detach and travel through vasculature to impede a distant blood vessel (Aminde et al., 2017; Béjot et al., 2016; Gibson & Attwood, 2016).

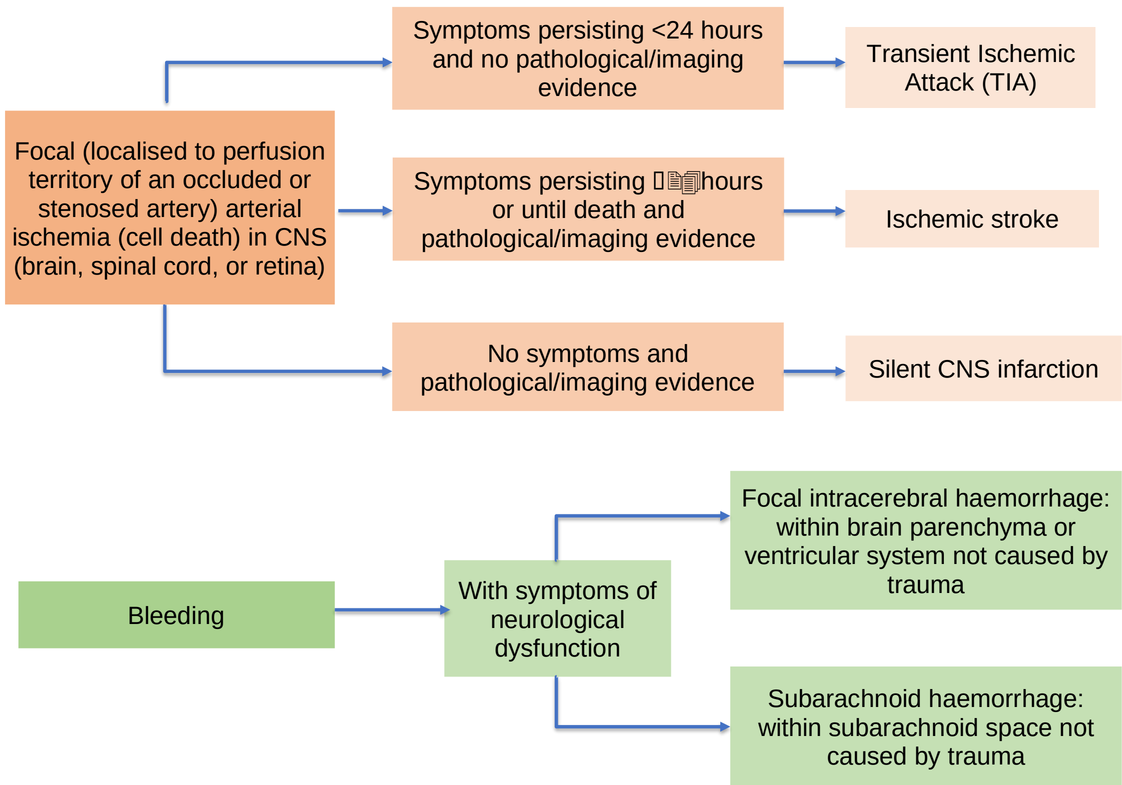

Figure 2.1 Schematic of pathophysiology of ischemic and haemorrhagic strokes (Adapted from (Auer, 2016; Gibson & Attwood, 2016; Sacco et al., 2013)).

This results in insufficient blood flow to either the entire or localised areas of the brain and loss of tissue perfused by the affected vessel (Gibson & Attwood, 2016; H. Zhang et al., 2011). Focal ischemic attacks caused by an occlusion in the cerebral circulation constitute the fourth highest cause of deaths and disability in the US (H. Zhang et al., 2011). The remaining 20% of strokes are haemorrhagic, defined by episodes of acute bleeding in the intracerebral or subarachnoid cavity of the brain parenchyma (Amin & Schindler, 2017; Flügel et al., 2016). A subarachnoid haemorrhage (SAH) event is caused by either: (1) the rupture of intracranial aneurysm of major blood vessels at the base of the brain, or (2) an arteriovenous malformation which bleeds into the space below the arachnoid membrane (Broderick et al., 2003). Intracerebral haemorrhage (ICH), where bleeding is into the brain parenchyma itself, is associated with significantly worse functional impairments (e.g. inability to swallow or incontinence) and greater mortality compared to IS (Bhalla et al., 2013).

2.4 THE GLOBAL BURDEN OF STROKE

As the world's second leading cause of death, dementia and long-term disability and the leading cause of pre-mature death, stroke has a more devastating impact than other established non-communicable diseases (Feigin, Abajobir, et al., 2017; Feigin, Norrving, et al., 2017a; Feigin, Roth, et al., 2016; Roth et al., 2015; Yan et al., 2016). In 2015, stroke moved for the first time from the third to the second largest cause of DALYs in the world (Feigin, Norrving, et al., 2017a). Approximately 6.7 million of 17.5 million CVD-related deaths are attributable to stroke, and age-standardised prevalence in those >65 years is estimated to be between 36-73/1000 person-years (Iacoviello et al., 2018). Stroke is likely to remain a global health issue for the foreseeable future due to an aging population and a worldwide epidemic of major stroke risk factors such as hypertension and diabetes (Feigin, Krishnamurthi, Parmar, et al., 2015; Feigin, Norrving, et al., 2016).

While age-standardised mortality rates of stroke have declined in the last two decades, the absolute numbers of individuals affected (particularly young people and those in low and middle income countries), stroke-related deaths, survivors and DALYs lost have profoundly increased with substantial geographical variations in stroke burden (Feigin, Krishnamurthi, Parmar, et al., 2015; Feigin, Norrving, et al., 2017a; Feigin & Norrving, 2014; Katnelson et al., 2012; Mozaffarian et al., 2016; Roth et al., 2015). Increases in stroke-related deaths can be attributed to increasing life-expectancies and a growing elderly population (Béjot et al., 2016). Stroke-related deaths, incident strokes and prevalent strokes have increased from 1990 to 2015 by 41%, 66% and 84%, respectively (Feigin, Norrving, et al., 2017b). These increases may be attributable to increases in incidence of haemorrhagic and IS stroke in younger adults aged 20 to 64 years (Feigin, Norrving, et al., 2017a). The last two decades have also seen an increase in the absolute numbers of haemorrhagic stroke incidences. The 2010 Global Burden Study reported an 18.5% increase in global age-standardised, haemorrhagic stroke events from 1990–2010 (Krishnamurthi et al., 2014). A total of 62.8 million DALYs lost due to haemorrhagic stroke and highest incidences (80%) and deaths (63%) were reported in developing countries in 2010 (Krishnamurthi et al., 2014).

According to the 2013 Global Burden of Diseases study, stroke is no longer a disease of the elderly (Feigin, Roth, et al., 2016). Two-thirds of all strokes affect people <70 years of age, and 60% of all strokes and over one-third of stroke-related hospitalisations are experienced by those <65 years of age (Amin & Schindler, 2017; Feigin, Norrving, et al., 2017a, 2017b). There was a significant 35% increase in the total number of childhood strokes and a 25% increase in incidence among young adults (20–64 years) between 1990 and 2013 (Béjot et al., 2016; Feigin, Norrving, et al., 2016, 2017a; Krishnamurthi et al., 2015). This was concomitant with an increase in the prevalence of obesity, smoking, alcohol consumption, hypercholesterolemia and diabetes mellitus among young adults (Béjot et al., 2016).

2.4.1 Stroke impact on health-related quality of life, economic and healthcare systems

Stroke is the second and third largest cause of DALYs in developing and developed countries, respectively (Feigin, Krishnamurthi, Parmar, et al., 2015; Feigin, Norrving, et al., 2017a). Approximately 20–30% of stroke survivors have severe and permanent disabilities, with 70% having a compromised work capacity (Gibson & Attwood, 2016). As many as 44–75% are dependent on caregivers and family for self-care activities (Gibson & Attwood, 2016). Neurological disabilities include paralysis, compromised co-ordination, deficits in sensory function and language (Gibson & Attwood, 2016). Cerebral stroke constitutes the second biggest contributor of epilepsy and stupor in elderly patients (Dąbrowska-Bender et al., 2017). Often symptoms such as reduced physical mobility can promote severe psycho-emotional consequences including low self-esteem, depression, limited social contact and withdrawal from a social support system (Dąbrowska-Bender et al., 2017).

Rates of cognitive impairment and dementia increase substantially with stroke incidence (Feigin, Krishnamurthi, Bhattacharjee, et al., 2015; Norrving et al., 2015). Healthcare systems suffer significant financial strain to manage the disability and handicap experienced by long-term stroke survivors (Feigin, Krishnamurthi, Bhattacharjee, et al., 2015; Norrving et al., 2015). In the US, the average lifetime costs attributed to inpatient care, rehabilitation and follow-up equates to approximately $140,048, with stroke-related care costing over $30 billion each year (Amin & Schindler, 2017; Seshadri & Wolf, 2010). Severe strokes which score >20 on the National Institutes of Health Stroke Scale cost significantly more than milder strokes, with co-morbidities augmenting the overall costs (Seshadri & Wolf, 2010).

2.5 STROKE BURDEN IN NZ

Age-standardised stroke incidence in NZ is among the lowest compared to other developed countries (Krishnamurthi, Ikeda, et al., 2020) and only accounted for 7.4% of all NZ deaths in 2017 (Ministry of Health, 2017). The following are trends observed among cases registered in the greater Auckland region acquired during the Auckland Regional Community Stroke (ARCOS I—IV) studies (Feigin, Krishnamurthi, Barker-Collo, et al., 2015). Over the last 30 years, there has been a steady decline in 30-day IS case fatality (due to improved post-stroke care) (33.1% over 1981/82 to 18.8% over 2011/12), SAHs(6.6% over 1981/82 to 4.2% over 2011/12) in and first ever and recurrent strokes (from 211/100,000 persons/year over 1981/82 to 153/100,000 persons/year over 2011/12) (particularly in people aged >65 years, NZ Europeans [henceforth referred to as Caucasians] and Asians) (Feigin, Krishnamurthi, Barker-Collo, et al., 2015; Fink, 2016; Krishnamurthi et al., 2018). In this region, age-standardised rates of stroke mortality have also declined over 1981/82 to over 2011/12 across all ethnic groups (98/100,000 over 1991/92 and 37/100,000 over 2011/12) (Feigin, Krishnamurthi, Barker-Collo, et al., 2015).

However, the proportion of recurrent strokes and age-adjusted incidence rates (particularly large-artery atherosclerosis) remain high among Māori (192/100,000 people/year over 1981/82 to 192/100,000 people/year over 2011/12) and Pasifika (152/100,000 people/year over 1981/82 to 275/100,000 people/year over 2011/12) compared to Caucasians (209/100,000 people/year over 1981/82 to 154/100,000 persons/year over 2011/12) (Feigin, Krishnamurthi, Parmar, et al., 2015; Feigin, Mensah, et al., 2015; Fink, 2016; Salmond et al., 2007; Statistics New Zealand, 2017). Māori display worse 28-day case fatality rates (53/100,000/persons/year compared to 35/100,000/persons/year among Caucasians over 2011/12) and SAH incidence (age adjusted rate between 2002 and 2011 of 1.24 (0.55-2.81) compared to RR 0.75 (0.50-1.13) among Caucasians) while rates of all strokes remained significantly high among Pasifika (Feigin, Krishnamurthi, Barker-Collo, et al., 2015; Krishnamurthi et al., 2018). Onset of stroke occurs at a younger age in these groups compared to Caucasians (59.6, 61.6, and 67.5 compared to 75 years) and they also display greater risk factor incidence such as diabetes and obesity

(Feigin, Krishnamurthi, Barker-Collo, et al., 2015; Krishnamurthi et al., 2018). Lifestyle risk factors maybe more prevalent in Pasifika due to their generally low socioeconomic status and experiences of rapid acculturation and sociocultural change (Paterson et al., 2016). Additionally, significant burden is seen among males in terms of first-ever and recurrent strokes (age adjusted rates of 167/100,000/persons/year compared to 140/100,000 among females over 2011/2012) with an increasing trend in crude IS incidence rates in young persons (16–64 years) (50/100,000/persons/year over 2002/03 to 55/100,000/persons/year over 2011/12) (Feigin, Krishnamurthi, Barker-Collo, et al., 2015; Norrving et al., 2015; Soliman et al., 2014).

Available data for national stroke statistics is limited to the NZ Annual Health Survey which describe the crude (unadjusted) prevalence/percentage of people affected by stroke in the entire NZ population. Work by Sandiford, Selak and Ghafel (2016) also report ethnic trends in 28-day case fatality rates. These data reflect similar trends to the ARCOS studies (Ministry of Health, 2019) (Figure *2.2 and* Figure *2.3)*. Māori and Pasifika display worse fatality rates compared to Caucasians (age/sex standardised rate of 1.36 and 1.06 over 2000-2004 and 1.51 and 1.42 over 2010-2014) (Sandiford et al., 2016) . However, observations from the 2019/ Annual Health Survey indicate crude prevalence rates are declining for young onset strokes and Māori. It must be noted though that data was: (1) based solely on self-report (as opposed to ARCOS data collection methods through clinical records) and (2) only collected for three quarters of the survey year due to COVID 19 restrictions, reducing the sample size analysed and wider confidence intervals (Ministry of Health, 2020b).

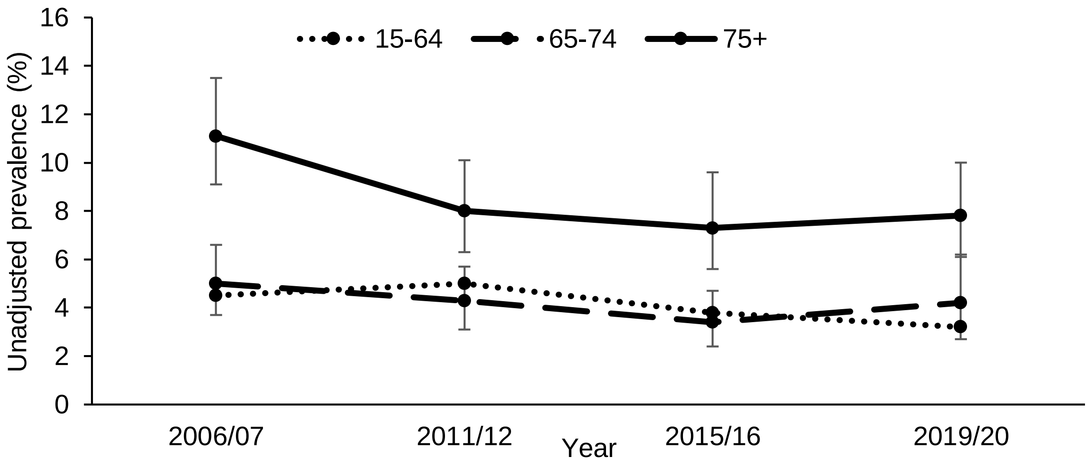

Figure 2.2 NZ time trends in stroke prevalence across age groups. Data points are in % with 95% CIs (Data extracted from (Ministry of Health, 2019))

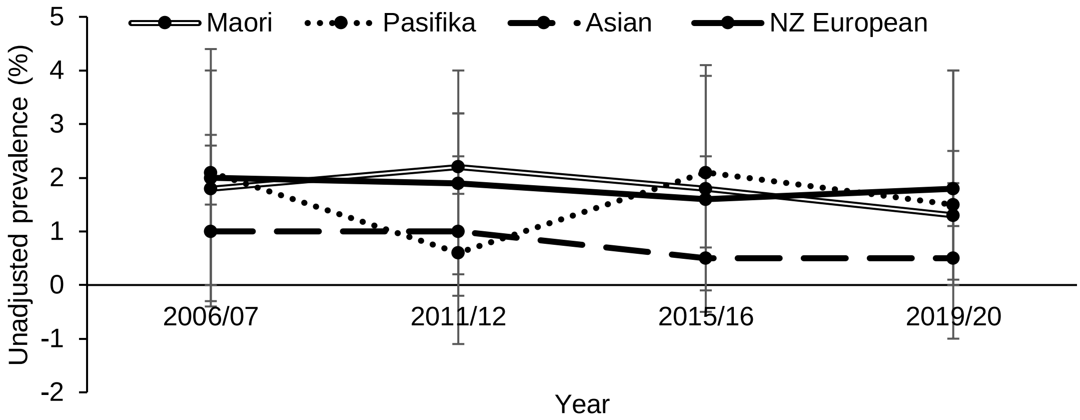

Figure 2.3 NZ time trends in stroke prevalence across ethnic groups. Data points are in % with 95% CIs (Data extracted from (Ministry of Health, 2019)

2.6 STROKE RISK FACTORS

Policies that promote short- and long-term population welfare and stroke prevention need to be informed by the: (1) identification of important risk factors, (2) extent to which each risk factor augments or mitigates a population's stroke burden, and (3) possible interactions between them (Feigin, Roth, et al., 2016; Seshadri & Wolf, 2010). The pathogenetic processes that underlie different subtypes in addition to an individual's age, geographical location and economic status determine what variables constitute stroke risk factors (Amin & Schindler, 2017; Seshadri & Wolf, 2010). Nevertheless, certain risk factors are conducive for all stroke subtypes and are classified into modifiable and non-modifiable risk factors. Key modifiable risk factors (amenable to change and target for primary prevention strategies) are summarised in Table 2.2.

Table 2.2

Modifiable Risk factors for stroke.

Chronic alcohol consumption (5.8%) **	Hypertension (140/90 mmHg) (47.9%) **
Psychosocial stress (17.4%) **	Cholesterol (26.8%) *
Smoking/tobacco use (12.4%) *	Diabetes (3.9%) *
Sedentary lifestyle (35.8%) **	Cardiac causes (9.1%) **
Obesity (body mass index [BMI] and proportion of waist to hip) (18.6%) **	Suboptimal diet quality (23.2%) **

*Risk factors linked to all stroke subtypes.
**Risk factors for ICH
In brackets: Relative population importance of ten risk factors that collectively account for 90% of universal stroke risk according to the 2016 INTERSTROKE study (Feigin, Norrving, et al., 2017a; Goldstein & Sacco, 2016; Mozaffarian et al., 2016; O'Donnell et al., 2016). Data is for all ages, genders and ethnicities.

While hypertension remains the primary target for stroke prevention, regional variations in stroke incidence and subtypes can be attributed to differences in the relative contribution of each risk factor (Feigin, Roth, et al., 2016). According to Feigin et al. (2016), more than 90% of the 2013 global stroke burden was due to the combined effect of obesity, sedentarism[3], high-fasting plasma glucose and total cholesterol, dietary intake high in sugar and sodium and low in vegetables, alcohol consumption and smoking. High-fasting plasma glucose, total cholesterol, systolic blood pressure (BP) and BMI, in addition to behavioural risk factors, were the leading causes of stroke-related DALYs, particularly in low-income and middle-income countries (Feigin, Roth, et al., 2016; Iacoviello et al., 2018).

In NZ, those of Māori and Pasifika descent are twice as likely to be smokers and have a higher prevalence of diabetes, hypertension, obesity, chronic alcohol consumption and poor dietary habits compared to other ethnicities (Bay et al., 2015; V. Feigin et al., 2006). This may explain the higher stroke incidence, stroke-related mortality and age- and gender-standardised hospitalisation rates in these populations (Bay et al., 2015). As the overall research focus centred around modifying behavioural risk factors, the literature evidence on the associations between stroke risk and chronic alcohol consumption, psychosocial stress, smoking/tobacco use, sedentarism and suboptimal diet quality[4] are further explored below.

2.6.1 Chronic alcohol consumption

Out of all the risk factors, the relationship between alcohol consumption and stroke risk is unique. A curvilinear relationship is suggested between level of alcohol intake and IS-related mortality (Wood et al., 2018). According to a meta-analysis of 35 observational studies, light to moderate consumption (1 standard drink (12g of alcohol)/day for females and 2 standard drinks/day for males) seemingly exerts a protective effect from CVD and first-ever IS (28% risk reduction) (Goldstein & Sacco, 2016; Katnelson et al., 2012). The mechanisms by which this is achieved is by increasing HDL-C levels, apolipoprotein A1 and adiponectin and reducing fibrinogen and platelet aggregation (Goldstein & Sacco, 2016; Katnelson et al., 2012; Kernan et

[3] See glossary
[4] See glossary

al., 2014; Soler & Ruiz, 2010). Conversely, daily bingeing (>3 drinks/day) increases first-ever IS risk by up to 69% as well as recurrent stroke (Goldstein & Sacco, 2016). Such increases are due to a heightened risk for hypertension, cardiomyopathy, Diabetes Mellitus, hypercoagulability, reduced cerebral blood flow, atrial fibrillation and other arrythmias (Goldstein & Sacco, 2016; Katnelson et al., 2012; Kernan et al., 2014; Seshadri & Wolf, 2010; Soler & Ruiz, 2010). Additionally, there is a general consensus that cigarette smoking often accompanies heavy drinking, further increasing risk (Seshadri & Wolf, 2010). For both SAH and ICH, any amount of alcohol consumed is found to be independently deleterious and risk follows a concentration gradient (Kernan et al., 2014; Pollack et al., 2014).

In a NZ context, socioeconomically-deprived individuals and Māori were more likely to be hazardous drinkers than their counterparts (Bay et al., 2015; Ministry of Health, 2019). Daily hazardous alcohol consumers (>40g/day for females, >60g/day for males) have significantly greater risk of IS-related mortality compared to those who completely abstained (J. Connor et al., 2005, 2013). In 2007, 25.7% of IS-related deaths in Māori 35–44 year olds could have been eliminated if light-to-moderate levels of alcohol were consumed (J. Connor et al., 2013). Nonetheless, alcohol does not induce any protection against haemorrhagic stroke-induced mortality, with risk being significantly higher for all levels of male and female alcohol consumers compared to abstainers (J. Connor et al., 2013).

2.6.2 Chronic psychosocial stress

Psychosocial stress is defined as “at least several periods of self-reported tension, irritability, nervousness, anxiety or sleeplessness attributed to poor health, family relationships, living arrangements, occupational stress, economic/financial stress and stressful life events” (Booth et al., 2015, p. 2). In recent years, people’s experiences of psychosocial stress have significantly increased due to globalisation and rapid social and cultural transformation and challenges (M. Liu et al., 2017). Chronic stressors are ongoing difficulties which have a long-lasting, severe impact and have a high likelihood of recurrence compared to short-lived acute stress events (Dohrenwend, 2006; M. Stults-Kolehmainen & Sinha, 2014). Psychosocial factors associated with stroke risk include: job stressors, psychological and behavioural factors (depression, mood, anger, coping), interpersonal relationships (social activity, qualify of life) and social deprivation (Graber et al., 2019). In NZ, prevalence of stress was more common in females, decreased with age, was 5.7% higher in Māori than non-Māori, and 2.1 times greater in those living in NZ's most socioeconomically-deprived areas (Ministry of Health, 2016, 2019)

It is a widely held view that perceived chronic psychosocial stress plays a critical role in promoting stroke risk and incidence of IS and haemorrhagic stroke, particularly in females (Booth et al., 2015; Egido et al., 2012; Graber et al., 2019; O'Donnell et al., 2016).
The standardised, international case-control INTERSTROKE study classifies recurring periods of general stress over a year as exacerbating stroke risk (Henderson et al., 2012; O'Donnell et al., 2010). These observations were mirrored in a recent systematic review where psychological stress contributed towards a 39% increase in stroke risk (Graber et al., 2019). Stress associated with one's occupation and interpersonal factors increased stroke risk by 35% and 16%, respectively (Graber et al., 2019). Similarly, Henderson and colleagues (2012) reported a two-fold increase in stroke mortality and 31% incidence of IS among older adults who fell within the parameters of greatest psychosocial distress over a six-year follow-up period. Tsutsumi, Kayaba and Ishikawa (2011) demonstrated that employees with high job demands and poor job control (e.g., limited decision-making authority) had >5-fold higher risk for incident stroke. However, conflicting findings have also been reported. For instance, Torén and co-authors (2014) established no links between psychosocial job stress exposure and increased stroke risk.

There is a paucity of longitudinal research investigating the impact of psychosocial stress on stroke-related health outcomes in the NZ population. Research conducted to date is also not consistent with international evidence. A 2014 study demonstrated that there were no increases in acute IS admissions following the 2010 and 2011 Christchurch earthquakes (T. Y. Wu et al., 2014). Nonetheless, the degree of earthquake severity and infrastructure damage was considered to have elongated discharge periods for stroke patients (T. Y. Wu et al., 2014). Chronic stress experiences following the earthquakes were postulated to mediate this pathway, though investigators conducted no explicit measures of stress levels to validate the role of stress. These observations were also mirrored in an eight-year follow-up study of meat-processing plant workers who experienced mental health impact after being made redundant from their jobs (Keefe et al., 2002).

2.6.3 Smoking/tobacco use

A considerable body of literature demonstrates how cigarette/tobacco smoking increases the risk of silent brain infarction (by up to 50%), first IS event (two-fold), and SAH/ICH (three-fold) (Goldstein & Sacco, 2016; Katnelson et al., 2012; Mozaffarian et al., 2016; Seshadri & Wolf, 2010). The 1970s oral contraceptives studies were the first to identify the role of cigarette smoking as a risk factor for stroke, which has a synergistic effect on other stroke risk factors such as systolic blood pressure (Mozaffarian et al., 2016; Seshadri & Wolf, 2010). Smoking induces greater risk for females than males, and constitutes an independent risk factor for all stroke subtypes (Amin & Schindler, 2017; Cesare et al., 2013). The relative risk for smokers <55 years of age of developing cerebral infarct was 2.9, while for those >74 years of age it was 1.1 (Soler & Ruiz, 2010). The Nurses' Health study, a prospective eight-year follow-up study involving nearly 120,000 females, identified an increased risk for SAH and thrombotic stroke in smokers (Yu et al., 2016). Smoking also accentuates progression and subsequent instability of atherosclerotic plaques, facilitates platelet aggregation, increases blood viscosity, slows coronary flow velocity, and damages endothelium/blood vessel linings (Amin & Schindler, 2017; Mozaffarian et al., 2016; Soler & Ruiz, 2010). Smoking shares a proportionate, dose-dependent relationship with stroke and CVD risk. Compared to non-smokers, passive smokers still have twice the risk of stroke (Soler & Ruiz, 2010). Those who smoke 1–14 cigarettes daily have a 4-fold relative risk of having an SAH while those who smoke 25 or more cigarettes daily have a 9.8-fold higher risk (Seshadri & Wolf, 2010). Even more concerning is newer evidence suggesting that stroke risk increases by 20–30% with exposure to environmental tobacco smoke, after accounting for other risk factors (Kernan et al., 2014; Malek et al., 2015).

Although former smokers still have a higher risk of stroke compared to non-smokers (relative risk of 1.34), smoking cessation can equalise total and IS risk to that of abstainers within 2–4 years of cessation (Goldstein & Sacco, 2016; Katnelson et al., 2012; Mozaffarian et al., 2016; O'Donnell et al., 2016; Shah & Cole, 2010). Up to 60% risk reduction can be achieved with cessation, regardless of how many cigarettes were originally smoked, when smoking was initiated or the presence of other risk factors (Mozaffarian et al., 2016; Shah & Cole, 2010). Asian smokers who smoked >20 cigarettes/day and quit had 0.66 and 0.58 reduced risk of IS and SAH compared to current smokers (Song & Cho, 2008).

The impact of smoking and secondhand smoke exposure on NZ stroke prevalence rates is well documented, with a general coherence to international trends (Heeley et al., 2011; Mason et al., 2016). While the number of current and daily Māori and Pasifika smokers have significantly decreased from 2012 to 2019, prevalence is still the highest among Māori and Pasifika (Glover et al., 2013; Ministry of Health, 2016, 2019) Compared to other ethnicities, Māori and Pasifika are still more likely to be daily and current smokers (Bay et al., 2015; Ministry of Health, 2019). Māori females have one of the highest smoking rates in the world, with age-adjusted rates of smoking in Māori females 3.7 times higher than non-Māori (Glover et al., 2010; Ministry of Health, 2019). Prevalence of smoking is also 1.7 times more likely in Pasifika and 3.6 times more likely in adults residing in more socioeconomically-deprived areas (potentially due to the over-representation of Māori and Pasifika in deprived areas) (Bay et al., 2015; Glover et al., 2010; Ministry of Health, 2019).

2.6.4 Sedentary lifestyle

Meta-analytic and longitudinal evidence pertaining to physical activity and stroke confirms a graded, inverse relationship between amount and duration of physical activity and stroke incidence (Goldstein & Sacco, 2016; Howard & McDonnell, 2015; Katnelson et al., 2012; Mozaffarian et al., 2016). For effective stroke risk reduction, the American Heart Association/American Stroke Association recommends approximately 150 minutes of moderate intensity or 75 minutes of vigorous intensity exercise (e.g., jogging) per week and muscle-strengthening activities at least twice a week (Kernan et al., 2014; Mozaffarian et al., 2016). The benefits of exercise originate from its modulatory capacity in: (1) regulating bodyweight and reducing depression, (2) lowering BP, (3) improving lipid metabolism and endothelial function, (4) reducing blood viscosity, fibrinogen levels and platelet aggregability, and (5) reducing insulin resistance (raising HDL and lowering LDL cholesterol levels) and improving glucose tolerance (Howard & McDonnell, 2015; Katnelson et al., 2012; Kernan et al., 2014; Seshadri & Wolf, 2010; Soler & Ruiz, 2010).

The impact of physical exercise in reducing the risk of total stroke, IS and haemorrhagic stroke as well as incidence and mortality has been well documented in non-randomised cohort studies (Howard & McDonnell, 2015; Kernan et al., 2014; Soler & Ruiz, 2010). An average risk reduction of 10–30% can be achieved in moderately to highly active males and females (Kernan et al., 2014). Some research observations outline gender-specific effects of physical activity on stroke risk (McDonnell et al., 2013; Willey et al., 2009). A 2010 meta-analysis concluded that females required more intense physical activity for similar stroke risk reduction compared to males (Diep et al., 2010). However, more recent evidence indicate a dose response relationship with stroke risk and risk reduction by up to 20% regardless of gender (J. Li & Siegrist, 2012). From 2006/07 to 2015/16, the prevalence of NZ-based Asian, Pasifika and Māori adults who performed vigorous physical activity significantly reduced, and adults living in socioeconomically-deprived areas were less likely to be physically active (Ministry of Health, 2016). To our knowledge, no prior studies have reported NZ-specific relative risks for stroke in relation to physical activity/or inactivity. Given the prevalence of inactivity in NZ's most stroke-susceptible populations, research in this area is highly warranted.

2.6.5 Suboptimal diet quality

Dietary guidelines both in NZ and internationally advocate for the crucial role of diet quality in regulating stroke risk (Benjamin et al., 2018; Dijkstra et al., 2014; Meschia et al., 2014; Ministry of Health, 2015; Mozaffarian et al., 2016; New Zealand Guidelines Group, 2009). A dose-related, up to 22% reduction in stroke risk and mortality can be achieved by following a Mediterranean diet (wholegrains, fruits, nuts and vegetables and omega-2 rich fish) or the Dietary Approaches to Stop Hypertension diet (fruits, vegetables, low-fat dairy products, and reduced intake of total and saturated fat) (Goldstein & Sacco, 2016; Kontogianni & Panagiotakos, 201; Mahe, Ronziere, Laviolle, & Golfier, 2010; Mozaffarian et al., 2016; Seshadri & Wolf, 2010). The benefits of a Mediterranean diet consumption include: (1) preventing arterial thrombosis, (2) reducing biomarkers of sub-clinical inflammation and oxidative stress linked to stroke, and (3) facilitating clinically-relevant, long-term changes in modifiable risk factors such as obesity, systolic BP, type 2 diabetes and dyslipidaemia (Amin & Schindler, 2017; Benjamin et al., 2017; Katnelson et al., 2012; Kontogianni & Panagiotakos, 2014; Mahe et al., 2010; Mozaffarian et al., 2016; Seshadri & Wolf, 2010; X. Zhang et al., 2015).

Western dietary patterns (higher intakes of red and processed meats, refined grains and sweets) increase stroke risk in American females by up to 56% (Mahe et al., 2010; Mozaffarian et al., 2016; Sherzai et al., 2012; X. Zhang et al., 2015). French Caucasian patients who had a symptomatic IS event consumed a diet rich in saturated fatty acids and low in mono-unsaturated fatty acids prior to their stroke (Mahe et al., 2010). Table 2.3 summarises dose response relationships of specific food items and stroke risk reduction or increase, as reported across several recent prospective cohort and epidemiological studies. Nonetheless, these trends are not consistently replicated (Q. Sun et al., 2017) and the effects of fish intake are dependent on stroke subtype, gender and geographic residence (W. Zhao et al., 2019).

NZ dietary guidelines endorse a diet with a higher intake of vegetables, fibre, legumes, fruit, fish and shellfish, poultry, and wholegrains, which has been associated with decreased stroke risk (Ministry of Health, 2015). According to the 2015/16 Adult NZ Health Survey, Māori, Pasifika and Asians and those living in socioeconomically-deprived areas were less likely to eat the recommended daily servings of fruits and vegetables (two to three servings respectively) (Bay et al., 2015; Ministry of Health, 2016). The prevalence of NZ adults of all ages, genders and ethnicities who ate at least two servings of fruit per day also declined significantly between 2006/07 and 2015/16 (Ministry of Health, 2016).

Table 2.3

Dose relationships between stroke risk and specific food intake increments

Food type	**Dose response relationship**
Fruits	Every 200 g/day, 32% risk reduction in total stroke (Hu et al., 2014)
Vegetables	200 g/day, 11% risk reduction in total stroke (Hu et al., 2014)
Wholegrains	90 g/day (approx. 3 servings/day), RR* of 0.88 for IS (Aune et al., 2016; J. Chen et al., 2016)
Fish (>200 g/week)	4% risk reduction in hemorrhagic stroke (Zhao et al., 2019)
Milk	200 g/day, 7% risk reduction in total stroke (De Goede et al., 2016)
Cheese	40 g/day, RR* 0.97 of total stroke risk (De Goede et al., 2016)

Food type	Dose response relationship
Low-fat dairy(milk products with <2g fat/100g, cheese with <20g fat/100g)	200 g/day, RR* 0.96 of total stroke risk (De Goede et al., 2016)
High-fat dairy(milk products with ≥2g fat/100g, cheese products with ≥20g fat/100g	200 g/day, RR* 1.04 of total stroke risk (De Goede et al., 2016)
Potassium (abundant in vegetables, fruits, wholegrains, legumes, nuts, dairy)	1 g/day, 10% risk reduction in total stroke (D'Elia et al., 2014), 90-120 mmol/day, RR* 0.76 of total stroke risk (Aburto, Hanson, et al., 2013)
Red meat	>50 g/day, RR* 1.11 of total stroke risk (Kaluza et al., 2012) and RR* 1.22 of total stroke risk (Pan et al., 2016)
Processed red meat	>0 g/day, RR* 1.15 of IS risk (Kaluza et al., 2012) although no significance was seen in study by Pan et. Al. (2016)
Fresh red meat	>70 g/day. RR* 1.15 of IS risk (Kaluza et al., 2012; Pan et al., 2016)
Sugar-sweetened beverages	1 serving/day, 33% increase in IS risk (Narain et al., 2016) although Pase et. al. (2017) did not find an association
Artificially-sweetened beverages	1 serving/day, 8% increase in total stroke risk (Narain et al., 2016) and HR** 2.96 of IS risk (Pase et al., 2017)
Sodium	≥2g/day, RR* 1.24 of IS risk and RR 1.63 of stroke (Aburto, Ziolkovska, et al., 2013)

RR: Relative risk ratio <1 suggests a reduced risk; >1 suggests an increased risk in the group who met the threshold intake of the given food item
HR: Hazard ratio > 1 suggests an increased risk, < 1 suggests a smaller risk

2.7 CURRENT RECOMMENDATIONS FOR STROKE PREVENTION

Given the global upward trend in stroke incidence, disability and deaths, increased efforts at primary and secondary prevention need to be aggressively undertaken. Preventative actions addressing behavioural risk factors can help: (1) mitigate the incidence of not only stroke but also coronary heart disease, cancer, diabetes and pulmonary heart disease, (2) reduce the likelihood of stroke-associated dementia and cognitive decline, and (3) curb threats to society's socioeconomic progression (Feigin, Norrving, et al., 2016; Norrving et al., 2015). Prevention of strokes requires the combined efforts of several sectors, including, but not limited to, governmental bodies, non-government organisations, health sectors, communities, industries and individuals (Feigin, Norrving, et al., 2016; Norrving et al., 2015). Such actions also need to begin early in life and be carried on throughout, given that most lifestyle behaviours are initiated in childhood (Norrving et al., 2015).

2.7.1 Primary prevention of stroke

To achieve more effective treatment of acute stroke and curb the degree of disability, therapeutic strategies such as stroke units and recombinant tissue plasminogen activator treatments have been developed (Katnelson et al., 2012). However, there is a scarcity of these in developing countries as well as some developed countries due to limited resources (Katnelson et al., 2012). Furthermore, 75–77% of strokes that occur each year are first-ever strokes (Iacoviello et al., 2018; Katnelson et al., 2012; Parmar et al., 2015). Therefore, primary prevention measures are central to limiting premature death in future generations, mitigating the growing stroke burden and achieving a sizeable public health benefit (Beaglehole et al., 2011). A sizeable 75–80% reduction in stroke risk across all genders and ethnicities can be achieved through interventions that reduce behavioural risk factors (Feigin, Roth, et al., 2016; Goldstein & Sacco, 2016; Katnelson et al., 2012; Kulshreshtha et al., 2013; Norrving et al., 2015). Such PHBC-based interventions holds great promise in mitigating preventable stroke events, improving health outcomes and reducing associated costs of healthcare (Feigin, Norrving, et al., 2016; J. Zhao et al., 2016). These strategies also need to be tailored to resource availability, country-specific stroke epidemiology and an individual's as well as a region's unique stroke risk profile (Feigin, Norrving, et al., 2016; O'Donnell et al., 2016).

There are two main approaches to primary prevention (Goldstein & Sacco, 2016; Meschia et al., 2014; O'Donnell et al., 2010). A population-wide approach aims to shift risk factor distribution in the population, primarily through environmental changes (Goldstein, 2016). Successful strategies that have significantly reduced CVD-related mortality in the US and other developed nations over the last decade include: (1) legislative regulations on tobacco control, (2) raising prices and limiting marketing of industrially-produced unhealthy food items, (3) food labelling, (4) evoking taxes based on alcohol content, reducing promotion and merchandising of alcohol, stringent up-regulation of drink-driving penalties and early interventions for at-risk drinkers, (5) implementing awareness of nutritional information in restaurants, (6) providing healthy food options and mandating physical activity in schools, and (7) committing public spaces and reserves for recreational centres and parks (Beaglehole et al., 2011; Goldstein & Sacco, 2016). Such strategies are capable of instigating at least small changes in risk factor distribution and benefits extend to the entire population (including high-risk patients) (Beaglehole et al., 2011; Feigin, Norrving, et al., 2016). Major reductions in stroke incidence and burden inequalities and prospective gains in healthcare costs can also be achieved through such interventions (Beaglehole et al., 2011; Feigin, Norrving, et al., 2016).

Nonetheless, the current focus of worldwide stroke prevention programmes is to target those with a high absolute risk of stroke/CVD, owing to the prevalence of hypertension and dyslipidaemia (Béjot et al., 2016; Feigin, Norrving, et al., 2016, 2017b). NZ-based clinicians use risk estimation tools which compute an absolute, 5–10 year risk of a CVD based on the presence of major vascular risk factors (Feigin, Norrving, et al., 2016; Goldstein & Sacco, 2016; Parmar et al., 2015). Those with a risk of 15% over the next 5 years or ≥30% over the next 10 years are classified as high risk for having an established CVD (Feigin, Norrving, et al., 2016). Identification of high-risk patients assists healthcare professionals to motivate them to undertake lifestyle modifications and comply with treatment plans (Goldstein & Sacco, 2016). Aggressive implementation of such strategies in combination with medication regimes can theoretically reduce CVD incidence by at least 11% (Feigin, Norrving, et al., 2016).

Despite their unique benefits, the shortfalls of both high-risk and population-wide approaches have been widely debated (Table 2.4) (Beaglehole et al., 2011; Béjot et al., 2016; Feigin, Krishnamurthi, Barker-Collo, et al., 2015; Feigin, Norrving, et al., 2016, 2017b; Yan et al., 2016).

2.7.2 Limitations of current PHBC-based strategies

Increasing engagement and preventing relapse must be the top priorities for PHBC interventions (Fjeldsoe et al., 2011). In NZ, stroke risk awareness, marketing initiatives to educate and empower individuals to improve health and health apps have been part of policy interventions for years (J. Bauer & Reisch, 2019). Despite these endeavours, it is reasonable to argue that solely – or even largely – relying on such strategies is not sufficient to curb the increasing stroke-associated disability rates, risk factor prevalence, young onset strokes and growing burden in elderly and minority groups (Feigin, Krishnamurthi, Barker-Collo, et al., 2015). Similarly, the sustainability of prevention efforts made by app-based initiatives are not without concern. Despite initial CVD risk factor modifications and PHBC implementation, only short-term changes have been documented to date (Conroy et al., 2014; Hingle & Patrick, 2016; Pagoto et al., 2013).

Table 2.4

Current shortcomings in high-risk and population-wide measures (Data adapted from (Beaglehole et al., 2011; Béjot et al., 2016; Feigin, Krishnamurthi, Barker-Collo, et al., 2015; Feigin, Norrving, et al., 2016, 2017b; Yan et al., 2016).

High risk	• Complex interactions of multiple stroke determinants
	• Excludes the majority of at-risk population and promotes false reassurance of no risk in low-to medium- risk individuals, limiting motivation to modify existing risk factors
	• Adequate/meaningful recommendations to reduce risk behaviours[5] and improve medication adherence often not received, potentially due to ineffective communication between clinicians and patients
	• Limited stroke awareness, its risk factors and management in general population due to insufficient access to preventative measures, health resources and prediction models
	• Inadequate focus on alcohol consumption and diet in stroke/CVD risk algorithms
	• Unaffordable consultation costs for CVD risk assessment (doctor's fees, laboratory visits)
	• Inadequate population-specific algorithms to calculate risk
Population wide	• Cost and investments associated with setting up (e.g., increasing health food outlet numbers)
	• Controversial changes in policy and legislation which are often not supported by the heavyweight industries (e.g. reducing salt quantities in processed foods)
	• Limited large scale behavioural changes (e.g., sodium intake) may be challenging due to the addictive nature of lifelong habits

Possibly one of the greatest contributors to limited effectiveness of current PHBC interventions are an overreliance upon patient education as the underlying facilitator of PHBC (Brouwer-Goossensen et al., 2016; Sullivan & Waugh, 2007). Receiving accurate knowledge about the risk-reducing benefits of PHBC is often the first step in instilling confidence in the ability for PHBC (Egger et al., 2017). However, education and awareness are simply one aspect of a core set of determinants that dictate PHBC (Simpson et al., 2011). Physical and diet-related PHBCs based on 'advice provision' only show moderate, short-term (<six month) improvements in outcomes (Bayley et al., 2015; Fjeldsoe et al., 2011; Kelly & Barker, 2016; Kuriakose et al., 2020; Michelini et al., 2014). Attrition rates as high as 30% at 12 months have been reported in weight loss and obesity treatment programmes (Hadžiabdić et al., 2015). While 5% of smoking cessation attempts that were unaided last for at least six months, approximately 50% report relapse over the following years (West, 2017). Users of mHealth apps that are founded upon 'advice giving' methods often lack the inclination to consistently access app

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features over time to cultivate PHBC (Hingle & Patrick, 2016). Even amongst stroke survivors, repeated education on physical activity and its associated benefits does not inspire greater engagement with exercise (Boysen et al., 2009; Morris et al., 2012; Simpson et al., 2011).

Two primary errors of educational strategies are the fundamental assumptions that: (1) common-sense drives behaviour change, and (2) translating information from expert sources is capable of driving PHBC, a concept founded on conventional doctor-patient information transfer models (Kelly & Barker, 2016). Patients often report that their ability to undertake PHBCs are limited by other factors as opposed to a lack of understanding on the importance of a healthy lifestyle (Kelly & Barker, 2016). Therefore, factors beyond knowledge that moderate when and how PHBC recommendations are undertaken must be systematically assessed.

2.8 THE ROLE OF MOTIVATION

Initiating and sustaining new behaviours is achieved by one's own motivation and desires (Samdal et al., 2017). Motivation requires significant cognitive investment but is critical for ensuring successful PHBC, as it guides and maintains complex goal-related behaviour change (Egger et al., 2017; Frost et al., 2018). In the context of intervention-mediated PHBCs, it is important to recognise that motivation is: (1) a person's capacity to recognise an issue and having a purposeful intention to act upon it, (2) is multi-dimensional, influenced by internal and external factors forming the conditions of change, and (3) capable of fluctuating over time and in response to varying situations (Hardcastle et al., 2015; R. Ryan et al., 2011). Social psychological theories highlight the importance of harnessing motivation and converting it into action, in addition to a robust self-regulatory capacity for successful PHBC (Bayley et al., 2015; Hardcastle et al., 2015; Samdal et al., 2017). An individual's self-regulatory strength is a renewable cognitive resource that depletes in response to demands for regulating one's thoughts, feelings and behaviour (Samdal et al., 2017).

Public health practitioners and PHBC strategists face considerable challenges in implementing PHBC among unmotivated individuals, especially if they don't have pre-existing health conditions that require constant monitoring (Dennison et al., 2013; Hardcastle et al., 2015; Kelly & Barker, 2016; Simpson et al., 2011). mHealth app engagement may also be limited among such individuals, even if they have a high risk factor prevalence (Dennison et al., 2013). Those with little to no motivation for PHBCs lack the intent, interest or need to initiate change and are resistant to any change recommendations (Hardcastle et al., 2015). In education-based interventions and clinical settings, the norm is to provide advice on the most obvious drivers of disease or proximal determinants (e.g., smoking) (Egger et al., 2017; Kelly & Barker, 2016). Nonetheless, chronic disease is characterised by a complex hierarchical aetiology where immediate visible causes of disease are preceded by more medial and distal determinants (Egger et al., 2017). The vested interests of those disinclined to PHBC lie in the complex social, political and economic milieu that characterise such distal determinants (Kelly & Barker, 2016). Therefore, the key to profound and long-lasting PHBCs in unmotivated individuals is to move beyond resolving proximal determinants and address medial and distal driving forces of behaviour (Egger et al., 2017). Figure *2.4* is an illustration of the intensity of motivation needed to initiate diet-related PHBCs at different stages of the disease determinant hierarchy. The more distal the determinant, the more barriers experienced for PHBC and greater the motivation and effort needed to successfully implement PHBC.

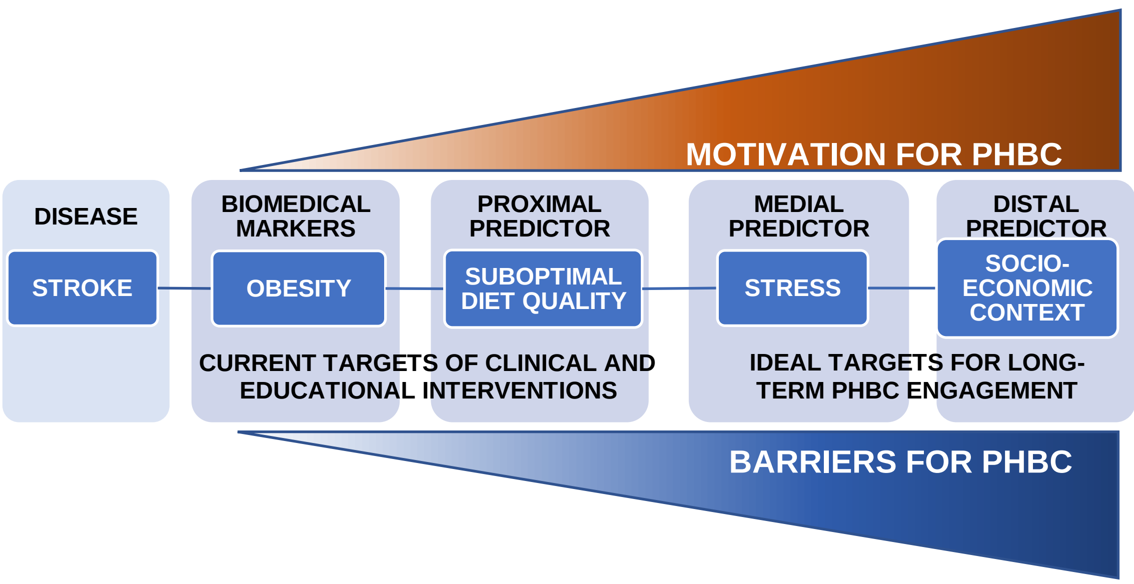

Figure 2.4 Process pathway of determinants leading to chronic disease development and intensity of the motivation and barriers experienced along this pathway (Data extracted from (Egger et al., 2017)).

Thus, better support for PHBC can be provided with thoughtful consideration of what motivates individuals and the constraints that limit them. This research hypothesizes that motivation for PHBC occurs when: (1) there is a truly intrinsic desire (i.e., health beliefs) to initiate change and (2) environmental conditions (i.e., SEDep and psychosocial stress) that influence such changes are optimal. These variables are considered as moderators in the causal pathway between motivation and PHBC and are reviewed in the following sections.

2.8.1 Health beliefs and PHBC

Central to health promotion research are a number of theoretical models that improve behavioural understanding, rationalise and provide context for behaviours and frame important issues (Glasson et al., 2011). Table 2.5 outlines five theories based on health cognitions (thoughts and feelings individuals associate with health behaviours) that are widely used to determine psychological determinants of PHBC. These models of social cognition share common PHBC determinants such as intentions, expectation of outcomes and self-efficacy (Conner & Norman, 2015).

Table 2.5

Summary of commonly used social cognition models to predict PHBCs (Data adapted from (Conner, 2010; Conner & Norman, 2015, 2017; Mullan et al., 2015; R. M. Ryan & Deci, 2017)

Model	Key determinants of PHBC
Protection Motivation theory (Maddux & Rogers, 1983)	-Perceived susceptibility and severity of disease -Belief in the effectiveness of PHBC -Extrinsic + intrinsic rewards of risk behaviours -Barriers to PHBC -Self-efficacy
Self-determination theory (Deci & Ryan, 1985)	-Competence/self-efficacy for PHBC -Perceived behavioural control and self-regulation[6] -Relatedness: feeling that PHBCs are supported and valued by others
Theory of planned behaviour (Ajzen, 1991)	-Attitudes towards PHBC (beliefs about its outcomes) subjective norms[7] (others' thoughts around undertaking PHBC) -Perceived behavioural control over PHBC (access to resources and opportunities to perform PHBC)
Social cognitive theory (Bandura, 1986)	-Expectation of outcomes (physical, social and self-evaluative) -Socio-structural factors (impediments or opportunities for PHBCs) -Self-efficacy

One such model is the Health Belief Model (HBM), a four-factor predictive paradigm that merged from the work of US public health researchers Hochbaum, Kegeles, Leventhal and Rosenstock (Hochbaum et al., 1952). The model is endorsed by the World Health Organization

[6] See glossary
[7] See glossary

as an effective practice-based model of health promotion and education (Villar et al., 2017). Figure *2.5* demonstrates the constructs of the HBM and how these determine the likelihood of PHBCs reducing the risk of stroke.

The perceived risk of developing a disease, contributed to by perceived susceptibility and severity of disease, determines an individual's 'psychological state of readiness' to undertake PHBC (Battawi & Sofar, 2018; Sulat et al., 2018). Normally, those with a strong state of readiness need minimum situational cues and suitable environmental conditions to undertake PHBC (Battawi & Sofar, 2018). Those who perceive themselves at high risk of an illness are more likely to be concerned by existing risk factors and adhere to PHBC recommendations, compared to those who underestimate their own risk (optimistic bias) (Brouwer-Goossensen et al., 2016; Powers et al., 2008). Alternatively, fear can be counterproductive where the worry about developing an illness or its impact can lead to denial and not undertaking PHBCs (Brouwer-goossensen et al., 2016).

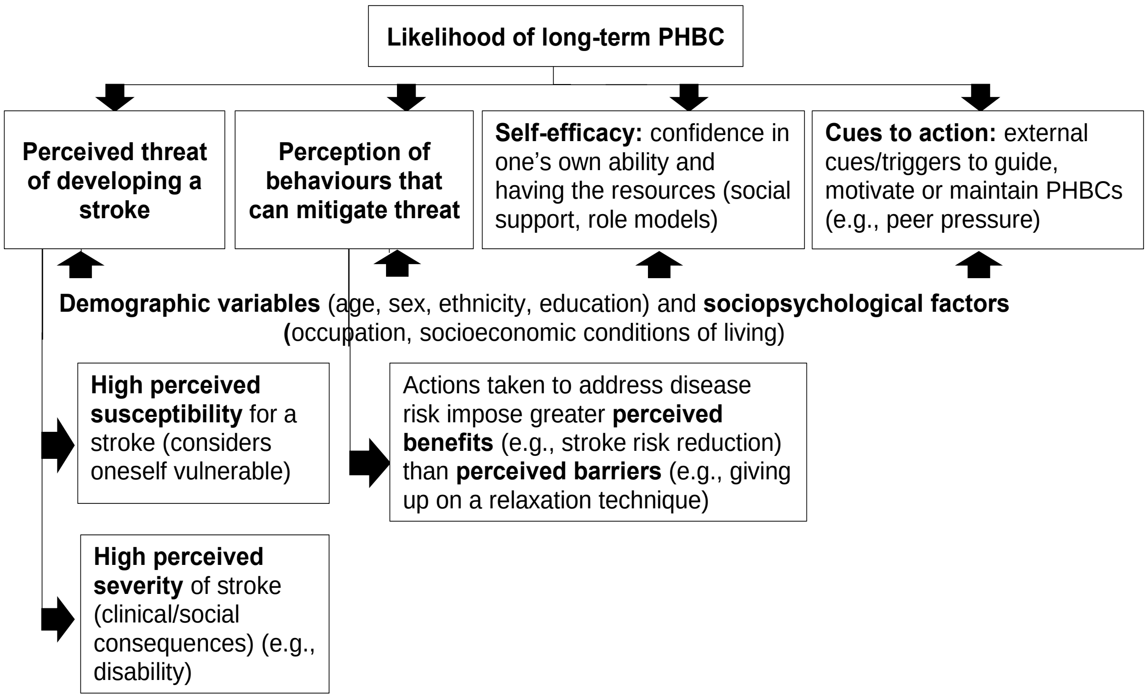

Figure 2.5 Conceptual framework of stroke related PHBCs based on the HBM (Data extracted from (Hardcastle et al., 2015; Mohammadi et al., 2017; Sulat et al., 2018; Villar et al., 2017)).

PHBC is also facilitated by the motivational propensity to ensure better health, substantiated by the belief that PHBC benefits (such as risk reduction) outweigh the physical/mental costs of implementing PHBCs (Brouwer-Goossensen et al., 2016; Conner, 2010; Sulat et al., 2018). Conversely, pre-set beliefs of the efforts involved in PHBC (e.g., perceiving exercise as ‘too difficult’) and anticipating that its costs outweigh its benefits can minimise its importance (Hardcastle et al., 2015). Situational cues/external compulsions can assist one to acknowledge a potential risk for illness development and, if strong enough, may elicit PHBCs even without a state of readiness (Powers et al., 2008).

The parsimonious model is one of the most functional and cited frameworks with proven capacity to predict PHBCs for disease prevention and explain health inequalities (S. Choi & Duffy, 2017; Farrag et al., 2017; Hoseini et al., 2014; Sulat et al., 2018; Villar et al., 2017). Compared to other models of social cognition, the HBM was regarded as a better fit for Study 1 objectives as the intent was to determine if high perceived susceptibility and severity for stroke motivated PHBCs in a healthy population. Adequate risk perception, especially for CVDs and stroke, is critical for initiating changes in lifestyle risk factors (Kraywinkel et al., 2007). The following sections review the literature evidence on the impact of HBM constructs in predicting PHBCs associated with stroke risk: healthy diet[8], physical activity, alcohol intake and smoking.

2.8.1.1 HBM, diet and physical activity-related PHBCs

A large number of empirical studies concede that perceived benefits and barriers to eating healthily has the greatest predictive impact on diet-associated PHBC intentions (H.-S. Kim et al., 2012). The most noted barriers to healthy eating are irregular working hours and insufficient time to prepare healthy meals, cost and accessibility, and taste preferences (Alm & Olsen, 2017; Macdiarmid et al., 2013; McMorrow et al., 2017). Craving for palatable foods[9], boredom, an active social life and emotional imbalances (e.g., social/peer pressure, stress) have also been noted as barriers for healthy eating, particularly among college students (Macdiarmid et al., 2013; Silliman et al., 2004). Some authors conclude that improving self-efficacy in vegetable preparation and taste perception of unfamiliar vegetables increases vegetable consumption (D. Brown et al., 2015; McMorrow et al., 2017).

Perceived barriers constitute the most important determining factor of physical activity

[8] See glossary
[9] See glossary

among the elderly (Khorsandi et al., 2017). Attendance in exercise programmes is influenced by self-efficacy, perceived risk for illnesses in which sedentarism is an important risk factor, and perceived barriers in following an exercise regime (Khorsandi et al., 2017; Villar et al., 2017). Women who work long hours, have obligations or experience significant time pressure are also not likely to exercise, while household conflicts limit involvement in sporting activities among young adults (M. Stults-Kolehmainen & Sinha, 2014).

2.8.1.2 HBM and alcohol-related PHBCs

A considerable body of literature exists on the influence of HBM constructs on alcohol-related behaviour, focusing on recognised barriers, cues to action and self-efficacy traits. Young people often perceive themselves at low risk of alcohol-related health issues due to the 'invincibility fable', a form of cognitive egocentrism where an individual assumes an 'it won't happen to me' attitude (Champion et al., 2015). Other barriers in this age group include the social context around drinking and pervasive, pro-drinking social norms, shown to also predict future alcohol misuse in Brisbane-based high school students (J. P. Connor et al., 2011). In those >55 years of age, intentions to drink >6 times/week were for celebratory occasions, to pursue relaxation and stress relief and peers endorsing frequent drinking (Haydon et al., 2016). However, bingeing[10] was limited in this age group as it promoted a sense of irresponsibility and the benefits of alcohol intake were only short-term (Haydon et al., 2016). For war veterans and Swedish individuals with mild to moderate alcohol dependence, maintaining appearances and a desire to hide the issue were significant barriers in seeking out treatment (Burnett-Zeigler et al., 2011; Finn et al., 2014). Such individuals felt seeking treatment indicated failure, experienced shame and feared the stigma and societal marginalisation associated with being labelled an alcoholic (Burnett-Zeigler et al., 2011; Finn et al., 2014). Limited media messages on the addictive impact of alcohol and insufficient support systems also impede cessation in patients with alcohol use disorders (Mona et al., 2014).

Perceived benefits for *not* drinking have also been well characterised in the literature. A

[10] See glossary

predominant benefit of not bingeing for Australian females is health concerns and a low perceived tolerance to its after-effects (e.g., hangovers) (Haydon et al., 2016). Females aged 25 to 34 and over 45 years had limited intent to drink even occasionally, due to commitments or concerns from family members (Haydon et al., 2016). In short, the literature pertaining to beliefs and normative referents that drive alcohol intake strongly suggests age and generational disparities.

2.8.1.3 HBM and smoking-related PHBC

The perceived benefits of quitting smoking are well documented, both in NZ and globally and across a broad range of demographic groups. Table 2.6 summarises the literature on primary motivations for intentions to quit, quit attempts or abstinence across different populations, particularly NZ's Māori and Pasifika groups. The impact of cigarette costs and proximal social environment on smoking behaviour is a double-edged sword. Normally the cost of cigarettes does not constiute a singular cause for quitting and even if it does, such quit attempts are temporary and smoking is re-initiated once the cost can be met (Fernandez & Wilson, 2008; Glover et al., 2010). Among Māori, this factor was discounted as a viable reason for quitting, especially if they could smoke after paying for necessities (Glover et al., 2010, 2013). Additionally, cigarette costs are highly variable across regions. For example in the US, cigarettes are one of the affordable pleasures in low socioeconomic status groups (Drope et al., 2018). Therefore, disproportionately high prevalence of smoking in low socioeconomic status groups suggests that cost, while a motivator, may not translate into long-term cessation.

The barriers to intentions for quitting and effective smoking cessation across a range of demographic and socioeconomically-diverse populations has also been well explored. Table 2.7 summarises the barriers that contribute towards early smoking initiation, relapse after quitting or limited use/discontinuation from support programmes.

Table 2.6

Perceived benefits of smoking-related PHBC that promotes quit intentions, attempts and abstinence

CITED REASONS	RELEVANT DEMOGRAPHICS AND REFERENCE(S)
Health improvements: • Addressing aging and pre-existing health conditions • Preventing worsening health (e.g., being too sick to smoke, hospitalisation) and smoking-related illness manifestation (e.g., shortness of breath) • Maintaining ongoing fitness and longevity • Witnessing poor health in family members who are smokers	Older smokers, Māori and former NZ smokers, smokers with financial difficulties, young NZ smokers (<25 years) (Breitling et al., 2009; Caleyachetty et al., 2012; Glover et al., 2010, 2013; Karalus et al., 2010).
Diagnosis of a mental health condition	Low socioeconomic status Australian smokers (Boland et al., 2019)
Inability to afford cigarettes and prioritizing other necessities	Pasifika (Glover et al., 2010, 2013; Karalus et al., 2010)
Reduced enjoyment of smoking (e.g., negative aesthetics) **Cognitive dissonance**[11]	(Glover et al., 2010, 2013).
Legislative changes (e.g., workplace smoking restrictions, tobacco taxation) • Reducing normality of smoking and its social acceptability • Strengthening beliefs about adverse impacts	Females, adolescents (Goldade et al., 2012; Norrving et al., 2015; Reid et al., 2009)
CUES TO ACTION	
Area-wise smoking restrictions and advertising (TV, graphic warning labels on packets)	Pasifika (Glover et al., 2010).
Church community • Highlights conflicts between smoking and church doctrine • Evoking smoke-free environments within prayer areas	Pasifika (Glover et al., 2010; Karalus et al., 2010)
Clinician support: • Providing smoking cessation advice and/or quitting	30–49 year old who began to experience the adverse impacts of smoking(Glover et al., 2010)
Family: Promoting social undesirability of smoking by: o Drawing on feelings of obligations o Fear of negative repercussions if they are found out o Not receiving financial support to smoke	Māori and Pasifika (Glover et al., 2010, 2013)
o Positive role modelling to children o Concern for family members' health o Impact during pregnancy	Older individuals, Pasifika/ Māori (Fernandez & Wilson, 2008; Glover et al., 2010, 2013; Karalus et al., 2010)
Active peer support and quitting as a group	(Boland et al., 2019)

[11] See glossary

Table 2.7

Barriers which limit smoking cessation or promotes relapse after abstinence

BARRIERS	RELEVANT DEMOGRAPHICS AND REFERENCE(S)
Neighbourhood deprivation and economic instability (1) greater exposure to environmental stressors, (2) low perception of community cohesion and (3) greater sensitivity to community threats**): Increase stress and anxiety and lowers self-efficacy**	Low socioeconomic status smokers in the US (Boland et al., 2019; Brown-Johnson et al., 2014; Businelle et al., 2010). Young adults (Carlson et al., 2018)
Pro-smoking norms: Reduces self-efficacy, promotes relapse. • Smoking is a socialising tool and a facilitator for conversing and meeting new people • Smoking is a characteristic trademark of Māori and Pasifika cultural norms and inclusiveness, promoting social pressures, permissive family attitudes and normalising the behaviour. Abstainers experience social exclusions and identity dissonance • NZ smoking culture: smoking as a rite of passage	Low socioeconomic status, US-based treatment seekers (Businelle et al., 2010), low socioeconomic status smokers (Carlson et al., 2018), young adults (Carlson et al., 2018; Goldade et al., 2012), Māori and Pasifika ex and current smokers (Glover et al., 2010; Karalus et al., 2010)
Nicotine craving and addiction: Decrease self-efficacy to quit and increases relapse rates. • Helplessness and powerlessness over cravings exacerbated by pro-tobacco advertising • The emotional link to smoking impedes developing a consistent, unambivalent need to quit	Low socioeconomic status, US-based treatment seekers (Businelle et al., 2010), young adult smokers (Carlson et al., 2018) Māori and Pasifika (Glover et al., 2010; Karalus et al., 2010)
Smoking as a method for weight control: Limits quit attempts	Young adult, low socioeconomic status smokers (Carlson et al., 2018) Māori ex and current smokers (Glover et al., 2010)
Habit, enjoyment and routineness of smoking, paired associations with other behaviours (e.g., alcohol) and smoking is almost as an involuntary action**:** Limits quit attempts	18-39 year old, Current and ex-smokers (Balmford & Borland, 2008), low socioeconomic status smokers (Boland et al., 2019), Māori ex-smokers (Glover et al., 2010)
Being reminded of smoking under specific contexts (e.g., smell, sight), discomforts associated with quitting such as withdrawal symptoms: Promotes relapse	Māori ex-smokers (Glover et al., 2010)
Coping with stress and adversity: Low situational self-efficacy, promotes relapse. • Recurrent stress, boredom and tiredness can trigger cravings for smoking-induced pleasure, energy and relaxation	Low socioeconomic status treatment seekers (Businelle et al., 2010), young adult, low socioeconomic status smokers (Carlson et al., 2018), Māori and Pasifika ex and current smokers (Glover et al., 2010; Karalus et al., 2010)
Limited knowledge of smoking-related health issues: Limit's motivation to quit	Māori and Pasifika (Glover & Thornley, 2010)
Self-classifying as intermittent (non-daily) or context-dependent smokers, and not addicted: Resistance to cessation support and quit attempts	Māori (Glover et al., 2010)
Quitting is an effortful and time-consuming commitment: Limit's motivation to quit	Māori (Glover et al., 2010)
Fatalistic life attitude: Limit's motivation to quit • Quitting is redundant at old age as death is imminent and 'damage has been done' attitude	Older Māori and Pasifika (Glover et al., 2010)
Scepticism of the adverse health impact of smoking: Limit's motivation to quit	Māori (Glover et al., 2010)
Low confidence in treatment intervention: Limits quite intent and successful attempts • Pharmacotherapies are not effective/daunting and promote a perception of being ill • Costs associated with treatment access, visiting clinician and pharmacies	Young adult, low socioeconomic status smokers (Carlson et al., 2018), Māori and Pasifika (Glover et al., 2010; Glover & Thornley, 2010)

2.8.1.1 HBM constructs and stroke-related PHBCs

To date, only a handful of empirical studies have explored the relevance of HBM constructs in predicting PHBCs for stroke risk reduction or specificially in stroke survivors. An Australian study demonstrated that among older individuals, perceiving themselves at a high risk for a stroke predicted intent and likelihood for exercise and weight loss-associated PHBCs (Sullivan et al., 2009). Intentions to exercise among senior citizens with major risk factors were also fostered by self-efficacy and perceived benefits of exercising (Karen et al., 2008; Sullivan et al., 2009). Such trends emphasise the importance of associating PHBC benefits with improved risk factor profiles in such individuals. Conversely, weight loss intentions were limited by perceived barriers (e.g., time and effort) and facilitated by subjective norms (beliefs about how significant others wanted them to behave) (Sullivan et al., 2009). College students of 25 years of age with three modifiable risk factors and competent healthy literacy reported a low perceived stroke risk, which contributed towards poorer dietary patterns (Perrin, 2020).

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Among TIA/IS survivors, those who considered themselves more susceptible to recurrent stroke if lifestyle modifications were not proactively pursued were more likely to engage in PHBC (Sullivan & Waugh, 2007). Perceived benefits of PHBC (e.g., easing depression and anxiety, improving energy, etc) dictated exercise-related PHBCs or their maintenance (Brouwer-Goossensen et al., 2016; Morris et al., 2012). On the other hand, likelihood for exercise was impeded by: (1) perceived negative outcomes (e.g., exercise won't improve their condition), (2) motivational barriers (laziness, poor mood), (3) effort of exercise and (4) vulnerability, anxiety and worry around social interactions and communication (Morris et al., 2012; Simpson et al., 2011). High self-efficacy and self-determination[12] endorsed a 'can do' attitude for patients' intent to undertake physical activity, diet and smoking cessation (Brouwer-Goossensen et al., 2016; Morris et al., 2012; Simpson et al., 2011). For such patient populations, social support from family, patients with similar disabilities and qualified personnel provided emotional support, guidance and assurance for improving physical function (Morris et al., 2012; Simpson et al., 2011).

While an individual's health beliefs play a critical role in determining PHBC likelihood and/or maintenance, it is simply one aspect among a myriad of other key contributors. The next section will review the literature evidence supporting the influences of socioeconomic deprivation as a deterrent for diet-related PHBCs.

2.8.2 Environmental conditions for PHBCs

Another critical distal determinant of chronic disease incidence is socioeconomic context as individual behaviours takes place within the wider the social context (Kelly & Barker, 2016). Socioeconomic position is used to collectively describe the social and economic influences on an individual's or group's position within their society's structure (Salmond et al., 2005). In practice, investigators use many measures of socioeconomic position, including income poverty, living standards and class/socioeconomic status (Salmond et al., 2005). Income, education or social class are the most common indicators of socioeconomic status in most studies exploring health inequalities, (Darin-Mattsson et al., 2017). Socioeconomic deprivation (SEDep) is a practical approach to describe an individual's relative societal position and ownership and distribution of social, cultural and economic resources. Deprivation measures at

[12] See glossary

the neighbourhood and individual level have been well utilised over the last few decades, each having a separate causal impact upon health (Salmond & Crampton, 2012).

2.8.2.1 SEDep influences on stroke incidence and dietary behaviours

A considerable body of literature reports that individuals that are highly deprived and/or residing in areas of high deprivation have: (1) higher stroke mortality and incidence, (2) younger age stroke hospitalisations, and (3) greater death or disability six months post admission (Addo et al., 2012; Grimaud et al., 2011; Heeley et al., 2011; Metcalfe et al., 2005; Thrift et al., 2006). Co-morbidities (e.g., hypertension) and stroke risk factor prevalence (e.g., chronic alcohol consumption, sedentary lifestyle and suboptimal diet) are also greater in these populations (Carter et al., 2008; Melaku et al., 2018; Ministry of Health, 2012, 2016). NZ's most stroke-susceptible groups, Māori and Pasifika, are more likely to live in the most deprived areas of NZ. 23.5% of Māori as opposed to 6.8% non-Māori reside in the most deprived neighbourhoods (Williams, 2017). Similarly, 56% of Pasifika reside in the most deprived areas, although this is area specific with the greatest percentage recorded in the Counties Manukau District Health Board Catchment (83%) (D. Ryan et al., 2019).

Internationally, proof of the impact of individual and area-level socioeconomic differentials upon dietary patterns is omnipresent (Metcalf et al., 2006; Thornton et al., 2011). Obesogenic dietary patterns and poor adherence to dietary guidelines is commonplace in individuals facing higher economic stress or residing in disadvantaged neighbourhoods (Dijkstra et al., 2014; Pacheco et al., 2018). Such groups tend to consume energy-dense, nutrient-poor foods (e.g., processed meats, fast foods) in addition to having reduced fruit and vegetable intake (Amuzu et al., 2009; Darmon & Drewnowski, 2015; Kern et al., 2017; Ministry of Health, 2008; Nordanstig et al., 2017). Older, Dutch individuals with low monthly household incomes demonstrate less adherence to recommended vegetable and fish intake compared to their wealthier counterparts (Dijkstra et al., 2014). In the US, fast food intake is highest among those of lower education (Thornton et al., 2011). Low-income households purchase 9.7 more grams of added sugar/1000 calories than high income households, effectively raising risk of CVDs by 26% (Allcott et al., 2018). Conversely, high income earners or residents of more advantaged communities prefer healthier dietary options (e.g., fruits and vegetables, wholegrains) and avoid sodium/added sugar options (Allcott et al., 2018; K. Ball et al., 2015).

The percent of NZ adults living in areas of high SEDep who consume recommended proportions of fruit and vegetables has dropped by 43% from 2006/07 to 2015/16 (Ministry of Health, 2016) (Table 2.8). Metcalf et al. (2006) reported that NZ individuals of low occupational class, with a gross combined family income of <$30,000 p/a and no tertiary education have less intake of fibre, vegetables, fruits and milk. Conversely, consumption of saturated fats, starch, cholesterol, eggs and beer are significantly higher in these groups (Metcalf et al., 2006). Non-Māori and less socioeconomically-deprived individuals tend to have diets that are better aligned with the NZ Food and Nutrition Guidelines for Healthy Adults (Wong et al., 2017). This entails higher consumption of dietary fibre and seven micronutrients including calcium, iron and vitamin C, and lower intakes of energy, macronutrients, sodium, zinc, and vitamins B6 and B12 (Wong et al., 2017). Compared to Caucasians, Māori and Pasifika were: (1) more likely to have a higher intake of fast foods/hot chips, (2) prefer salt-rich foods, (3) consume dietary sources rich in total, saturated and monounsaturated fats, (4) purchase unhealthier food items from convenience stores, dairies or service stations, and (5) less likely to purchase healthy foods from supermarkets (Blakely et al., 2011; Metcalf et al., 2014; Ministry of Health, 2011, 2012, 2016, 2019).

Table 2.8

Age, sex and ethnicity-adjusted rate ratio of recommended servings of fruits and vegetables consumed between demographic categories

Group	**Adjusted rate ratio**
Māori v. non-Māori	0.88*
Pasifika v. non-Pasifika	0.84*
Most v. least deprived	0.69*

*p < 0.05. *Data acquired from Ministry of Health, 2016*

Policies to promote healthier dietary choices and lifestyle habits have relied heavily on taxation/subsidising food costs (J. Bauer & Reisch, 2019). Nonetheless, dietary inequalities that follow a socioeconomic gradient continue to exist and obesity rates are increasing yearly (J.

Bauer & Reisch, 2019). Therefore, a more comprehensive exploration of why people eat the foods that they do is warranted for improving healthy dietary choices in deprived populations.

2.8.2.2 Factors influencing food choice motivations

There has been a shift in the demand for different types of consumer foods in the last few decades (J. Bauer & Reisch, 2019). This is concurrent with advancements in technology and radical changes in food accessibility, community and household structures, ethnic composition and social norms (J. Bauer & Reisch, 2019; Daniels et al., 2015; Dimitri & Rogus, 2014). Understanding food concerns and perceptions has therefore never been more important. A major arm of current consumer research is dedicated to understanding the role of the human decision-making process and resistance to choosing healthier dietary options (J. Bauer & Reisch, 2019).

Studying food choices is not an easy feat given the dynamic and evolving nature of food choices over one's life course and situational influences and complex considerations of what and where to eat. According to the 1982 Gutman theory of means-end chain, consumers follow a specific choice criteria in selecting food products (Buckley et al., 2007). Food choices are inter-temporal decisions based on value of present or delayed utilities, and they frequently involve a cost-benefit analysis (Cavaliere et al., 2014). Franchi (2012) characterises four key elements that affect food choices, including: (1) fulfilment achieved from specific food consumption, (2) how a specific food fits within the environment of consumption and/or its function, (3) reliability and health interpretation associated with foods, and (4) price associated for a given product.

Several models have been derived from food choice research, all attempting to cohesively explain what factors influence food choices. Motivations for food purchase and consumption has a multi-factorial origin. In order to integrate multiple individual and environmental drivers, a socio-ecological approach in behavioural influences should be undertaken (J. Bauer & Reisch, 2019; Casey et al., 2010; Cavaliere et al., 2014; Fotopoulos et al., 2009; Franchi, 2012) (*Figure 2*.6).

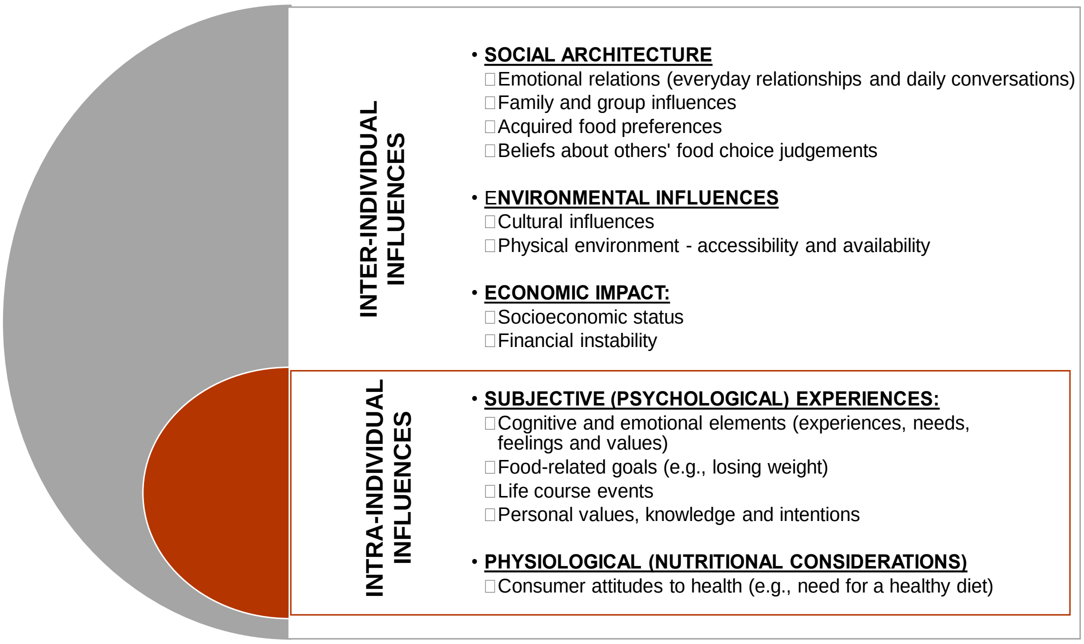

*Figure 2.*6 Food decisions are embodied in and controlled by complex food systems. Such considerations mould the behavioural criteria that orient food choices (Data extracted from (J. Bauer & Reisch, 2019; Casey et al., 2010; Cavaliere et al., 2014; Fotopoulos et al., 2009; Franchi, 2012)

2.8.2.2.1 Inter-individual influences

The physical, socio-cultural, economic and policy milieu (human-made or modified) affects opportunities to obtain food at both the micro- and macro-levels and subsequently affects food choices (Lake, 2018; Sushil et al., 2017). Due to area-level discrepancies in diet, how one’s environment shapes decisions on food purchase and consumption has been widely studied (Barosh et al., 2014; Giskes et al., 2009).

The three most influential components of an individual’s food environment that affect food preferences are price, physical access and quality of food sources (Casey et al., 2010; Pacheco et al., 2018). Manufacture of energy-rich foods is in high demand due to lobbying by major food industries (beef, dairy, sugar, ultra-processed food and beverage sectors) and agricultural systems (Swinburn et al., 2019). The neighbourhood food climate (e.g., distribution of convenience stores, supermarkets and fast food outlets) may not always be conducive of healthy eating (Casey et al., 2010; Hager et al., 2016; Lake, 2018). Subsequently, the inability of food systems to provide healthy diets is one of the main contributors towards the growing prevalence of global obesity and overweight individuals (Silva, 2019).

2.8.2.2.1.1 *Accessibility and availability of food outlets*

Measuring food access at some level of geographic aggregation has been the focus of empirical studies aiming to assess the association between the food environment and health outcomes or diet quality (Chaix et al., 2012; Drewnowski, Aggarwal, Hurvitz, Monsivais, & Moudon, 2012). Typical measures of access include physical access (e.g., distance to the closest supermarket) or the cluster of different food outlets per unit area (i.e., number, density, type and location) (Drewnowski et al., 2014; Pacheco et al., 2018; Sushil et al., 2017). The public health literature documents that it is a constant struggle for individuals residing in low-income areas to access sufficient healthy food to eat (Hager et al., 2016; Swinburn et al., 2019). Globally, due to residential segregation and land-use zoning, areas of high community deprivation/low income are characterised as either food deserts or food swamps (Allcott et al., 2018; Bardenhagen et al., 2017; Cooksey-Stowers et al., 2017; Gorton, 2013; Hager et al., 2016; Kern et al., 2017; Sushil et al., 2017; Swinburn et al., 2019).

Food deserts are areas with no retailers (supermarkets/grocers) that sell high quality healthy foods and the nearest supermarket is typically >1 mile from residents' homes (Allcott et al., 2018). Conversely, food swamps are over-abundant with establishments manufacturing calorie-dense, nutrient-poor and processed foods, with typically ≥four convenience stores within 0.4 km of residents (J. Fielding & Simon, 2011). The most deprived neighbourhoods are often the object of ubiquitous marketing by major fast-food franchises, as seen in lower socioeconomic status neighbourhoods in the US (Kern et al., 2017; Sushil et al., 2017). Rural grocers tend to have no shelf space available to stock fresh produce due to: (1) a lack of consumer demand in volumes that ensure profit, (2) limited infrastructure for food distribution (e.g., roads, storage, frequency of delivery), and (3) increased costs associated with refrigeration, farming and transportation for perishables (Bardenhagen et al., 2017; D. Brown & Brewster, 2015; Coleman et al., 2013; Dimitri & Rogus, 2014; Kern et al., 2016). Instead, foods provisioned in such stores and convenience shops are predominantly packaged/processed, have longer shelf lives, are calorie-dense and addictive (D. Brown & Brewster, 2015).

There are often long travel times to an affordable grocery store for residents of highly deprived communities, shown to be associated with higher BMI in residents (Bardenhagen et al., 2017; Breyer & Voss-Andreae, 2013; D. Brown & Brewster, 2015; Chaix et al., 2012; Cooksey-Stowers et al., 2017; Swinburn et al., 2019). Such challenges can be further exacerbated by transportation difficulties, such as not owning a car or poor access to public transportation (Allcott et al., 2018; Chaix et al., 2012). 70% of low-income residents in Arkansas, Louisiana and Mississippi live approximately 30 miles from a mainstream supermarket and evidence poor quality diets (Connell et al., 2012). Grocers in this region stock significantly fewer fruits and vegetables, contributing to this dietary disparity (Connell et al., 2012). A Scottish study demonstrated that residents living in deprived urban areas had to travel more than four miles to the nearest supermarket while takeaway shops were more readily accessible (Sauveplane-Stirling et al., 2014). As a result, residents may forgo travelling frequently to supermarkets or spending money on private transportation to more distant outlets (Chaix et al., 2012). Instead, calorie-dense, pre-packaged, non-perishable foods sold at the nearest food outlet maybe preferred, contributing to greater odds of both overweight and obesity in food swamp residents (Bardenhagen et al., 2017; Cooksey-Stowers et al., 2017; Lake, 2018; Pacheco et al., 2018).

The last 30 years has seen a change in the structure of NZ urban food retailing, with an exponential decline in small grocers and increase in large supermarkets, fast-food outlets and restaurants (Day et al., 2013). A 2017 study defined approximately 147 census area units as potential food swamps within the most deprived areas of NZ (Sushil et al., 2017). Units of increasing SEDep also show greater proximity to unhealthy food outlets from population centres (Sushil et al., 2017). Density of fast-food/takeaway outlets and convenience stores were 73% and 64% higher in the most deprived census area units compared to those least deprived (Sushil et al., 2017). However, some evidence indicates all retail types (takeaways, convenience stores and supermarkets) are twice the distance in least deprived neighbourhood residents (Pearce et al., 2007; Pearce, Day, et al., 2008; Pearce, Hiscock, et al., 2008). Major urban areas in NZ (Christchurch, Auckland and Wellington) reported a significant four-fold increase in fast food outlets from 1966 to 2006 (Sushil et al., 2017).

The impact of the food environment on dietary intake is largely inconsistent. Overall diet quality and intake of nutritious foods, obesity rates and health outcomes (e.g., diabetes) tend to be better in communities with greater availability of full-service supermarkets/grocers (Coleman et al., 2013; Dimitri & Rogus, 2014; Drewnowski et al., 2012; Dubowitz et al., 2012; Lake, 2018). Conversely, food swamps diminish such outcomes (Dubowitz et al., 2012; Lake, 2018; Mohr, Wilson, Dunn, Brindal, & Wittert, 2007). Fast food supply and demand has been on an exponential rise in recent decades, fostering unhealthier nutritional profiles and adverse health outcomes such as increasing stroke risk (Thornton et al., 2011). In the US, residents of low-income urban neighbourhoods are at increased risk of developing co-morbidities due to greater access to fast food outlets and energy-dense meals (Hager et al., 2016). A 2011 Massachusetts study yielded a significant 0.11 unit reduction in BMI among females with every km increase in distance to the closest fast-food outlet (J. P. Block et al., 2011). Greater prevalence of 'healthy' takeaways and restaurants is shown to diminish intake of fast-foods (Caspi et al., 2012).

Recommendations for policy changes and community interventions that improve access and availability of healthy foods are currently in effect in an effort to improve healthy dietary uptake (Giskes et al., 2009). Nonetheless, a limitation of purely geographic measures is that they do not accurately reflect the personal food environment of residents (Chaix et al., 2012; Drewnowski et al., 2012, 2014). Influences of access and availability on food purchasing decisions have been highly inconsistent across the literature (Giskes et al., 2009; Pearce, Hiscock, et al., 2008; Thornton, Crawford, & Ball, 2010). Some studies show differential store density is not correlated to nutritional inequality between high- and low-socioeconomic status neighbourhoods (Allcott et al., 2018; Caspi et al., 2012; Dubowitz et al., 2012; Lake, 2018; Thornton et al., 2011; Turrell & Giskes, 2008). The assumptions underlying food deserts have been challenged due to: (1) food deserts not being exclusive to areas of concentrated poverty, (2) residents travelling up to 5.2 miles out of their immediate neighbourhoods for obtaining cheaply-priced, health foods and brands, and (3) affluent communities not always having more retailers selling affordable health foods (Allcott et al., 2018; Bardenhagen et al., 2017; Breyer & Voss-Andreae, 2013; Dimitri & Rogus, 2014; Drewnowski et al., 2012, 2014). Dubowitz and colleagues (2014) found 98% of residents of American food deserts frequented full-service supermarkets approximately 4.3 km away. Thus, mere physical proximity to health food stores may not be an accurate index of health food accessibility, especially for those who shop by car (Chaix et al., 2012; Drewnowski et al., 2012, 2014). Instead, other factors such as other individual preferences may have greater explanatory power. A critical component of the food environment that affects choices is the consideration of food affordability and is the focus of discussion in the next section.

2.8.2.2.1.2 Impact of food prices

Food costs and affordability are fundamental contributors of economic inaccessibility to healthy foods and are affected by socioeconomic status factors such as income and education (Barosh et al., 2014; Blakely et al., 2011; Breyer & Voss-Andreae, 2013; Burns et al., 2013; Kern et al., 2017). Food prices are regulated by governments and the global market. Two key assumptions that underlie healthy food affordability are that, first, food prices are reasonably equal between supermarkets and grocers (Breyer & Voss-andreae, 2013; Drewnowski et al., 2012). Secondly, such retailers are assumed to offer nutritious, higher quality *and* affordable food options (Breyer & Voss-andreae, 2013; Drewnowski et al., 2012). However, there is no guarantee that grocers/supermarkets within a given area will sell produce that is affordable, healthy, high quality or meets customer demands (D. Brown & Brewster, 2015; Drewnowski et al., 2014). Secondly, there are often price discrepancies in foods purchased from grocery stores/supermarkets in the same city, a critical but under-articulated component of the food environment (Breyer & Voss-andreae, 2013). Corner/convenience stores also are inclined to charge more for basic groceries and healthy foods as opposed to large supermarkets, contributing towards increased food costs (Baudry et al., 2017; Breyer & Voss-Andreae, 2013; Kern et al., 2017). Typically, a healthier diet (e.g., Mediterranean diet rich in fruits, vegetables, fish and nuts) costs $1.50 more daily than an unhealthy diet (diet rich in processed foods, meats and refined grains) in the US (Kern et al., 2017; Mozaffarian et al., 2016; Rao et al., 2013). Conversely, on the basis of price per calorie, refined grains and foods which are high in sugars, fats, and oils and sourced from specialist outlets, takeaway shops and fast food franchises are substantially cheaper compared to fresh produce (Appelhans et al., 2012; Barosh et al., 2014;

Breyer & Voss-andreae, 2013; Kern et al., 2017; Lake, 2018). In 2020, Statistics New Zealand (2020a) reported a 3.6 % price increase in fruits and vegetables compared to 2019.

Low-income earners tend to allocate less money to health foods and, as household income increases, people are more willing to pay for vegetables and dairy (Allcott et al., 2018; Dijkstra et al., 2014). Consequently, low-income families often rely heavily on nutrient-poor and calorific foods to obtain the required daily calories (for the whole family) at an affordable cost (Chaix et al., 2012). Among an Australian population of parents/primary caregivers, fruit intake is limited by higher perceived costs in addition to perceived availability to fruit sources and wastage concerns (Glasson et al., 2011). Price discounts have the capacity to improve healthy dietary intake, with every 10% price decrease in fresh produce promoting a 6–7% increase in purchase (Andreyeva et al., 2010). A six-month NZ randomised control trial found a significant increase in the purchase of healthy foods (up to 1.20 kg/week) with a 12.5% price discount (Blakely et al., 2011). Nonetheless, such changes were limited to Caucasian and Pasifika, and *not* Māori participants.

Very little is known about food price variations according to area-level SEDep status. In neighbourhoods that undergo urban gentrification[13], grocery stores may be plentiful but are too costly to cater to low-income residents despite geographic proximity (Breyer & Voss-andreae, 2013). This promotes a migration of residents to areas of lower living costs and gives rise to suburban food deserts where affordable grocery stores are > 1 mile from residents (Balcaen & Storie, 2018; Breyer & Voss-Andreae, 2013). However, Kern et al. (2017) found no impact of neighbourhood socioeconomic status upon healthy or unhealthy food prices within chain supermarket venues. Similarly, highly deprived areas in the Netherlands display similar price margins and quality of produce compared to advantaged areas (Giskes et al., 2009).

The research to date has tended to focus on price and accessibility as two key motivations linking dietary inequalities and SEDep. However, less literature has explored the role of other factors that could play an equally contributory role in dietary inequalities such as convenience (ease of access, time-saving, or labour-saving) (Dimitri & Rogus, 2014).

[13] See glossary

2.8.2.2.1.3 Convenience (food preparation)

An important component of diet quality consideration is real or perceived time scarcity in terms of time spent on meal preparation and shopping (Dimitri & Rogus, 2014). Time has become a scarce entity due to: (1) cultural, economic and sociodemographic changes in the past decade, and (2) complexity of activities people want to participate in, resulting in a demand for time-saving activities and services (Brunner, van der Horst, & Siegrist, 2010; Casini et al., 2019; Daniels et al., 2015). Lack of time as one struggles to balance work and family demands, and the stress associated with this, is commonplace in today's working generation (Alm & Olsen, 2017). Preparation of food is one activity an individual might consider as either a chore or a leisure (Casini et al., 2019). For someone who considers food preparation an effort, the likelihood of home-based food production decreases if the cost of time is involved (Buckley et al., 2007; Casini et al., 2019). For these individuals, cooking is often perceived as an unnecessary, organisational and scheduling complication, regardless of time constraints or lack of energy (Daniels et al., 2015).

As a result there is a high demand for food convenience, defined as minimising tedious food preparation activities with services/products that entail: (1) saving time during food-related activities, (2) reducing physical effort (e.g., preparing shopping lists, price checking), and (3) saving time and mental energy invested in decision-making (planning, shopping, preparing, clearing up etc.) (Brunner et al., 2010; Buckley et al., 2007; Casini et al., 2019; Daniels et al., 2015). This has translated into a radical conversion of food consumption from being homemade to convenient (time-saving, on the run) in the last few decades (Casini et al., 2019; Daniels et al., 2015). To cater to consumer preferences, food commercialisation has achieved a pinnacle in the manufacture of convenient/easy to prepare foods/foods eaten away from home (Brunner et al., 2010; Daniels et al., 2015; Dimitri & Rogus, 2014) . Since the early 19th century, convenience foods[14] have been one of the most fundamental food innovations and their variety has evolved radically (Daniels et al., 2015). Convenience foods now range from commercially processed canned/jarred/frozen/dried/fresh packaged foods (Daniels et al., 2015).

[14] See glossary

Preference for time- and effort-saving food activities through convenience food intake is subjective and situation-dependent (Table 2.9) (Daniels et al., 2015). Considerable evidence exists to show that age and convenience food intake share a negative correlation, potentially because older adults may have more time for meal preparation (Brunner et al., 2010; Daniels et al., 2015) Additionally, older adults tend to preserve conventional cooking methods as cooking meals from scratch was the norm when they were younger and convenience foods were not readily available (Brunner et al., 2010; Daniels et al., 2015). However, when age physically limits one's ability to cook and the social enjoyment of cooking ceases (e.g., care-dependent elderly), demand for convenience foods increases (Daniels et al., 2015). Key demographic groups that preferentially seek convenience foods as well as commonly cited reasons for their intake are summarised in Table 2.9 (Buckley et al., 2007; Daniels et al., 2015).

Table 2.9

Types of convenience food consumers and commonly-cited reasons for convenience food intake

DEMOGRAPHIC GROUP
• Ageing population/ >45 year old (Buckley et al., 2007; Daniels et al., 2015)
• Young individuals, (18-34) (Casini et al., 2019; Daniels et al., 2015; Lee et al., 2020)
• Working individuals (Daniels et al., 2015; Jabs et al., 2007)
• Single mothers and parents with young children (Alm & Olsen, 2017; Brunner et al., 2010; Casini et al., 2019; Daniels et al., 2015; Jabs et al., 2007)
• Highly educated (Brunner et al., 2010; Djupegot et al., 2017; Konttinen et al., 2013) • Low socioeconomic status individuals (Bukman et al., 2014)
• Single persons and decreasing household sizes (Brunner et al., 2010; Buckley et al., 2007; Daniels et al., 2015)
• Males (Brunner et al., 2010; Daniels et al., 2015; Djupegot et al., 2017)
• ≥Four member households (Daniels et al., 2015; Djupegot et al., 2017)
COMMONLY CITED REASONS FOR CONVENIENCE FOOD INTAKE
• Preference for smaller foods servings and minimal waste (Buckley et al., 2007)
• Ease of purchase (accessibility) and affordability (Brunner et al., 2010; Contini et al., 2018; Lee et al., 2020)
• Time constraints due to work-life commitments, reduced food preparation and clean up time due to issues around meal scheduling (Alm & Olsen, 2017; Brunner et al., 2010; Casini et al., 2019; Contini et al., 2018; Daniels et al., 2015; Djupegot et al., 2017)
• Limited cooking abilities, uncertainty/lack of confidence on specific cooking techniques (Alm & Olsen, 2017; Brunner et al., 2010)
• Rewarding children, loss of conventional mealtime patterns and demand for foods consumed on the go or in front of the T.V./phone (Buckley et al., 2007)
• Social environment (Buckley et al., 2007; Contini et al., 2018): Enjoyment attained with eating out and socialising with family and friends; peer pressure
• Expanding cultural milieu: growing demand for novel, innovative and multi-ethnic foods and new food experiences (Buckley et al., 2007)

Evidence on some of the convenience food preferences indicated in Table 2.9 has been contradictory. Some studies report convenience-based food decisions are prominent among low-income individuals while others suggest the opposite (Devine et al., 2009; Dimitri & Rogus, 2014). Daniels et al. (2015) report that highly educated individuals have a lower intake of convenience foods potentially due to greater appreciation for a sustainable and healthy diet. Few studies also suggest that households with live-at-home children are more inclined to spend more time home-cooking and consume unprocessed, fresh ingredients (perceived as healthier than processed foods) (Buckley et al., 2007; Daniels et al., 2015). In such households, convenience food consumption is limited due to: (1) valuing 'home-made, fresh family meals', (2) achieving family closeness as a result of eating together, and (3) feeding children a nutrient-dense, healthy meal (Daniels et al., 2015; Jabs et al., 2007).

The next section explores the role of food familiarity and norms determined by social interactions in driving specific food choices.

2.8.2.2.1.4 Familiarity and social norms

Food traditions impact food choices, particularly in migrant populations, as certain foods act as reminders of their community's origins and help them to keep in touch with their identity (Franchi, 2012; Rankin et al., 2018). Prior food experiences form hedonic, episodic memories which subsequently dictate whether a food type is enjoyed or not and shape people's food preferences and expectations (J. Bauer & Reisch, 2019; Higgs, 2015a; Rankin et al., 2018). Judgements of less familiar foods are more likely to be defined by semantic knowledge and existing theories than hedonic experiences (Higgs, 2015a). Therefore, familiarity-based food choices are dependent on prior knowledge and how accessible memories linked with such foods are (Higgs, 2015a). Hoek and colleagues (2017) demonstrated how consumers' familiarity with healthy and environmentally-sustainable alternatives (e.g., brown v. white rice) determined their preferences for these foods. It is harder to alter food choices in households in which unhealthy food intake is the norm (e.g., takeaways) and other foods are rarely served (e.g., vegetables) (J. Bauer & Reisch, 2019; McMahon et al., 2013). There is evidence to suggest vegetable consumption is related to past experiences and is a result of a transfer of eating habits and preferences developed during childhood (Glasson et al., 2011). General liking for specific fruits has also been found to be one of the strongest food choice predictor (Appleton et al., 2010). Among low- and high-income earners, 90% of nutrient inequality is attributed to an individual's inherent preference for certain food groups compared to other motivators (e.g., price and availability) (Allcott et al., 2018). Therefore, adherence to nutrition advice including unfamiliar foods can be difficult for individuals to follow and may be met with resistance (Giacalone & Jaeger, 2016; Rankin et al., 2018).

Food decisions are influenced by social norms and the choices and amounts consumed by others around us, specifying an implicit code for acceptable eating behaviour within a particular social context (J. Bauer & Reisch, 2019; Higgs, 2015b; Robinson et al., 2013, 2014). This notion forms the basis for several food advertising strategies where messages based on social norms (e.g., students preferring a brand of beer) promotes an increased purchase of that product (J. Bauer & Reisch, 2019; Robinson et al., 2013). Eating patterns are influenced by individuals observing and modelling the food behaviours of others (of relevance) and forming a perception on the proper/correct way of eating (i.e. what to eat, amounts) (Higgs, 2015b). Food choice driven by social norms are based on one's need to affiliate with others, conform to the norm for social acceptance or to portray a certain impression in public (Higgs, 2015b; Robinson et al., 2013, 2014). Such norms guide behaviour for perceived benefit to oneself (e.g., "Everyone else is behaving this way so I might as well too") (Robinson et al., 2013, 2014). Laboratory and observational studies show intake of fruits, vegetables, high-energy and unhealthy foods increases when peers are perceived to consume an equally high amount of these foods within a social setting (K. Ball et al., 2010; Lally et al., 2011; Perkins et al., 2010; Robinson et al., 2013). Nonetheless, such observations are not always consistent (Pliner et al., 2006). For example, eating to gain social approval does not necessarily predict better fruit and vegetable intake (Lally et al., 2011; Robinson et al., 2013).

The following sections will review intra-individual factors that also have a critical impact on food choices, purchase propensities and could explain disparities in diet quality. These include one's mood, concern for natural ingredients and ethical acceptability, sensory factors, degree of education and nutrition knowledge.

2.8.2.2.2 Intra-individual dimensions

In addition to empirical experiences and inborn food preferences, personal values and beliefs define one's goals and standards which in turn determine a person's emotional reactions and attitudes towards food (Franchi, 2012; Grebitus et al., 2013).

2.8.2.2.2.1 Mood

Due to the ambivalent nature of one's emotions towards food, most consumers often search for balance and a reduction in mental conflict (Franchi, 2012). Two principal neurobehavioural pathways regulate eating behaviour: a homeostatic system and a reward-based system (Appelhans et al., 2016). In the former, food consumption is regulated by a physiological-behavioural homeostatic feedback loop that seeks balance of energy (Appelhans et al., 2016). Contradictorily, the reward pathway is an automated process and dictates food intake based on its hedonic/sensory properties or in response to an appetitive desire or craving (Appelhans et al., 2016; J. Bauer & Reisch, 2019). Reward pathways are heuristic and mechanical responses are triggered under conditions of low self-regulatory strength and visceral factors (e.g., stress, hunger, tiredness) (J. Bauer & Reisch, 2019; Cavaliere et al., 2014; De Marchi et al., 2016). Activation of this pathway impacts judgement, limits effortful planning, challenges self-control and promotes spontaneous, impulsive food decisions that automatically gravitate towards calorific, palatable foods (Appelhans et al., 2016; J. Bauer & Reisch, 2019; Cavaliere et al., 2014; De Marchi et al., 2016; Salmon et al., 2014)

When battling stress and fatigue, individuals experience a mental conflict between momentary cravings to eat palatable foods and their long-term health goals (Radtke et al., 2014). When individuals can't satisfy all their inherent values (e.g., health *and* reward), they engage in temporal discounting[15] of food choice (Appelhans et al., 2016; Cavaliere et al., 2014; De Marchi et al., 2016; Franchi, 2012). In this instance, future utility of healthy food choices are

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discounted to gratify immediate, often imperceptive, needs (Appelhans et al., 2016; Cavaliere et al., 2014; De Marchi et al., 2016; Franchi, 2012). Such needs occur as a result of an individual's learnt associations between calorific foods and reward outcomes (Appelhans et al., 2016). A motivational drive to overeat in environments where highly appetising foods are easily obtained is also instigated (Appelhans et al., 2016)

Numerous empirical studies have argued that one's orientation for present or future utility significantly impact food choices that are healthy and sustainable (Cavaliere et al., 2014; De Marchi et al., 2016). Organic food intake is low among consumers who prioritise instant gratification and hedonic attributes of foods (Cavaliere et al., 2014; De Marchi et al., 2016). Such consumers have a limited understanding of, or undervalue, the long-term benefits of eating healthily and sustainably (Cavaliere et al., 2014; De Marchi et al., 2016). As the negative effects of a calorific diet may not be immediately experienced, these individuals often underestimate their future risk of diet-related health issues (Cavaliere et al., 2014; De Marchi et al., 2016).

2.8.2.2.2.2 Natural content and health concerns

Consumer awareness of the impact of food choices on health and a desire for well-being is growing every day (Chrysochou, 2010; Franchi, 2012). Food plays a critical role in preserving health and wellness in the exponentially ageing society (Franchi, 2012). Consumers who favour organic/natural food consumption regard such foods as being more environmentally friendly (organic, free of toxins) and respectful of animal health (De Marchi et al., 2016; Franchi, 2012). Natural foods are also perceived to be more flavourful, nutritious (due to limited processing during production), safer and more genuine than conventional alternatives (De Marchi et al., 2016; Franchi, 2012). Compared to food choices based on taste, choices based on naturalness and health intertwines a consumer's identity together with a view of the world (Franchi, 2012). Such choices are driven by four primary values: (1) environmental protection and, therefore, individual health preservation, (2) ecological values, endorsing biological cultivation, small businesses and fair trade, (3) fair relationship between environmental and life opportunities, and (4) responsibility for the care of future generations (Franchi, 2012).

Consumers of such orientation are often willing to pay more for natural food products and rely on labels on food packaging and restaurant menus to determine ‘healthiness’ of foods (De Marchi et al., 2016; Franchi, 2012). A given product’s ‘healthy’ image is represented not only by its nutritional information but also by its brand, promotion and advertising, labels and health claims[16] (Chrysochou, 2010). Several meta-analyses have reported that food decisions among 50% of consumers are influenced by nutrition labels and health claims (J. Bauer & Reisch, 2019; Cavaliere et al., 2014). A 2016 US study found health-oriented consumers favoured yoghurt products that had the USDA organic logo, advertised low-calorie content and a capacity to reduce the risk of illness (De Marchi et al., 2016). Interest in nutritional claims and value for healthy diets are typically seen among females and families with young children who prioritise family well-being (Cavaliere et al., 2015). Older individuals may actively seek health information on food products or prefer prodcuts with health-related claims, potenitially as a result of better awareness of disease susceptibility (Cavaliere et al., 2015). Conversely, young individuals may undervalue health claims due to a lower perception of diet-related health risks (Cavaliere et al., 2015). Individuals of high socioeconomic status typically frequent food outlets that provide calorific information in their menus (compared to fast food retailers frequented by low socioeconomic status customers) (Banterle & Cavaliere, 2014; J. Bauer & Reisch, 2019; Cavaliere et al., 2014). Greater health concern also successfully limits convenience-based food decisions (Brunner et al., 2010).

2.8.2.2.2.3 Ethical Beliefs

An individual’s concerns around environmental sustainability are abstract ideals that also dictate emotional reactions towards foods (likes or dislikes) (Grebitus et al., 2013). These include: (1) instrumental values such as morality and competence, feeling courageous and responsible and social concerns, and (2) terminal values which are either intrapersonal (e.g., peace of mind) or interpersonal (e.g., a peaceful world) and centred around concerns for security and safety of one’s self or society (Allès et al., 2017; Grebitus et al., 2013; Haws et al., 2014).

Such values promote greater concern for food production technologies, consideration of

[16] See glossary

who profits from food purchase, geographical origins of foods, and the energy and ecological costs of transportation (Caputo et al., 2013; Franchi, 2012). Food generated by global supply chains often travels thousands of miles prior to being consumed, and greenhouse gas emissions released by food transport could potentially accelerate global warming (Caputo et al., 2013). These consumers are driven by the environmental impact of food production, economic benefits and sustainable use of resources, leading to a rising demand for environmentally-friendly food choices (Banterle & Cavaliere, 2014; Reisch et al., 2013). Food labels such as carbon trust labels are often relied upon by these consumers during food purchase, as observed in a 2013 Australian study (Caputo et al., 2013; De Marchi et al., 2016). Grebitus et al. (2013) demonstrated that Canadian shoppers with environmentally-oriented food choices and who valued families'/society's health and security reported concerns around carbon emissions and water use associated with food production. A lower purchase of ground beef manufactured under these conditions was also observed in these individuals (Grebitus et al., 2013).

2.8.2.2.2.4 Sensory appeal

Food presentation and its physical attributes is becoming increasingly important during purchase decisions. Prior research highlights sensory appeal as one of the key criteria for food choice among older and high-income consumers (Allès et al., 2017; Franchi, 2012; Kamphuis et al., 2015; Locher et al., 2009; Whitelock & Ensaff, 2018). Food consumption and satiation is affected by exposure to food cues such as smell, vision and taste (J. Bauer & Reisch, 2019; Franchi, 2012). Taste perceptions are closely interwoven with the concept of food rewards, combining the sensory pleasure of eating, the emotion that prompts one to eat, and one's level of sensitivity to such rewards (Appelhans et al., 2011). Conditioned taste preferences occur as a result of the brain integrating the flavour, smell, consistency and temperature of a specific food type with the brand, experiences and memories associated with that food (Franchi, 2012). Therefore, taste-based food choices cannot be singularly attributed to food chemistry but also incorporate sentimental and motivational expectations, self-identity and values, socio-cultural and societal position (Franchi, 2012). Franchi (2012) identified 8 notable influences on developing food taste preferences (Figure *2.7*).

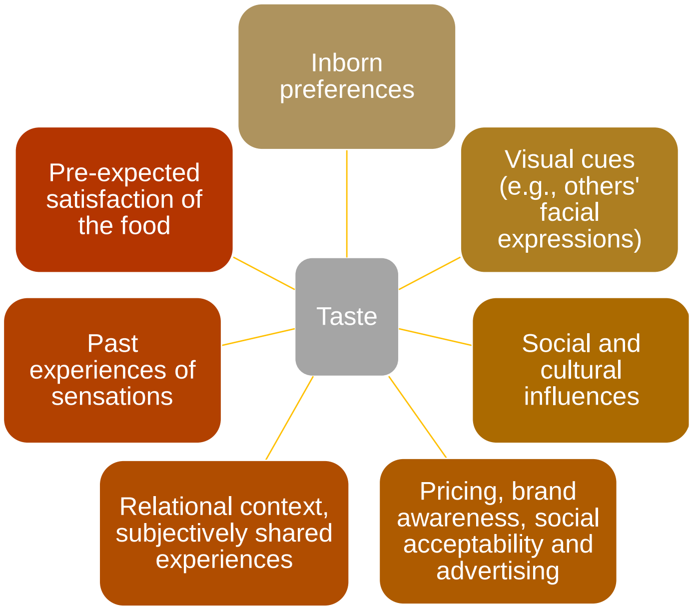

Figure 2.7 Influences on taste perception (Data extracted from Franchi (2012)).

Hedonic attributes of foods are a significant contributor towards Western dietary patterns (Allès et al., 2017), consumption of highly-processed and energy-dense foods and reduced wholefood intake (Lee et al., 2020). However, few studies also indicate that consumers of organic foods and healthy meals equally value taste as a food-choice motivator, indicating such consumers value food that is both natural and has sensory appeal (Baudry et al., 2017; Kamphuis et al., 2015). A preference for refined and high quality foods with hedonic appeal is commonplace among groups of high socioeconomic status (Kamphuis et al., 2015).

2.8.2.2.2.5 Educational influences and nutritional knowledge

A vast literature is dedicated to deciphering dietary inequalities based on educational status, especially as education is a conventional proxy for an individual's socioeconomic status. Current evidence reports a 39% and 45% increase in ultra-processed food and soft drink intake in those with no tertiary education (Djupegot et al., 2017). Reduced adherence to recommended guidelines for vegetable consumption and lower daily fruit intake is also seen among those with lower education (58.2%) compared to those more educated (77.8%) (Dijkstra et al., 2014; Giskes et al., 2009; Yen & Tan, 2012). Therefore, unhealthy dietary preferences in deprived individuals and communities may be attributed to a lack of education and learning opportunities about the benefits of healthy eating (Pampel et al., 2010).

Several mechanisms are in effect when considering educational influences on diet quality, with most evidence supporting the mediating role of nutrition knowledge (McLeod et al., 2011). Those with a more consolidated knowledge of nutrition have a greater understanding of the diet-health association, benefits of healthy eating and are likely to rely on nutritional information available on food labels (Brunner et al., 2010; Cavaliere et al., 2014). Increasing comprehension of food-related information subsequently promotes healthier food choices (J. Bauer & Reisch, 2019; Cavaliere et al., 2014). Takeaways and on-the-go foods are perceived to be composed of unhealthy and poor-quality ingredients, and as not constituting a proper meal (Brunner et al., 2010). Conversely, those with limited knowledge may not be able to fully comprehend nutritional claims and associations between food intake and health improvements (Banterle & Cavaliere, 2014; Cavaliere et al., 2014). Uneducated individuals and those of low socioeconomic status demonstrate poorer nutrition knowledge and tend to prioritise food as a necessity consumed to satisfy basic needs (Cavaliere et al., 2014; Dijkstra et al., 2014; Fahlman et al., 2010; McLeod et al., 2011) Conversely, those with higher education practise a ‘food is luxury’ orientation, providing both nutrition and pleasure (Cavaliere et al., 2014). Nutritional knowledge constitutes one of the strongest predictors of fruit and vegetable consumption (Appleton et al., 2010; Brunner et al., 2010; Glasson et al., 2011; Guillaumie et al., 2010; McMahon et al., 2013). Nonetheless, its association with dietary behaviours has been challenged with some evidence indicating that there is no impact (Macdiarmid et al., 2013).

In conclusion, it is important to consider the role of distinct food choice motivations that could drive socioeconomic differences in diet quality and an individual’s motivation to undertake related PHBCs. Lastly, the following sections focus on psychosocial stress as a distal determinant of PHBC initiation and maintenance.

2.8.3 Psychosocial stress and PHBC implementation

Stress is inherent in daily life and the cumulative impact of such stressors has a significant impact on long-term health-related outcomes (O’Connor et al., 2015). Between 2011 and 2016, the proportion of NZ adults who experienced significant psychosocial stress increased, with females reporting greater stress compared to males on the Kessler

Psychological Distress Scale (Ministry of Health, 2016). Some of the known reasons for psychosocial stress include: (1) increasing urbanisation of populations, (2) financial stresses, unemployment and marginality associated with deprivation, and (3) acculturation efforts among a growing migrant population (Carter et al., 2008; Curry, 2016; Pampel et al., 2010; Shang et al., 2017). During exposure to prolonged or cumulative stressors, coping mechanisms fail to fully re-establish physiological/psychological homeostasis due to the resulting overload, promoting a perpetual maladaptive state (Egger et al., 2017). Although the relationship is varied and complex, pathophysiological and behavioural mechanisms by which stress increases stroke risk are assumed to have pivotal roles (Figure *2.8*) (Booth et al., 2015; Egido et al., 2012; Kotlęga et al., 2016; M. Liu et al., 2017).

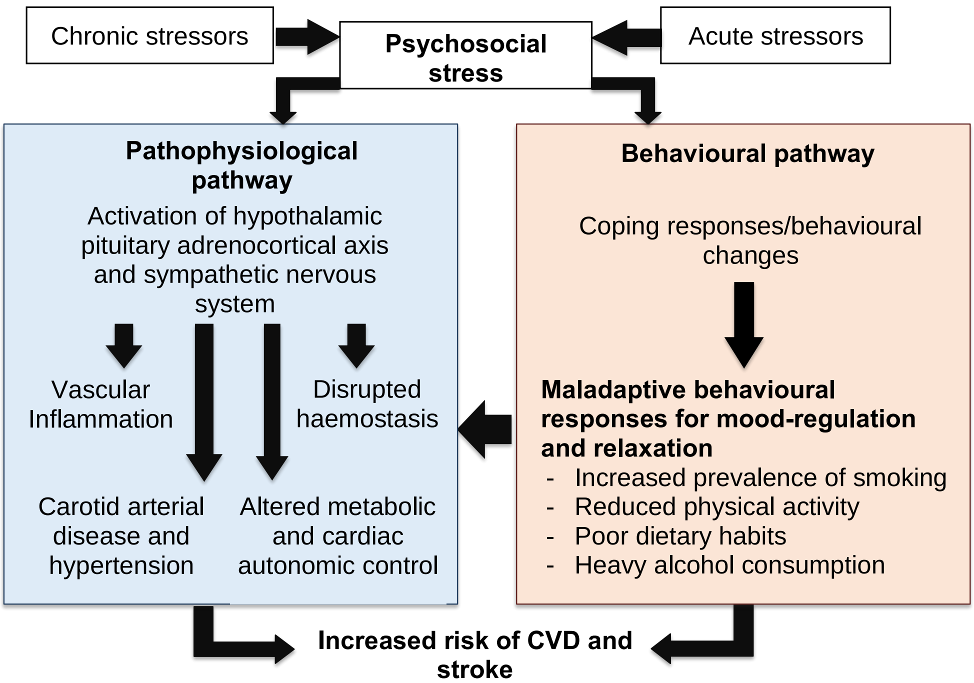

Figure 2.8 Intermediate mechanisms by which psychosocial stress increase CVD and stroke risk. Behavioural responses can also promote pathophysiological changes, e.g. smoking leads to vascular inflammation (Data extracted from (Booth et al., 2015; Egido et al., 2012; Kotlęga et al., 2016; M. Liu et al., 2017))

Coping strategies are multi-dimensional and multi-functional and such strategies can either be protective/adaptive or maladaptive/detrimental to an individual's health (M. Liu et al., 2017). The former includes strategies such as exercise and social support, while stroke risk behaviours such as smoking, alcohol consumption, sedentary lifestyle and unhealthy diets are common maladaptive coping methods (Dehghan, 2016; Holton et al., 2016; M. Liu et al., 2017). During stress, perceiving self-care and health-promoting behaviours as being too difficult is commonplace, especially if one experiences a loss of control or has trouble coping with the stressor (Mouchacca et al., 2013; M. Stults-Kolehmainen & Sinha, 2014). Initiating or maintaining PHBCs during stress is often a challenge for those who report the self-medicating benefits of compulsive, harmful behaviours (Pampel et al., 2010). Long-term exposure to chronic stress can dampen the brain's control of emotions and impulses and reduce prefrontal cortex activity and executive control (Groesz et al., 2012). Reduced activity of the prefrontal cortex in turn promotes hedonic drive and less conscious control over volitional behaviour (Groesz et al., 2012). An example could be submitting to nicotine cravings preceded by ineffective attempts to remain abstinent by depriving oneself of sources that trigger smoking (Groesz et al., 2012). The next sections review the most common coping strategies, their psychological foundations and their beneficial impact during stress.

2.8.3.1.1 Physical activity and stress

Considerable literature has been dedicated to studying the impact of stress and engaging in physical activity. There is a general consensus on a uniquely dynamic, bi-directional association between stress and physical exercise, albeit dictated by individual traits (M. Stults-Kolehmainen & Sinha, 2014). How one views exercise in relation to resolving or coping with stressors dictates its ability to either resolve or exacerbate stress. Some individuals use physical activity as a form of emotion-focussed coping to alleviate negative affect[17] (M. Stults-Kolehmainen & Sinha, 2014). Avid exercisers resiliently perform physical activity during times of stress, and low-moderate forms of exercise such as walking has been associated with regulating stress emotions (M. W. Chang et al., 2008; Seigel et al., 2002).

Alternatively, there is also ample cross-sectional and longitudinal evidence to suggest how stress, depression, and anxiety impedes likelihood of physical activity/exercise (Mouchacca et al., 2013; M. Stults-Kolehmainen & Sinha, 2014). Emotion-focussed copers are

[17] See glossary

often unmotivated to exercise during stress and succumb to less effortful, sedentary behaviours (e.g., TV watching) (Mouchacca et al., 2013; Sinha, 2008; M. Stults-Kolehmainen & Sinha, 2014). Viewing exercise as too effortful, time-consuming or an inconvenience is typical during negative affect, even among those who generally consider exercise an enjoyable activity (M. Stults-Kolehmainen & Sinha, 2014). Some reports indicate recovery from exercise is delayed during chronic stress, potentially as unpleasant feelings associated with stress are magnified during muscle damage following exercise (M. A. Stults-Kolehmainen & Bartholomew, 2012). Sometimes, exercise in itself can constitute a mental and physical stressor and interact with other psychosocial stressors, further impeding likelihood for physical activity (Coyle, 2000).

2.8.3.1.2 Stress and dietary behaviours

Using food as a chronic stress management technique has been widely recorded (Alm & Olsen, 2017; Groesz et al., 2012). Of those with chronic stress experiences, 30% tend to lose weight due to the stereotypical stress response that suppresses appetite and reduces overall calorie/energy intake (Adam & Epel, 2007; Dehghan, 2016; Groesz et al., 2012). However, overindulging in palatable foods for short-term pleasure and relief, irrespective of hunger, and reducing main meals/fruit/vegetable intake is more commonly reported in response to stress (Dehghan, 2016; Groesz et al., 2012; O'Connor et al., 2015). Referred to as 'emotional eating', palatable food intake is used to ameliorate negative emotions in individuals who do not have the necessary resources to deal with the stressor (Adam & Epel, 2007; O'Connor et al., 2015). Stress-induced dietary intake is also reinforced by the abundance of food outlets that sell affordable, calorically-dense foods in most Westernised countries (Adam & Epel, 2007). Negative perceptions of stress has been associated with greater carbohydrate intake while those who deal positively with stress follow a protein, micronutrient and fibre-rich diet (Dehghan, 2016). Similar findings have been reported in females in socially-disadvantaged neighbourhoods in an Australian study (Mouchacca et al., 2013).

The stress-eating relationship is a paradoxical one and mediated by specific psychobiological mechanisms. Similar to opiates and drugs of abuse, fats and sugars in palatable foods target the pleasure centres of the brain, providing short-term pleasure, improving mood and relieving worry and depression, giving rise to the idea of comfort foods[18] (Adam & Epel, 2007; Alm & Olsen, 2017; Groesz et al., 2012). Such foods increase serotonin production, a neurotransmitter critical for modulating anxiety and depression, and activate the brain's reward pathways (fast sensory inputs and heightening blood glucose and adiposity levels) (Adam & Epel, 2007; Dehghan, 2016; O'Connor et al., 2015). During chronic stress, the neuroendocrine hypothalamic-pituitary-adrenal (HPA) axis undergoes prolonged activation and cortisol production is enhanced (Alm & Olsen, 2017; Groesz et al., 2012). Repeated stimulation of the reward pathways consequently shuts down activation of the HPA axis (Adam & Epel, 2007; Dehghan, 2016; O'Connor et al., 2015).. Nonetheless, there is a subsequent feedback behavioural loop to acquire more of such foods each time, triggering compulsive overeating (Adam & Epel, 2007; Dehghan, 2016; O'Connor et al., 2015). Calorific foods can then appear to be highly 'addictive' if the stress experience is chronic and eating during such events is an effective coping mechanism (Adam & Epel, 2007). Such reinforced associations can become automatic processes which eventually don't require conscious thought (O'Connor et al., 2015). Therefore, chronic stress is capable of impairing normal inhibitions and prompting hunger, disinhibited eating and subsequent weight gain (Adam & Epel, 2007; Groesz et al., 2012; O'Connor et al., 2015).

2.8.3.1.3 Stress, smoking and alcohol consumption

The relationship between smoking and psychosocial stress has been well-characterised and several empirical studies concur on a robust, positive correlation (Boland et al., 2019). Intense negative affect while experiencing general stress and traumatic life events (such as death) reduce self-regulatory capacity and heighten cravings, triggering relapse among former smokers (Businelle et al., 2010; Glover et al., 2010, 2013). The calming impact of smoking during psychosocial stress experiences is commonly reported, especially among Māori who find smoking provides a break from the stress (Glover et al., 2010). However, the relationship

[18] See glossary

between smoking and stress is reciprocal, with approximately 41% of US smokers experiencing significant psychological distress about smoking (Boland et al., 2019). A higher incidence of perceived stress and negative affect is evident in the low-socioeconomic status, smoking population (Businelle et al., 2010). Nonetheless such findings are not always consistent (Caleyachetty et al., 2012). Complex brain circuity and neurotransmitter systems are involved in the neuro-adaptive changes that occur due to stress-induced alcohol use disorder. Primarily, stress-associated changes in the brain's reward circuitry and interactions with the HPA axis reinforce the addictive and reward impacts of alcohol to regulate mood and cravings (Abulseoud et al., 2013; Peltier et al., 2019).

According to the Verheul model of alcohol craving (Abulseoud et al., 2013), alcohol intake is sought to address three different types of cravings prompted by: (1) emotional contexts in which the stimulating and rewarding properties of alcohol are sought, (2) negative affect and a need for tension reduction, and (3) addiction characterised by an uncontrollable, obsessive thinking about alcohol (N. Choi & Dinitto, 2011). Psychosocial stress is a primary contributor to growing rates of alcohol abuse and there is a strong association between stress and all phases of drinking (initiation to relapse) (Peltier et al., 2019). Pre-clinical models, observational and longitudinal data assert that drinking onset and subsequent dependence occur upon experiences of negative affect, both in adults and adolescents (Hammerslag & Gulley, 2016; Johannessen et al., 2017). Experience of two or more significantly stressful experiences in the past year were four times more likely to trigger alcohol use disorder among females compared to males (Verplaetse et al., 2018). Higher relapse rates, binge drinking, cravings and dependence in response to unpleasant emotions are also typically observed in females (Anker et al., 2019; Anker & Carroll, 2010; Becker & Koob, 2016; Boykoff et al., 2010; N. Choi & Dinitto, 2011; Kendler et al., 2015). Females who socially drink and those that are alcohol-dependent report more cravings in a depressive state or when experiencing other unpleasant emotional reactions (Verplaetse et al., 2018). Similar to smoking, a rich body of literature concedes that psychological distress, depression and anxiety are higher in those who engaged in binge drinking (Abulseoud et al., 2013; Peltier et al., 2019). Alcohol-dependent individuals experience greater emotional stress, depression and anxiety which then translates into further binge drinking to cope with negative affect (Abulseoud et al., 2013; Peltier et al., 2019). On the contrary, Choi and colleagues (2011) observed no associations between psychological distress and frequency of drinking among females. Some authors go on to suggest that moderate alcohol intake (1–2 drinks per day) actually facilitates improved health and reduces psychological distress (N. Choi & Dinitto, 2011).

2.9 CHAPTER SUMMARY

Stroke pervasively affects individuals of all ages, genders and ethnicities, being the second leading cause of global death and confining survivors to long-term, severe debilitation. Primary prevention interventions to date, including the SR app, have largely relied on transmitting information about one's stroke risk, risk factors and education on the long-term benefits of PHBCs to motivate PHBCs. However, such interventions have low utility among those disinclined to PHBC or are unconcerned about future risk of a stroke, despite awareness of risk factor prevalence. Therefore, such apps are highly susceptible to limited engagement and PHBC maintenance. As a result, despite a myriad of such attempts, risk factor prevalence and stroke incidence is on the rise. Considerable cognitive resources are required to exert conscious control over conditioned risk behaviours over and above that which can be achieved through education alone (Hardcastle et al., 2015). Therefore, PHBCs are extremely difficult to achieve without strong motivations. The origins of chronic disease development follow a hierarchical pattern and determinants are often distal to the immediately visible contributors (e.g., smoking). As such, influences of health beliefs, SEDep and psychosocial stress on long-term motivation for PHBC warrant further investigation. In NZ, such investigations are particularly relevant as ethnic groups that suffer the greatest stroke burden tend to pervasively follow an unhealthy lifestyle.

Chapter 3 The role of health beliefs in PHBCs (Study 1)

3.1 INTRODUCTION AND STUDY OBJECTIVE

The rudimentary belief at the core of education-based PHBC interventions is that a response to lower the risk of stroke can be initiated when an individual is provided enough information and knowledge about their stroke risk behaviours. The *objective* of Study 1 was to determine whether more informed perceptions about one's stroke risk and its severity is sufficient to motivate PHBCs or other factors surpassed the impact of knowledge. Using the Health Belief Model (HBM) as its foundation, this study aimed to explored the impact of: (1) perceived stroke susceptibility and severity, and (2) barriers and benefits of PHBCs upon the likelihood of implementing and maintaining PHBCs. Participants were retrospectively classified into one of two conditions, i.e., Group 1 undertook two out of four changes in lifestyle risk factors (smoking, diet, exercise or alcohol intake) in the 12 months prior to this study; while Group 2 participants did not undertake any changes in lifestyle risk factors in the 12 months. These two groups of participants allowed the researcher to assess disparities in health beliefs, priorities and values between those who chose to, or those who chose not to, undertake PHBCs. Such understandings provided greater insight as to why some individuals resist PHBC recommendations despite being aware of their risk for future illness (including stroke) and/or benefits of PHBCs.

3.2 METHODS

3.2.1 Sample selection and participant characteristics

Ethical approval was obtained from the AUT Ethics committee (Appendix 1) prior to all study procedures being conducted. As Study 1 objective was to explore how participants who do or do not undertake PHBCs perceive their own risk of stroke and the benefits and barriers of PHBCs, purposive sampling was deemed more appropriate than random recruitment. Maximum variation in the lived experiences of the phenomena of interest can be attained using this sampling strategy (Patton, 2002). Additionally this method is inexpensive and reduces the time needed for participant recruitment. This method is considered appropriate in exploratory studies such as this one, and participant selection is based on convenience (i.e., easily accessible, close proximity to researcher, and suitable for study situation and aims) (N. Fielding et al., 2012).

3.2.1.1 Rationale for participant recruitment from the Reducing the International Burden of Stroke Using Mobile Technology (RIBURST) study

Users of the SR app was utilized as the sample pool for study recruitment as it was of interest to determine whether (1) an increased understanding of one's risk of a stroke and prevalence of risk factors motivated PHBCs among participants or (2) perceived barriers/benefits associated with PHBCs had greater utility in influencing motivation for change. The SR algorithm is a series of consecutive questions that prompt users to respond to questions (based on recall) such as 'Do you do at least 2.5 hours of physical activity per week?'. The questions acquire a user's self-reported: (1) non-modifiable risk factors (age, gender, ethnicity, family history of stroke or heart attack) and (2) modifiable risk factors (unhealthy weight, BP, unhealthy diet, sedentarism, psychological stress, alcohol intake, smoking incidence, personal history of CVD, cognitive problems or dementia, Diabetes, previous traumatic brain injury, left ventricular hypertrophy and AF). Based on their responses, the algorithm generates a given user's absolute and relative 5- and 10-year risk of stroke (Feigin & Norrving, 2014; O'Donnell et al., 2016; Parmar et al., 2015). Relative risk denotes one's risk for stroke compared to someone of the same age and sex who has no risk factors. The risk factors included in the SR's prediction algorithm are based on those identified by the INTERSTROKE study as crucial for stroke development (Parmar et al., 2015). The SR has shown comparable performance with the Framingham Stroke Risk and QStroke prediction algorithms for retrospectively predicting 5-year stroke risk of adults in NZ, Russia and the Netherlands (Parmar et al., 2015).

Currently, the application is being used as a data collection tool in the international, epidemiological, longitudinal, e-health research programme RIBURST (Feigin, Krishnamurthi, Bhattacharjee, et al., 2015; S. George et al., 2017). The study has a collective objective to generate a population-specific, stroke and non-communicable disease risk-scoring system (Feigin, Norrving, et al., 2017b). Users who install the SR app on their devices can browse through a research section inbuilt within the app that outlines the objectives of the RIBURST study and the consent form (Feigin, Krishnamurthi, Bhattacharjee, et al., 2015). Users then voluntarily consent with no interaction with RIBURST researchers, and submit their encrypted responses into a secure database at AUT University (Feigin, Krishnamurthi, Bhattacharjee, et al., 2015). These users are also prompted, via email reminders and push notifications, to resubmit their responses after 12 months (Feigin, Krishnamurthi, Bhattacharjee, et al., 2015).

Participants for this study were primarily selected from the existent RIBURST study pool. The advantages associated with using the RIBURST sample was twofold. Firstly, this sample pool provided the ability to evaluate changes in lifestyle risk factors (PHBCs) over a year. As the overarching research focus was to assess factors that not only influence PHBC initiation but its long-term maintenance, the RIBURST cohort was deemed optimal for participant recruitment. Compared to advertisement responders who report PHBCs over a year purely on recall (Section 3.2.1.4), SR responses collected at both time points in the RIBURST study may be more accurate. Therefore, users of the app provided a readily available pool of participants that allowed eligibility criteria to be determined. Secondly, as RIBURST participants were more privy to their 5–10 year risk of a stroke and their risk factor prevalence, the impact of this information upon motivation to undertake PHBCs could be better explored.

3.2.1.2 Recruitment and consenting procedures for RIBURST participants

Participants meeting the first set of eligibility criteria were pre-screened from the RIBURST database. Those consenting to the RIBURST study who agreed to be contacted for future studies were initially approached via email by an approved RIBURST study researcher. As a result of this email, potential participants were able to decide if they wanted to participate in Study 1, and indicate their wishes, without any direct contact from the researcher. Those interested in taking part consented to their contact details being provided to the researcher by the RIBURST study staff. These potential participants were then emailed by the researcher with a REDcap link to electronic versions of the information sheet and consent form (to ensure voluntary and informed participation) (Appendix 1) in addition to the second set of eligibility criteria questions. Upon clicking the REDcap link, the participant was directed to a REDcap web-based URL that displayed the information sheet (in PDF form) and consent form questions. Participants were encouraged to read through the information sheet and if they did not have any questions, completed and signed (via an e-signature) the consent form prior to commencement of interviews. If they met the criteria, participants completed a demographics questionnaire where they selected their appropriate gender, age, ethnic and professional status. Information sheets were posted to those who specified they would like a paper copy and signed consent forms were sent back via a pre-paid envelope provided to them.

3.2.1.3 Identifying potential study participants from the RIBURST sample pool

Potential participants from the RIBURST sample pool were identified for initial contact only if they met the first set of inclusion criteria:

- Over 20 years of age and NZ-based
- Submitted Figure *3.1* answers into the SR algorithm at RIBURST baseline and at 12 months follow-up in the year prior to the study to ensure relatively recent SR data.

Furthermore, eligibility was confirmed based on participants' answers in the second set of eligibility criteria questions (after the consent form was signed):

- Had no history of stroke, heart attack or a chronic health condition such as diabetes or arthritis (This was to exclude participants who undertook adaptive behaviours primarily to manage their health conditions)
- Were contactable by residential telephone/video call and able to communicate verbally in conversational English (without support and/or an interpreter).

Improvements in BMI (BMI>25 to <25 kg/m^2) and BP (>140 to <130 mmHg) were precluded as an entry criteria for Group 1 as some participants may be unsure of accurate measurements and self-reporting is likely to be affected by subjective bias. Care was taken exclude participants who self-report such improvements in Group 2 also.

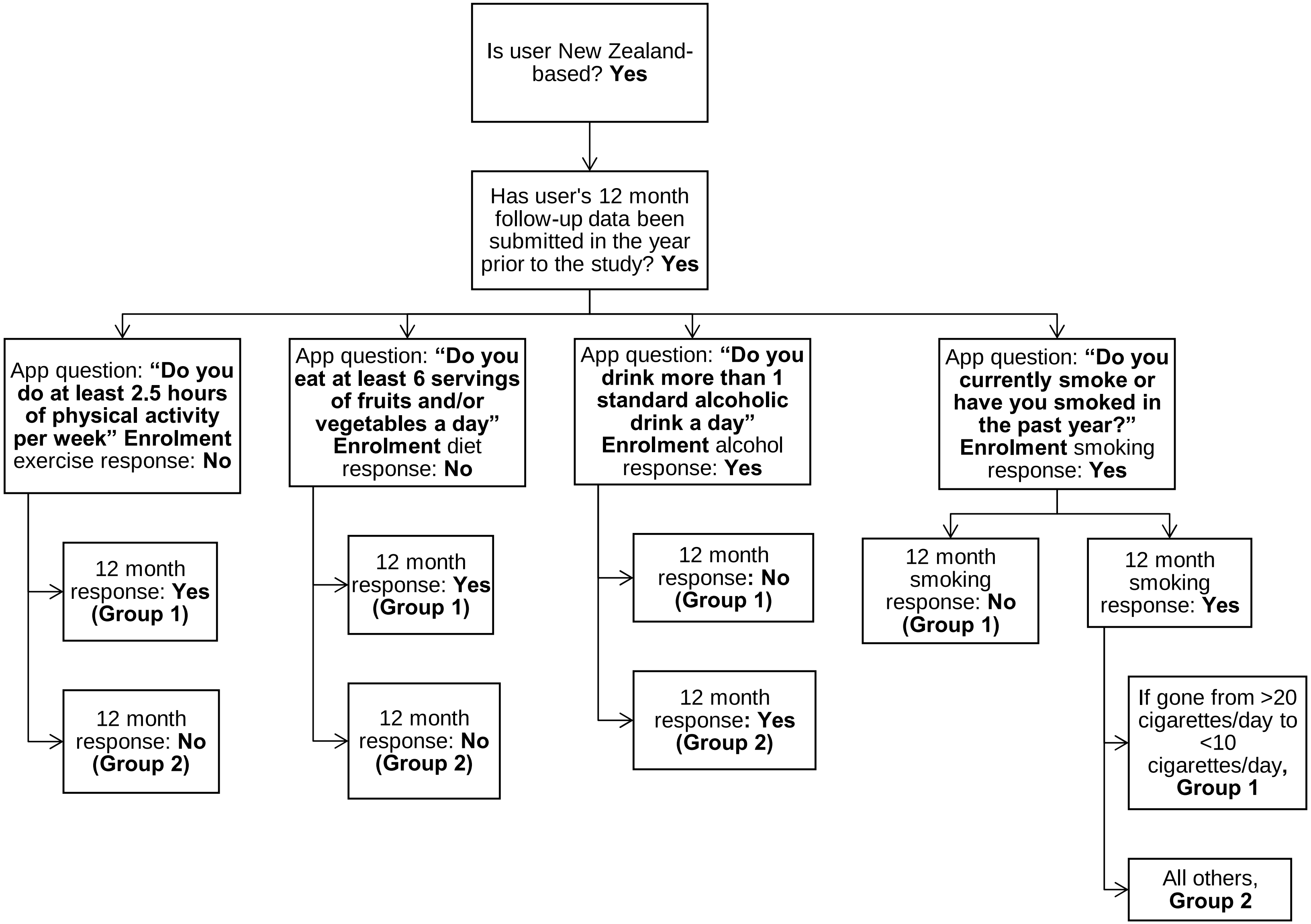

Figure 3.1 Schematic for sample recruitment. Group 1: PHBC undertaken (total n=19), Group 2: PHBC not undertaken (total n=20)

3.2.1.4 Participant recruitment through advertising platforms

Throughout the course of recruitment, there were difficulties obtaining participants who were: non-NZ-European, <35 years of age, smokers and alcohol consumers who met eligibility criteria from the RIBURST sample pool. As a result, a change in recruitment strategy was considered and enrolment of these participants through other avenues were considered. For recruitment through advertising platforms, non-probability sampling of self-selection using surveys was utilised (N. Fielding et al., 2012; Khazaal et al., 2014). Promotional study advertisements (Appendix 3) were publicised on advertising platforms such as AUT's staff Intranet (AUTi), social networking sites Yammer and Facebook, and job-seeking platforms including Student Job Search, Indeed.co.nz, and Trade Me Jobs, in addition to advertisement fliers being placed in community centres, medical centres and church halls – all viable recruitment methods utilised in previous studies for assessing health behaviours (Khazaal et al., 2014). Advertisements contained a REDcap link which forwarded viewers to the study information sheet and consent form (Appendix 4). The study advertisement followed strict ethical guidelines and advertisement responders chose to participate of their own accord and were not approached by the researcher directly.

As these participants were not part of the RIBURST study and their lifestyle risk factor changes over 12 months were not available, participants was prompted to complete a screening questionnaire after the consent forms were completed through REDcap. For example, to assess smoking-related PHBCs, advertisement responders were asked, "Have you quit smoking in the last 12 months or reduced the number of cigarettes smoked >20 to <10 per day?". Only those who met the study criteria were included.

Additionally, participants who owned a Smartphone were encouraged to download the SR app so as to gain more insight on the original research objective (impact of stroke risk awareness upon PHBCs). However, as the study intent was to also examine influences other than risk awareness upon PHBC motivation, participants who chose not to download the SR app were also recruited. Participants were recruited especially if they met the demographic categories that was required to obtain broad ranging perspectives.

3.2.1.5 Cultural consultation for recruitment and study design

From the onset of the study, the researcher was conscious of the cultural aspects surrounding participant recruitment and study design. This was particularly salient as the researcher sought to recruit Māori and Pasifika participants into all three studies. To guide consultation with Māori communities, the HRC Guidelines for Researchers on Health Research involving Māori (2010) were referred to. Firstly, a consultation process was undertaken with the Director of the Taupua Waiora Centre for Māori Health Research at AUT and the Office of Pacific Advancement to develop strategies on recruiting these participants and determine the suitability of the interview template for these ethnic groups.

Active discussions were conducted on the design and conduct of the study, in particular the interview process. The researcher also initiated a discussion with representatives of two Māori health organisations – Ngāti Whātua Orakei Kahui Rangahau and the National Hauora Coalition – to be active collaborators in the study. The collaboration would have included: (1) assistance with Māori recruitment and initiating contact with local Māori iwi, (2) advising on the cultural appropriateness of the study design to determine if methodology is culturally sensitive (specifically the conduct of interviews with Māori participants), and (3) improving researcher awareness of Māori customs, perspectives and cultural norms. The research proposal was initially under review by the research offices of both organisations. Nonetheless, a collaboration could not be established due to a complete lack of further correspondence from both foundations. Furthermore, recruitment of Māori and Pasifika participants was also facilitated by creating promotional advertisements on the NZ Māori and Pacific Jobs website. Community-based, Māori and Pasifika centred health care practices were provided advertisement fliers and clinic practitioners were approached and provided more information about the study.

3.2.1.6 Sample size consideration

Sample sizes in qualitative research tend to be small as the focus is on intensive interactions with participants and not expecting generalisable observations (Bradshaw et al., 2017). Sample sizes for this study were based on two primary considerations. Firstly, according to Morse (2000) and the pragmatic guiding principle of information power (Malterud et al., 2015), fewer participants are needed if more useable data can be collected from each participant. Therefore, participants selected were those that at least met two out of the four PHBC criteria outlined in Figure *3.1* (e.g., a given participant could have quit smoking but not undertaken diet or exercise-related PHBCs over 12 months). For example, if a participant changed their smoking and alcoholic behaviour at 12 months but did not for diet or exercise, they were classified in Group 1 for the smoking/alcohol criterion and Group 2 for diet and exercise. The interview questions were not designed to collectively assess change across different behaviours, but the motivation/influences that did/did not promote change.

The interview structure and open-ended nature of the questions also ensured richness of data generated across a range of PHBCs (Vasileiou et al., 2018). The second consideration was based on the most widely used principle of thematic saturation whereby interviews were terminated at the point at which no unique themes or findings were generated in subsequent interviews (Vasileiou et al., 2018). Sampling for both groups also aimed for gender, age and ethnic variation in participants to facilitate a variety of perspectives on stroke risk perception and barriers/benefits of PHBC. Māori and Pasifika experiences were also of particular interest due to high stroke burden in these groups. Section 3.3.1 of the results section reports the final sample size based on these considerations.

3.2.2 Data collection

3.2.2.1 Methodology: Theoretical rationale of study design

Successful long-term PHBCs require an integrated conceptual focus that examines PHBC perceptions from the individual’s point of view and considers the multi-level facets that influence PHBC. Humans are social beings whose health behaviours are shaped by their perceived health-related motivations and desires. For these reasons, a qualitative approach was undertaken. The conceptual model which shaped the interview questions to elicit participants’ PHBC perspectives and perception of stroke risk and severity was the Health Belief Model

(Stretcher & Rosenstock, 1997; Sulat et al., 2018). The theoretical basis of the study design was a qualitative, descriptive approach in which the findings could lay the groundwork for future studies. Previous healthcare studies, particularly nursing and midwifery research, have emphasised the use of qualitative description to learn from patients and use their descriptions to inform interventions (Bradshaw et al., 2017). This methodology is widely cited as improving understanding of the nature of events or experiences which have not been clearly defined (H. Kim & Bradway, 2018). Distinct from other qualitative theoretical approaches, qualitative description research discovers and understands participants' worldviews on a phenomenon (Bradshaw et al., 2017). The key features of the descriptive approach included: 1) using semi-structured interviews as the data collection method, 2) using purposive sampling to obtain insightful, rich information, 3) content or thematic analysis to evaluate obtained data, allowing low-inference interpretation, and 4) presenting a low-inference, rich description of participants' experiences and perceptions (H. Kim & Bradway, 2018).

The qualitative descriptive approach was utilised as the methodological framework for this study for two main reasons. Firstly, the objective of this study aligned directly with the philosophical foundations of qualitative description. This research sought to gain emic knowledge on beliefs, meanings and significance attributed to PHBCs so as to inform more targeted and effective behaviour-based prevention management techniques. This process incorporated the development of a theoretical framework that best described the overall meaning of the data as opposed to validating existing theoretical frameworks. Secondly, the research satisfied the ontological and epidemiological assumptions of qualitative description. By utilising the descriptive methodology, this research was philosophically guided by the naturalistic approach (Bradshaw et al., 2017). This approach provides researchers flexibility in whether or not to commit to a theory/framework at the beginning of a study, and the option to reject or commit to the framework as new insights are gained (H. Kim & Bradway, 2018). The research also drew on subjectivism as its epistemological foundation, which refers to an individual's subjective awareness of their reality.

Naturalistic research is based on an ontological viewpoint that many interpretations of reality exist and are created from the individual meanings ascribed to the phenomenon (Bradshaw et al., 2017; Colorafi & Evans, 2016; H. Kim & Bradway, 2018). Meanings are shaped by one's values, cognitions and interaction with the sociocultural environment, creating a unique reality for each participant that either endorsed or inhibited PHBC. Therefore, PHBC perspectives were to be understood by literally describing and then analysing and interpreting the elemental meanings, without inferring too much. Subjective interpretations of PHBC were supported through reference to participants' verbatim quotes.

The study also acknowledged the contributory role of the researcher in the social construction of participants' realities (Bradshaw et al., 2017). The naturalistic approach requires the researcher to take a flexible and adaptable stance, amalgamating the researcher's philosophical standing, preconceptions and subjective interpretation of the data (Bradshaw et al., 2017). Throughout the study, the researcher took care not to impose their own PHBC interpretations upon participants' understandings. This was achieved by reporting findings as close to the participants' descriptions as possible (i.e., using their quotes) and only using interpretation to a degree that was consistent with the research objectives (Bradshaw et al., 2017; H. Kim & Bradway, 2018).

3.2.2.2 Researcher assumptions and pre-understandings

An essential part of qualitative descriptive research is the researcher's self-reflection, acknowledging pre-understandings about the phenomenon of interest acquired from formal research or informal experience. This minimizes bias of one's own influence on either the participants or the interpretation of their data (Bengtsson, 2016). Prior to this study, the researcher had some pre-conceptions about the likelihood of a stroke and its severity, and the benefits and barriers to PHBC. These were shaped through the researcher's professional experiences in the field of stroke prevention and management, and caring for a grandparent who was debilitated by a stroke. The following preconceptions and acknowledgements were reflected upon throughout the research process:

- Stroke has significant impact on one's health and quality of life, causing varying forms of debilitation depending on the degree of infarct

- Stroke is not only a disease of the elderly but is commonplace in young populations
- Stroke is not only caused by family history but can be due to poor lifestyle habits
- Successful, long-term PHBCs are possible if one has a desire *and* the necessary mindset and readiness to set PHBC plans in place and to resist relapse situations that threaten adherence
- The benefits of PHBCs for not only minimizing stroke risk but for overall health, and well-being significantly trump any associated barriers and must be adopted as much as is possible within an individual's capacity.

3.2.2.3 Interviews

Interviews were deemed the most appropriate way of gathering data for this study. The interview method allowed insightful knowledge to be obtained around participants' lived experiences and perspectives, and help probe into hidden issues (Braun & Clarke, 2013). Face-to-face exchange facilitates a rich interaction between the interviewer and interviewee (E. S. Block & Erskine, 2012; Guest et al., 2013). Non-verbal paralinguistic cues such as eye contact, facial expressions and body language can be captured for unambiguous, personalised and prompt feedback (E. S. Block & Erskine, 2012; Guest et al., 2013). Interviews with consenting participants took place from April to June 2019, prior to which rapport was built through introductions, clarification of questions about the study and consent to digitally record the interviews being obtained.

Interviews were conducted face-to-face and as all participants had access to video-calling services, no home visits were necessary. A semi-structured interview format that lasted 60 minutes was conducted with each participant which sought to gain an in-depth understanding of participants' perspectives on PHBCs based on the HBM framework (Appendix 5). The interviews also captured how often participants relapsed in their PHBC maintenance in the last 12 months. Consistently maintaining PHBC while relapsing into risk behaviours at least once on occasion (not daily) was characterised as relapse. Although SR download was not a prerequisite for study eligibility among advertisement responders, these participants were asked if they had downloaded the app at the start of the interview. Such information was of interest to determine if being aware of their risk of a future stroke and its associated severity provoked motivation for PHBCs. All participants were questioned on the main themes to guide the interview in a way that answered the research question. However, questions were open-ended to allow participants to provide as much comprehensiveness as they found fit. The order of questioning was allowed to change to logically follow the content that participants brought to the interview. New topics and themes that emerged were further explored as and when they arose, allowing the flow of the interview to be guided by the participants' responses. The interview also included spontaneous follow-up questions which were used to: (1) direct the dialogue towards the research focus, and (2) to clarify or expand on information provided by the interviewee or to elicit examples (Kallio et al., 2016). Interviews were conducted until saturation on core constructs was reached, that is, the point at which no new themes were yielded by additional interviews. Interviews were digitally recorded and transcribed verbatim as soon as possible after the interview.

3.2.3 Data analysis: General inductive analysis

The process of data analysis aims to condense the volume of collected data into grouped categories, synthesise meanings out of each category and theorise relationships, all the while staying true to the text in order to achieve trustworthiness (Bengtsson, 2016). A general inductive approach outlined by Thomas (2006) was deemed suitable for analysing the data given its appropriateness for use within the qualitative descriptive approach As opposed to imposing a pre-determined structure of analysis, codes and themes were identified as and when they arose from repeated reading of the dataset, and not simply if they fit within the constructs of the HBM. This understanding of inductive analysis is consistent with Strauss and Corbin's (1998) description: "The researcher begins with an area of study and allows the theory to emerge from the data" (p. 12).. The resulting output was the development of a framework created by underlying themes and categories ascertained from the raw data. Cognisant of these needs, descriptive thematic analysis complemented the qualitative descriptive methodology as it summarizes the patterns of meanings in the data and supported the naturalistic philosophical underpinnings of the study.

To keep true to the research objectives, critical decisions were made as to what was important in the data and relevant to the research questions. For example, participants' accounts of their family or peers undertaking PHBC were only considered for analysis if it motivated participants themselves to execute change. All analysis was undertaken by uploading raw interview data into the qualitative analysis software package, NVivo Version 12 (QSR International Pty Ltd, 2020). Data analysis incorporated 4 stages outlined in Table 3.1 (Bengtsson, 2016; Thomas, 2006).

3.2.4 Ethical considerations

It is necessary to adhere to some fundamental ethical principles when research involves human participants. Three forms of ethics (procedural, situational and relational) as described by Tracy (2010) that were addressed in this study are described in the following sections.

3.2.4.1 Procedural ethics

Of particular relevance to this section were voluntary participation, informed consent, confidentiality and non-maleficence. Ample opportunities were provided for participants to learn more about the study and make an informed decision about participation. While the information sheets were initially disseminated electronically, participants were encouraged to contact the researcher with any questions regarding the study. Pending questions were also answered at the outset of interviews to ensure the consent process was fully informed. Signed consent was sought prior to commencement of interviews. It was clearly stated to participants in both the information sheet and prior to the interviews that their participation in the study was voluntary and they were free to withdraw at any time.

Confidentiality was addressed during data collection, data cleaning and dissemination of research results, with the following measures undertaken:

- Interview recordings were destroyed immediately after uploading into a password-protected, electronic database on the AUT University server, which also housed all interview transcripts. All interviews were transcribed by the researcher

Table 3.1

4 stages undertaken in the analysis of interview transcripts to generate codes and themes

Decontextualization	a)	Data cleaning to generate transcripts in standard format. Transcripts were then thoroughly read to enable familiarization (of meanings) with the data. During this process, thoughts about participant experiences and their meanings were written down.
	b)	NVivo based coding was performed whereby each transcript was examined in detail, line by line and meaning units manually highlighted. Meaning units were relevant text segments assigned a label/category signifying the underlying meaning. These formed base level codes, each of which contained a constellation of key sentences or paragraphs. For example, laziness was a code related to a barrier for performing physical exercise.
	c)	When appropriate, the participants' own words were used as codes if they conveyed the core essence of the meaning unit. Contradictory or novel views within each code was captured.
	d)	The remaining transcripts were then labelled with these codes, with one segment being coded into more than one category if needed. A considerable amount of irrelevant (to the research objectives) text was not coded. Thoughts about the analysis were continually documented to assist with this sort of analysis, a process known as memoing
Recontextualization	e)	Data was checked to see if all aspects of the HBM framework was covered by re-reading the original transcripts alongside the final list of meaning units.
Categorization	f)	Following the first round of coding, broad codes were condensed by reducing the number of words without losing meaning and similar codes were merged together. The codes in each interview were compared to each other to create broader categories that linked codes across interviews (constant comparison).
	g)	Base level codes were then segregated into higher level codes (themes and sub-themes) which were derived from research aims. Each theme was named precisely according to the essence of the data it captured using mind maps and other visuals. Association between themes were assessed to determine the causal or hierarchical relationships.
	h)	Sub-themes were divided to reflect those who did and did not undertake PHBCs.
Compilation	i)	Triangulation was performed to ensure validity and reliability of obtained codes and themes
	j)	A description of the overarching theme following by the sub-themes was presented. Excerpts from original transcripts will be used as quotations to illustrate derived themes and categories. Quotes were referenced using the participant allocation (PHBC/non-PHBC group), age, gender and ethnicity.
	k)	A summary of codes, themes and sub-themes presented as a table

- Study-specific, unique ID numbers were substituted for participant names and pseudonyms were used for all other potentially identifying characteristics (modifications did not alter data interpretation) to prevent deductive disclosure. Digital recordings, and raw and coded interview transcripts were assigned the interview name followed by the unique participant ID
- Participants were informed of the nature and potential consequences of participating in the Information Sheet and the measures taken to ensure confidentiality.

It was anticipated that, although unlikely, the nature of the interview questions may result in participant distress. Non-maleficence and respect for the dignity of the participants was assured by letting participants know at the beginning of the interview that they did not need to answer a question if they didn't wish to, and that they could terminate the interview at any time. Throughout the interviews, participants' reactions to questions were monitored closely. At the end of the interview, participants underwent a debriefing session to minimize any negative after-effects from the interview (e.g., stress, low-self-esteem, confusion) and ensure participants were restored to pre-interview levels. The rationale for the questions used in the interview was explained during the debriefing if needed, and participants were given a chance to ask any further questions about the research. Participants were also provided the researcher's contact details for any further information and advised to contact AUT's counselling services if needed. Contact details were provided in the information sheet.

3.2.4.2 Situational ethics

Situational ethics are ethical considerations based on the understanding that the environment influences behaviours (Tracy, 2010). Participant data, if taken out of context, may be interpreted negatively. Therefore, the context within which participants' behaviours were undertaken were considered during data analysis. Any participant misgivings regarding the interview or interview questions due to their cultural or social upbringing were also discussed during the debriefing.

3.2.4.3 Relational ethics

Relational ethics indicates a researcher's respectfulness to participants and to their shared experiences and a mindfulness of the impact of their actions on others (Tracy, 2010). This was addressed by considering: (1) how a participant would feel about how their experiences were presented, and (2) whether the meanings that the researcher attributed to participants' accounts were accurate when findings were presented in a public forum. Exiting ethics were considered during the data dissemination phase. There is likelihood for readers to stigmatise or marginalise certain groups for their perceptions around risk of stroke and barriers on certain PHBCs. To minimize this risk, the conclusions were reported in a way that ensured that participants could not be individually identified.

3.2.5 Data quality

Validity and applicability of the findings can only be established by judging the quality of the research process and the data collected. In this study, 4 areas of quality were addressed for the research to be deemed credible:

- The researcher's theoretical perspective and the motives and presuppositions that led them towards this particular research focus (Section 2.8, Section 3.2.2.2)
- Harmony between the research methodology and methods. In this study, the tools and procedures for data collection were derived from the research questions and the theoretical constructs which informed the qualitative description study design
- Performing *self-reflexivity* at the end of each interview which included a self-reflective commentary about the researcher's subjective feelings, personal assumptions and biases during the interview and how they made sense of the data
- Strategies to establish rigour (discussed next).

Four areas of rigour were addressed: credibility, transferability, dependability and confirmability.

3.2.5.1 Credibility/ data trustworthiness

Credibility of both the research process and the obtained data was attained by:

- *A thick description of the data,* accounting for specific circumstantiality (cultural or social setting) that can influence responses and providing enough details in the final report (such as quotes) to allow readers to make their own conclusions
- *Multivocality*: achieved by listening attentively and recording participant viewpoints without interrupting with the researcher's own feedback or thoughts. The researcher was also aware of the differences in age, gender and cultural backgrounds between herself and participants and acknowledged the possible influences this can have on the researcher's self-reflection and report-writing. The researcher sought to develop a rapport with participants during interviews, allowing for nuanced analyses that contain deeper meaning (Koch, 2006; Tracy, 2010).

3.2.5.2 Transferability

Inferential generalisability of study observations in qualitative research is based on the congruence between the characteristics of the research sample and the population to which the conclusions are applied to (Koch, 2006; Ritchie & Lewis, 2003a). The beliefs, attitudes and perceptions towards PHBCs described in this study are likely to be experienced by participants currently enrolled in other NZ primary stroke prevention programmes. Other relevant populations include users of mHealth and PHBC-based apps and individuals who are advised by health practitioners to undertake PHBCs but are not motivated to do so.

3.2.5.3 Dependability, trustworthiness and confirmability

While the concept of dependability refers to data consistency, variation of an experience is actively sought in qualitative research (Ritchie & Lewis, 2003b). Rich rigour (data that displays complex and multifaceted constructs, data sources and context), was achieved by:

- Collecting data from participants informed by different social, cultural, age and gender contexts to provide varying perspectives on HBM constructs

- Cohesive and comprehensive open-ended interview structure, allowing a focus based on HBM constructs and flexibility for participants to delve into their experiences
- Constant reference to the data throughout analysis and writing.

Consistency in analysis (trustworthiness) of data, such as the themes and codes generated, was achieved by the process of triangulation. Two of the interview transcripts were analysed by both the researcher and two other researchers experienced in the qualitative research field (Associate Professor Rita Krishnamurthi and Dr Suzanne Barker-Collo). After review, generated codes and themes were discussed and a consensus reached. These strategies helped ensure that the generated conclusions were reflective of participants' experiences. However, the nature of general inductive analysis is such that thematic observations from the same dataset by different researchers are likely to be non-identical and can have non-overlapping elements.

Confirmability refers to the researcher adopting a stance that is relatively neutral and reasonably unbiased and was achieved by being transparent (honesty about the research process) (Colorafi & Evans, 2016). All preconceptions, theoretical positioning, methods and procedures were documented in explicit detail throughout the entire study and final report writing (Colorafi & Evans, 2016). Transcription was performed word for word without any omission of data.

3.3 RESULTS

3.3.1 Participant characteristics recruited for Study 1

Overall, 47 participants were approached to participate in the study and 37 were interviewed before data saturation was reached. For Group 1, 15 RIBURST participants and 4 advertisement participants, and for Group 2, 13 RIBURST participants and 5 advertisement participants were enrolled. Recruitment strategy sought to closely reflect the current NZ census data (Statistics New Zealand, 2018). Approximately 13 Caucasians, 3 Māori, 1 Pasifika and 3 participants of other ethnicity in a sample of 20 participants (per group) were interviewed. A summary of participants' demographic information is listed in Table *3.2*. Participants who undertook at least two out of four of the PHBCs of interest over 12 months in the sample were primarily >55 years of age, male, Caucasian and employed. Participants who did not undertake any PHBCs were also primarily >55 years of age, female, Caucasian and also employed. The SR app was downloaded by only two of the nine advertisement responders (Asian, 25–34-year-old and female) and others reported that they were not interested.

Table 3.2

Demographic distribution of participants in both groups

	Group 1 (N= 19)					Group 2 (N= 18)				
	N (%)					N (%)				
	Total	**Diet n=5**	**Ex.[a] (n=5)**	**Sm.[b] (n=4)**	**Alc.[c] (n=5)**	**Total**	**Diet (n=4)**	**Ex.[a] (n=4)**	**Sm.[b] (n=5)**	**Alc.[c] (n=5)**
<25	3 (16)	0	0	3 (75)	1 (20)	2 (11)	0	0	2 (40)	0
25–34	2 (11)	0	0	1 (25)	1 (20)	4 (22)	0	0	3 (60)	1 (20)
35-54	6 (32)	3 (60)	2 (40)	0	0	4 (22)	3 (75)	2 (50)	0	1 (20)
>55	8 (42)	2 (40)	3 (60)	0	3 (60)	8 (44)	1 (25)	2 (50)	0	3 (60)
Female	8 (42)	2 (40)	3 (60)	1 (25)	2 (40)	12 (67)	2 (50)	4 (100)	4 (80)	3 (60)
Male	11 (58)	3 (60)	2 (40)	3 (75)	3 (60)	6 (33)	2 (50)	0	1 (20)	2 (40)
Caucasian	13 (68)	4 (80)	4 (80)	1 (25)	2 (40)	10 (56)	2 (50)	3 (75)	0	4 (80)
Māori	1 (5)	1 (20)	0	0	1 (20)	3 (17)	1 (25)	0	2 (40)	0
Pasifika	0	0	0	0	2 (40)	1 (6)	1 (25)	0	1 (20)	0
Another ethnicity	5 (26)	0	1 (20)	3 (75)	0	4 (22)	0	1 (25)	2 (40)	1 (20)
Student	3 (16)	0	0	3 (75)	1 (20)	4 (22)	0	0	4 (80)	0
Employed	13 (68)	4 (80)	3 (60)	1 (25)	4 (80)	11 (61)	4 (100)	4 (100)	1 (20)	4 (80)
Retired	3 (16)	1 (20)	2 (40)	0	0	2 (11)	0	0	0	1 (20)

[a]Exercise-related PHBCs
[b]Smoking-related PHBCs
[c]Alcohol-intake-related PHBCs

Participants also reported any health conditions that they perceived acted as barriers or affected their ability to undertake PHBC (Table 3.3). This data was collected to provide contextual information that could inhibit the initiation or maintenance of PHBCs. Two participants in the non-PHBC group indicated that they were unable to undertake recommended levels of exercise due to pre-existing conditions such as atrial fibrillation, obesity or hypertension. These individuals were categorised into the group of participants who reported PHBCs that were often beyond their scope of ability, despite having a readiness to do so (Section 3.3.4.1). The two PHBC participants who self-reported that their health conditions made exercise difficult to perform, undertook physical activity in ways that fitted their capabilities (Section 3.3.4.3).

Table 3.3

Medical history of participants self-reported as affecting their capacity for PHBC

Health condition self-reported as a barrier	Number affected per group	Self-reported PHBC difficulty
Atrial fibrillation	1 PHBC participant 1 non-PHBC participant	Exercise
High BMI	1 non-PHBC	Exercise
High BP	2 non PHBC	Exercise
Osteosclerosis	1 PHBC participant	Exercise

3.3.2 Thematic analysis of qualitative interviews

Three salient themes were generated from the interview narratives that could be sequentially ordered to form a three-stage cognitive pathway, where each stage determined the likelihood of PHBC being successfully undertaken. Comparison of the PHBC and non-PHBC groups demonstrated clear distinctions in how this cognitive pathway was followed through. Each theme had a central organising concept: 1) An individual's readiness for PHBC was dictated by a strong motivational driver, 2) knowledge (how, when, where) to execute PHBCs, the social environment and self-regulatory capacity predicted the ability to enact change, and 3) original motivations, PHBC benefits and self-regulatory capacity predicted likelihood for maintaining PHBC and resist relapse. Table 3.4 summarises the themes, sub-themes and codes that emerged from the data. Each theme is reviewed in a separate section below.

In each of these sections, risk behaviours referred to include smoking, drinking >1 standard drink of alcohol per day, eating < 6 serves of fruits and vegetables per day or undertaking < 2.5 hours of physical activity per week. For those who reported low fruit/vegetable intake, consumption of processed foods (high energy, nutrient-poor) was also explored. In the following sections, the percentages of participants indicated refers to the primary demographic group that reported the given concept.

Table 3.4

Themes, sub-themes and codes generated from data analysis

THEME	SUB-THEME	CODES
Motivational drive for PHBC readiness	The reluctant individual	Resistance to external advice
		Natural habits
		PHBC-related costs and inconvenience
		Dislike for PHBC or not as effective as risk behaviours
		Management of negative affect using risk behaviours
		Norms and rules of social engagement
		A lack of concern due to notions around fatalistic attitude[19], youth, controlled risk factor engagement (everything in moderation), overall good health
	'I want to but then I don't': The mental push-pull dynamic	Guilt in performing risk behaviours
		'I know I should but I'm not ready'
		Planning for the future
	Valuing future gains over momentary pleasures	Children and role-modelling
		Validation from family and peers
		A health scare
		Worsening outcomes due to risk behaviour
		Short-term goals such as travel
		Prophesising and prioritising future health outcomes
		Exposure to poor health of others due to risk behaviours
Self-regulation, action planning and the social environment dictates PHBC implementation	'PHBC is beyond my control'	Physical limitations such as poor health
		Situational constraints and prioritisation
		Anti-PHBC social and familial norms, social identity and fitting in
		Stress and negative affect
		High perceived self-efficacy to implement PHBC at more opportunistic times
	The procrastinator	Excuses to put off PHBC
		Lack of sufficient support
		Half-hearted efforts
	Mindful action planning	Cold turkey[20] methods
		PHBC within capabilities
		Specific programmes/interventions
		Risk behaviour substitutes

[19] See glossary
[20] See glossary

THEME	SUB-THEME	CODES
PHBCs are maintained through original motivations, benefits accrued, self-efficacy and self-regulation	Significance of the original motivator and PHBC benefits	Short-term goals limited long-term PHBC maintenance
		Long-term health concerns and family-centred values promoted PHBC maintenance
		PHBC benefits are self-reinforcing feedback loop for maintaining PHBC
	Self-affirmations and support systems promote self-efficacy	Verbal encouragement
		Pro-PHBC culture: peers' practice of PHBC and desire to fit into new norms
		Positive self-talk
	Self-regulation dictates likelihood of relapse	Eliminating the enabler
		Self-discipline
		Diminished self-regulatory strength predicts temporary relapse (convenience and low effort preferred)
		Going overboard
		Addictiveness of risk behaviours enhanced during low self-regulatory resource
		Seeing it, smelling it triggers relapse
		Avoid risk behaviour triggers at all costs
		Travelling and celebratory occasions
		PHBC reinitiated after self-regulatory reserves are back up, original PHBC motivations recollected
		Permanent relapse: ongoing dissonance or change in priorities

3.3.3 Theme 1: Motivational drive for PHBC readiness

Readiness for PHBC represented the extent to which participants desired to modify existing risk behaviours and whether they perceived a need for PHBC. There was diversity in participants' attitudes towards PHBCs generating the three sub-themes: (1) complete reluctance towards change, (2) ambivalence around change promoting a mental push-pull effect, and (3) desire for change based on prioritising future gains over momentary pleasure. These perspectives underpinned participants' attitudes towards PHBC which then either encouraged or inhibited readiness for change.

In both the PHBC and non-PHBC groups, the severity of a stroke event was well appreciated across all gender, age and ethnic groups. Participants acknowledged the likelihood of dying from a stroke, the potential for disability in stroke survivors that aligned with the severity of the stroke and the short and long-term consequences of a stroke (upon health, social life and relationships).

> "Every aspect of your life it is changing. From activities of daily living to, you know, it depends if it's just a little bit of motor issue, motor control, cognitive, speech. It can be from very mild to huge impact." (HBM_23, non-PHBC, female, 35–54 years, Other ethnicity)

Perceptions around risk behaviours were highly variable in the dataset. Participants in both groups primarily attributed the presence (or lack of) family history of stroke, age and prevalence of smoking, hypertension and obesity as impacting their risk of a future stroke. The relationship between alcohol intake and stroke risk was least understood with uncertainty how much alcohol is health-promoting. When prompted, not eating a healthy diet and high stress were acknowledged as increasing the risk of stroke by a majority of participants in the PHBC group. Sedentarism was deemed an important risk factor for most non-PHBC participants. Two or more lifestyle risk factors were correctly identified by more males (62%), >35 year olds (69%), employed participants (77%), participants with a tertiary education (38%) and earning $70-90,000 p/a (46%) in both the PHBC and non-PHBC groups. Among Caucasians, only 54% were able identify two or more lifestyle risk factors.

> "The whole lowering your meat consumption and increasing your vegetable consumption overall is good for a whole lot of stuff...in terms of overall wellness. And then I don't know if there's a connection between sugar, specifically to strokes, but overall health, reducing that, reducing alcohol consumption, which is a big thing. Exercise gives you that whole, I mean, it's all to do with cardiovascular health, getting the heart rate up, blood pumping." (HBM_8, PHBC, female, >55 years, Caucasian)

It was of particular interest to determine perceived stroke susceptibility and severity of stroke among Māori and Pasifika participants. All participants in these ethnic groups acknowledged the severe impact of stroke on an individual's health and quality of life. They perceived themselves to be susceptible *if* the aforementioned risk factors (in particular smoking) were present. 60% of Māori were able to identify at least two or more lifestyle risk factors while the sole Pasifika participant identified one.

> "My chances [of stroke] are definitely greater because I smoke and because of my ethnicity as well, like I'm Pasifika and I know that's another risk factor, I know that I don't exercise much that could be another reason that I could have a stroke." (HBM_31, non-PHBC, female, 25–34 years, Pasifika)

3.3.3.1 Sub-theme 1: The reluctant individual (non-PHBC participants)

For most non-PHBC participants, a lack of concern regarding the adverse impact of risk behaviours and/or future risk of stroke (or other health issues) limited readiness for PHBC. These observations were consistent across both users and non-users of the SR when the former were queried on the impact of knowing their five- to ten-year stroke risk probability on PHBC motivation. 60% of non-PHBS participants did not fear a future stroke even if they were able to identify two or more of their own risk factors (modifiable and/or non-modifiable).

> "I think it's probably higher than other people my age, but yeah. Not to a point where I'm incredibly concerned." (HBM_33, non-PHBC, female, 25-34 years, Māori)

Limited concern occurred for a number of reasons. Readiness for PHBC was in part mediated by how risk behaviours were classified as being health-adverse. Some participants were either uncertain or sceptical about the role of such behaviours in relation to enhanced stroke risk.

"I don't know about stroke [its relationship with unhealthy diets]. Cholesterol is affected by your diet. Not sure about stroke, processed food for gastric cancer is a factor. Don't know about stroke." (HBM_5, non-PHBC, female, >55 years, Caucasian)

For those >55 years of age and male (40%), there was the overall suggestion that risk behaviours didn't threaten longevity or health due to an absence of serious health concerns. Modifying such factors would be contingent upon the development of a serious illness. These participants were *unable to recognise the long-term adverse impact of risk behaviours.* Observing relatively good health in others who engaged more heavily in risk behaviours (e.g., older family members who smoked for years) also reduced concern.

"It's just a matter of being within the headspace of doing something to change. Right at this stage, I don't have a particular external catalyst that was saying, 'this is going to happen'. But I guess I'm at the point where I've got more time on my hands and conscious that I haven't been out walking as much but haven't given it a priority." (HBM_16, non-PHBC, male, >55 years, Caucasian)

Some participants (>55 years of age and employed (75%), 25% Māori and 50% Caucasians) did not feel a need to undertake PHBC as they felt they had overall good health. Additionally, these participants reported they were already engaged in other health-protective behaviours (e.g., eating well, exercising, controlling hypertension). The following participant reiterates his level of overall fitness and good health despite being a daily consumer of alcohol (above recommended levels).

"Usual things like my cholesterol, it's low. We are fit very fit healthy people. We are regular trampers. Just in the last few days, we've signed up to go on a trip to Nepal. Next week, we're going to be heading off for a six-day tramp around Mt Ruapehu. I mention these things to sort of indicate the level of health and fitness that we actually enjoy, even though we are 70. We are actually very, very healthy." (HBM_1, non-PHBC, male, >55 years, Caucasian)

Everything in 'moderation' and nothing in excess was a generally salient theme among males, those >55 years of age (67%) and Caucasians (67%). These participants spoke about how they only engaged in risk behaviours either moderately, intermittently or these were only context-specific indulgences. As a result, participants rationalised that intermittently performing risk behaviours did not pose significant health risks and, hence, PHBC was not necessitated. Most commonly, regular smokers and alcohol consumers minimized the impact of what they perceived as 'moderately' engaging in risk behaviour.

> "Maybe its [risk for health issues] not as high if I don't smoke. I still have risk because its junk food, it's not healthy. I know the consequences. But I think for now that to eat junk food, but not every time. Maybe three to four times a week. I think that's fine for me, not every day." (HBM_35, non-PHBC, male, <25 years, Māori).

Some social alcohol consumers considered themselves in greater control and knowing when to stop, rationalising the 'self-moderation of risk behaviours'.

> "I enjoy having a couple of drinks, but I after that I'm like, 'Okay, that's enough now.' So, I'm gonna stop and have a cup of tea." (HBM_10, non-PHBC, male, >55 years, Caucasian)

In addition to a lack of concern, the current utility of risk behaviours outweighed the long-term, futuristic benefits of PHBC, limiting readiness for PHBC. Such individuals chose to ignore the future health consequences of their risk behaviours. Among <25-year-olds (50%) and Māori (33%) youth fostered a thinking that they had ample time to overcome future health risks associated with current risk behaviours. These participants considered their age safeguarded them from any adverse health effects. Instead, PHBCs were considered only necessary when health issues (stroke or otherwise) were more prone to happen or when priorities changed (e.g., when participants wanted to begin a family).

> "I've got a family history of blood disorders and things, combined with smoking. But then I look at it like my age. I'm 21 and in 5 or 10 years, I don't think I'd have a stroke. Even though I see stroke patients that are my age coming through. I'm like, 'No, that's not me. … Why shouldn't I just have one [smoke] right now and deal with the consequences like later?'" (HBM_37, non-PHBC, female, <25 years, Caucasian)

On the other hand, 75% of >55 year olds, Caucasians and males reported fatalistic attitudes and were not motivated by longevity as a reason for PHBC. These participants held the view that death is inevitable and trying to avoid it by changing habitual behavioural norms is futile. Participants also reported that circumventing adverse health due to risk behaviours was inconsequential as the damage has already occurred (e.g., lung issues in smokers) or they were too old for benefits to be relevant.

> "I take the view, I'm 70. If I knock, knock over tomorrow, with a stroke, I've had a pretty good life anyway. So, I'm going to live my life the way I want to. If drinking alcohol is going to create a problem for us, well then so be it. I hope I do live for a couple of years. So, I hope it doesn't happen tomorrow, but if it does it does." (HBM_1, non-PHBC, male, >55 years, Caucasian)

Some participants (57% males, 43% 25–34 year olds and 14% Māori and 43% other ethnicity) simply did not enjoy eating fruits/vegetables or exercising. These participants also previously struggled to successfully execute PHBCs or did not find healthy alternatives as effective as actual risk behaviours (e.g., vaping v. smoking for relaxation).

> "I tried to switch to a vape as well, but I didn't really get into that too much. I was getting nothing of the same effect." (HBM_32, non-PHBC, male, <25 years, Other ethnicity)

Diet-related costs and convenience associated with meal preparation affected readiness for diet-related PHBCs (earning <$30-50,000 p/a, 75% female, 50% >55 year olds and Caucasian). Participants resorted to convenience foods as they were perceived to be more cost-effective than healthy alternatives or they did not have the time to prepare meals.

> "As a student you have deadlines, eating outside is more better rather than come home and cook some meals. McDonald's is just beside my campus, so that will be easy for me. Other healthy food stores are quite far, and I need to take a bus 5,10, 15 minutes... Also, the healthy food is quite expensive, so $10 for one meal is quite expensive. So, with $15 and 5 people, you tend to go to fast food places just for 5 bucks you can eat more." (HBM_30, non-PHBC, male, <25 years, Other ethnicity)

Smokers and alcohol consumers, 59% males, 44% >55 years of age, 11% Māori and Pasifika and 56% Caucasian reported that risk behaviours began very young. As a result, these behaviours were embedded into their daily norms and limited their capacity for PHBC (e.g., a routine of having a cigarette after waking up). Risk behaviours became almost involuntary and something beyond their conscious control. Participants often couldn't specify a particular reason for performing the risk behaviour.

> "It is more about more about a habit. You know, it's part of my kind of, it's part of my kind of daily routine, you know, and that's kind of become ingrained." (HBM_10, non-PHBC, male, >55 years, Caucasian)

The practice of risk behaviours (in particular smoking, alcohol consumption and unhealthy diets) was widespread in families/communities of some participants (57% males, 43% <25-year-olds and 14% Māori and Pasifika and 43% other ethnicity). Social norms that advocated these behaviours lessened readiness for PHBC. Smoking and alcohol intake in particular were inbuilt into the rules of social engagement to strengthen peer relationships, meet new people and converse with others. Interacting with peers who actively partook in risk behaviours triggered a desire to fit in and not be excluded from future gatherings. Young participants often experienced a powerful force to mimic what everyone was doing.

> "You can be more social if your friends circle smokes; then you yourself feel like doing it. If you're smoking, you can really stand anywhere and you find somebody to talk to. I sort of noticed it also helps you in your career, at times because you're more into the group. Meet other people that helps you in your work as well. It helps you in your work relationships, to grow in your career." (HBM_28, non-PHBC, female, 25-34 years, Other ethnicity)

For older participants, alcohol intake and socialising were interwoven aspects and a means to relax together. Some described alcohol was imperative in social interactions.

> "Once a week, I might meet with some friends at a pub and have a couple of beers sort of thing. But that's it's all about catching up with friends. It's a social imperative. The alcohol is imperative. You know, you got four people sitting down, having a drink sharing something like that in common, as a way of relaxing. It's a great social lubricant." (HBM_7, non-PHBC, male, >55 years, Caucasian)

Alternatively, even in the presence of peers or family members who advocated for PHBCs, those who felt personally unprepared for PHBCs strongly resisted such encouragement (67% female). Some participants only visited their clinicians to receive prescriptions, and any advice for PHBC was disregarded or minimized. They held the view that risk behaviours were a personal choice and the decision to undertake PHBCs would need to come from their own priorities and values. These participants emphasised the critical role of willpower in implementing PHBCs.

> "I have many people wanting me to quit. But I don't think it really helps, it only helps you to the point. And now I've got to the point where I'm like, 'If you can't accept me like this, I don't care. Move on. Stop telling me what to do.'" (HBM_28, non-PHBC, female, 25-34 years, Other ethnicity)

Smokers viewed any advice that they received to quit from other family members who were long-term smokers was hypocritical.

> "I know older smokers who do encourage me to stop like young. Okay and you're looking at them and asking 'Why are you telling me that, you smoked for 15 years. You are closer to those health problems; you should be quitting.'" (HBM_34, non-PHBC, female, <25 years, Caucasian)

Some participants (67% female and other ethnicity) successfully masked risk behaviours such as smoking from family members, fearing repercussions if they were caught. Smokers reported that their workplaces had smoking restrictions in place, or they did not want to smoke in front of children. Role-modelling was also evident in terms of professional outlook. Participants did not want to publicly perform risk behaviours that negated the value of their respective professional positions (e.g., medical professions such as nursing). Such limitations were overcome by only smoking when they were alone or physically removing themselves from an environment that criticised such behaviours.

> "I'm personally aware of my leadership and role-models, that is one of the other reasons why I had to kind of quit [smoking in front of clients] because I didn't want to role-model that bad behaviour." (HBM_30, non-PHBC, female, 25-34 years, Māori)

In summary, these participants felt no qualms in pursuing risk behaviours and were motivated by present as opposed to future utility of lifestyle choices. Nonetheless, a portion of non-PHBC participants acknowledged the importance of PHBCs and experienced guilt when performing risk behaviours. Despite this guilt, these participants were reluctant to undertake

PHBC. It is this cognitive push and pull that the next sub-theme further describes.

3.3.3.2 Sub-theme 2: 'I want to but then I don't': The mental push-pull dynamic (non-PHBC participants)

58% of non-PHBC participants (70% female, 36% 35–54 year old and 54% Caucasian) experienced cognitive dissonance, reporting a transitional state between wanting to pursue PHBCs and also not wholeheartedly forgoing risk behaviours. These participants reported that they desired good health and were ambivalent in continuing risk behaviours. Such opinions came to the forefront when participants experienced the maladaptive effects of risk behaviours or they reduced their capacity to do activities that they enjoyed.

> "I'll get back and I'll be coughing for like, I don't know, like an hour after I've gone for my run. Yeah, that's one of my big things that makes me think, 'Oh sh**, I probably should stop.'" (HBM_32, non-PHBC, male, <25 years, Other ethnicity)

Use of the SR app was also a wake-up call for some participants. Participants reported that prior to the app, they had underestimated their risk of a stroke or how adverse certain risk behaviours could be on their overall health and increase their stroke risk. Although not sufficient to actively evoke PHBCs, better awareness of stroke risk and risk factors through the SR was acknowledged.

> "I'm actually doing the Riskometer. And it gave me a little bit more insight. But what really woke me up was the impact of exercise, lack of, that it can have. And that was scary. I always thought, 'I have a low risk. You know, there's no family history'... And from that, I thought, 'Uh oh.' So I think I realised that my risk is higher than I thought it was. Purely because of I'm not doing anything at all." (HBM_23, non-PHBC, female, <35–54 years, Other ethnicity)

Most participants reprimanded themselves for their over-dependency on risk behaviours and experienced guilt following the risk behaviour (80% female, 50% Caucasian and 20% Pasifika). However, participants stated that these were transient moments of precariousness and such PHBC triggers were quickly dismissed. Therefore, the 'push' towards PHBCs was reciprocated by an equivalent 'pull' back to the risk behaviour, where the convenience to not alter one’s lifestyle outweighed indecision.

> “I don't like eating it [high-calorie comfort foods] and when I do eat, it tastes like a piece of guilt. And I just don't like it anymore. But I just do it [eat takeaways] because I don't have the energy to prepare meals.” (HBM_30, non-PHBC, male, <25 years, Other ethnicity)

These participants reported that the actual act of enforcing smoking and alcohol-related PHBCs was far more difficult that simply wanting to undertake PHBC. Participants often attributed blame to the underlying addictive nature of risk behaviours.

> “I’ve been smoking for maybe 10–15 years, I started in school. And when I tell people that they say, ‘Oh you can easily quit smoking.’ But I'm like, ‘I would if I could.’” (HBM_31, non-PHBC, female, 25–34 years, Pasifika)

Others in this group often lacked a significant motivator to propel them into performing PHBCs, despite having the knowledge, means and methods to do so. Some participants just didn’t want to engage in PHBC or were not yet prepared to.

> “I've got the lozenges and I've got the chewing gums. I've got the patches like they're just sitting there doing their thing. And like I've got like the qualification here as a nurse to be able to dispense that stuff …so it's like I have all the access I want but none of the actual inclination to.” (HBM_34, non-PHBC, <25 years, female, Caucasian)

These participants expressed a futuristic commitment to PHBC (67% female, 50% 25–34-year-olds and 17% Māori and Pasifika and 33% other ethnicity). They commented that PHBCs were more likely to occur when circumstances were favourable and sacrificing risk behaviours was necessary to satisfy more important priorities (e.g., beginning a professional role where role-modelling health behaviour was essential). There was an overall consensus that they would be successful implementing PHBCs on the first go.

> “I think that's just at the stage I am in my life right now as well. So it's just me and my partner, and we don't have any kids. But I think that when it comes to settling down and having children, that will definitely trigger me to stop smoking.” (HBM_33, female, 25–35 years, Māori)

Therefore, the losses associated with giving up risk behaviours overtook the desire to exercise PHBCs in this group of participants. Nonetheless, PHBC-imbued benefits were more salient and constituted a powerful motivator for change in another subset of participants. This sub-theme is further explored in the next section.

3.3.3.3 Sub-theme 3: Valuing future gains over momentary pleasures (PHBC participants)

Readiness for PHBCs was characterised by a substantial motivational driver. The dataset revealed several contributors for endorsing a resolute motivation for change. A predominant aim for most PHBC participants was to achieve a holistically better present and future, in terms of physical and mental health and social relationships. Family was an important factor for participants wanting to achieve better personal health and well-being. Participants who were parents conveyed a desire to live long enough to see their children grow up and to have the necessary health and energy (e.g., physical fitness) to be involved in their children's activities. These perspectives were particularly salient among >35-year-old and 75% males and Caucasians.

> "A big motivation for me, and I'm sure for lots of women is wanting to be around for the kids. You can see a lot of people change their lives as soon as they have children because they want to be there." (HBM_8, PHBC, >55 years, female, Caucasian)

The aspiration to role-model good lifestyle choices unfolded prominently within the dataset (75% males and 50% Māori). Parents prioritised their children's health and well-being by not engaging in risk behaviours that could have negative health impacts for their children or promote their uptake in their children. Such individuals conveyed a strong sense of obligation to do what is right by their children and translate 'exemplary behaviour' to them.

> "Family mainly, because we had a family growing. Want to be a good role-model by not smoking." (HBM_17, PHBC, male, 35–54 years, Other ethnicity)

Several participants (<35 year olds and 75% males and other ethnicity) spoke about the tension to undertake PHBC due to their spouse or partner. Partners expressed concerns about participants' health or aversions to the unpleasant aesthetics connected to risk behaviours (e.g., smell of cigarettes). As a result, participants reported feeling pressure to choose the behavioural outcome most meaningful to them.

> "My partner really doesn't like it. That's why I reduce it [smoking], that's another reason is because of my partner… she doesn't really like it. Like my mom and dad also tell me to quit... They [friends] always like scare me a lot. They show me the stats for the stroke and like all the other diseases because of the smoking. They say, 'You're going to have a stroke because of the smoke so try to stop it.'" (HBM_35, non-PHBC, male, <25 years, Māori)

For those who interacted with peers who were undertaking PHBC, a desire to conform to changing social norms was evident. These participants described the attitude that "if they can do it, I can". This was particularly relevant in young smokers whose peers were converting to vaping to replace smoking.

> … "she [friend] smoked every day. But she's gone to like, vaping… It is that kind of, like, peer pressure, like, 'If they can do it, I can do it' kind of thing." (HBM_10, non-PHBC, male, >55 years, Caucasian)

However, PHBCs prompted by family pressure or financial hardship were undertaken reluctantly by some participants, as they weren't planned or intended, but due to external circumstances beyond their control.

> "I only do it because my husband exercises. He runs every day, and he'll run for an hour every time. And he does that, too, so that he can live a really long life. So I do it because I have to, not because I want to. But I get really bored." (HBM_9, PHBC, female, 35–54 years, Caucasian)

Physical and mental health and well-being featured notably among reasons for initiating PHBC (67% males, 83% >55-year-olds and Caucasian). The development of a one-off health crisis (that may or may not be related to the risk behaviour) was a PHBC motivator among many of the older participants. Participants described these as a wake-up call, triggering them to re-evaluate their risk of disease and the need for better lifestyle choices to limit the likelihood of further health issues. Participants stated that development of a health concern changed their attitudes towards PHBC, increasing concern for their health which was previously not a priority.

> “Overall health has come into focus for me in the last 18 months to 2 years, because I've had that menopause thing and I've gone, ‘Oh, God, you know, everything's starting to fall apart.’” (HBM_8, PHBC, female, >55 years, Caucasian)

For some (82% female, 36% 25–34 year olds, 18% Māori and 45% other ethnicity), worsening outcomes self-attributed to the cumulative effects of risk behaviours were triggers for PHBCs. This either manifested as (1) adverse health reactions (e.g., difficulty breathing following smoking), (2) reduced bodily performance or functioning (e.g., inability to exercise due to binge-eating), or (3) social or financial hardships (e.g., increasing costs of cigarettes). For several ex-smokers, unpleasant aesthetics of smoking (e.g., smell, impact on teeth) prompted them to quit. Another motivator for some participants was the inability to perform activities they enjoyed (e.g., sport) due to health impacts of risk behaviours.

> “The smell of it [smoking]. My hands smelt bad. And I wouldn't like it. Then I started diving, and it was really impacting my breathing. I noticed the only health effect I had, the immediate one was I couldn't do hiking. I couldn't go uphill. And that was the major one. I’m like ‘Sh**, I need to stop.’” (HBM_28, PHBC, 25–35 years, female, Other ethnicity)

For some, poor health status of family members prompted participants to undertake PHBCs. In doing so, participants reported that were better able to support the management of their family member’s condition (prominent in older participants: 58%).

> “My wife was on the edge of Type 2 diabetes… the doctor said, ‘Well, you need to do something about it.’ So we reduced the amount of food. And at that stage, I was 103 (kg)… But I'm down at 95 (kg) now.” (HBM_4, PHBC, male, >55 years, Caucasian)

Several participants (>55-year-olds, Caucasians and 67% male) spoke about short-term goals such as travel or participating in a sports event as a cue to initiate weight management PHBCs. Participants sought to achieve/maintain a target weight to have the energy for the strenuous effort associated with such activities.

> “I like to keep my weight between a certain parameter. And if you travel, because we're doing travel next month, I want to be lower than that parameter.” (HBM_14, PHBC, male, >55 years, Caucasian)

Prophesising future outcomes was used by some participants (57% female, 71% 35–54 year olds and 29% Māori and 43% Caucasians) to validate their decision to undertake PHBC. Envisioning a future that is healthier, having the opportunity to achieve goals of value, and increasing life span were all considerations that invoked PHBC. For many, simply the fear of impending health issues prone to transpire if risk behaviours continued was sufficient to trigger PHBC. For these participants, future utility of PHBCs had precedence over momentary benefits of risk behaviours. As noted in Section 3.3.3.1, perceived susceptibility to stroke, although acknowledged, wasn't a significant motivator for PHBC for most participants. Instead, risk and severity of other immediate health issues (e.g., hypertension, obesity) were more concerning. These participants displayed sound knowledge of the importance of lifestyle risk factors and their role in chronic health conditions. The following accounts reflects these concepts:

> "Before I got married, I was at the point of drinking every day. I was, like, 'If I'm like this at 19 at 30, what am I going to be like?' And I'd be like, 'I can't continue like this.' And then when I met my husband, I had this motivation to work for something more, because before I never pictured myself having a child… And for the first time, I was like, 'Well, what if I actually got pregnant? How would this work out?' So, I had the motivation to stop. And cure my body." (HBM_37, PHBC, <25 years, female, Other ethnicity)

Witnessing disease outcomes suffered by family members or friends were triggers for PHBC readiness. Participants had a lived reality of what their future health could be if PHBC wasn't undertaken. This led to a greater appreciation of the health impacts of risk behaviours and a 'that is not going to be me' attitude.

> "I can take a look how my father has suffered [from smoking]. He sometimes has asthma and finds it hard to breathe. He also has cataracts, and his body is quite skinny. I know I look like that, but he's been smoking since 15, 19 or so; now, he is 55 [years of age]." (HBM_36, PHBC, male, <25 years, Other ethnicity)

Once a desire and readiness for PHBC was established, participants transitioned to the stage for executing PHBCs. The factors that dictated whether PHBCs were successfully initiated or not is described in the next theme.

3.3.4 Theme 2: Self-regulation, action planning and the social environment dictates PHBC implementation

Readiness alone did not successfully predict PHBC implementation. In addition to having the knowledge of how they would action PHBCs, a number of factors influenced how capable participants were to execute PHBCs. The dataset illustrated the diverse challenges that participants faced which influenced their self-regulatory capacity to perform PHBCs. These observations gave rise to three sub-themes including: (1) PHBCs are beyond voluntary control, dependent on emotions and moods and restricted by the environment, habits and physical capacity, (2) procrastination and delaying PHBCs, and (3) mindful action planning which includes a focussed effort to perform PHBCs.

3.3.4.1 Sub-theme 1: 'PHBC is beyond my control' (non-PHBC participants)

Many of the participants experienced a conundrum in deciding whether to refrain from or engage in risk behaviours. They viewed PHBC as being too hard to perform, accompanied by a sense of powerlessness over their inability to successfully execute PHBCs.

> "I start out with the best of intentions of thinking I won't drink during the week. But then it doesn't end up happening." (HBM_9, PHBC, female, 34–54 years, Caucasian)

Physical limitations such as poor health was recognised as often reducing participants' capacity for exercise and diet-related PBHCs (>35 year olds, 67% female and 92% Caucasian, 27% students and 73% employed). The manifestation of poor health/injury was often the consequence of not engaging in PHBC in the first place, resulting in a cycle of self-destruction (e.g., being sedentary promoted weight gain which then limited the ability to exercise).

> "I've got a treadmill and I used to use that regularly. But I found if I did it a lot over a week I'd get the atrial fibrillation at the end of the week. So I've just cut back on that now so. Until I get the atrial septal defect repaired, I probably won't start. I won't do too much again." (HBM_18, non-PHBC, >55 years, female, Caucasian)

The majority of participants were reluctant to perform diet- and exercise-related PHBC under sub-optimal conditions and had limited capacity to go out of their comfort zones and focus on health promotion. A number of situational constraints that limited PHBCs were observed within the dataset. Restrictions were primarily due to: (1) extrinsic conditions (e.g., poor weather limiting outdoor exercise, salient in participants earning <$30–50,000 p/a, student/employed, 67% female, 50% Māori and other ethnicities) and (2) prioritising time-critical tasks (e.g., work deadlines prioritised over exercise). Such situations promoted tiredness, low motivation and minimized the value of health benefits of PHBCs. For participants who considered PHBCs as physically/mentally effortful, there was a preference for activities that required minimal effort.

> "I think, 'You know what, actually I had a big day at work, and I'm stuffed. And hopping onto that sad old rowing machine; it's just not doing it for me. So, actually, I'm gonna do something else. I'm gonna binge watch an episode of something on Netflix, and just escape for a little while and have some fun.'" (HBM_25, non-PHBC, >55 years, female, NZ European)

Participants described that they often succumbed to a mental craving for risk behaviours during stress. Risk behaviours provided an energy boost, evoked relaxation or restored emotional balance (75% female, 38% 25–34-year-olds, 12.5% Māori and Pasifika and 50% Caucasians, 38% students and 63% employed). The self-medicating effects of smoking and alcohol intake were notably reported, rationalising them as a means of coping with the situation. This group were also more inclined to experience a cognitive push-pull (further discussed in Section 3.3.3.2). Stress and negative affect made participants feel powerless to resist risk behaviours despite the best of intentions. During moments of intensive negative affect, the short-term gains that risk behaviours provided were much more salient than future health benefits.

> "Definitely something I associate with, with getting to the end of the day [alcohol]. You know, if I had a good day, and I've achieved quite a bit, I'm more likely to have a drink, quite honestly, then, you know, have a drink because I've had a shi*** day. It's a drug [alcohol], isn't it? It's up to a point, you keep feeling better and better." (HBM_7, non-PHBC, male, >55 years, Caucasian)

Smokers engaged in cost reallocation, particularly during stress. The cost that could have been spent on healthy food items was re-allocated to purchasing cigarettes and essential needs such as groceries were foregone.

> "When stress levels are high, I choose to buy smokes instead of buying food which is more expensive than just 2-minute noodles, right?... I'm like, 'No, just buy the cigarettes and I'll eat noodles this week.' Instead of buying the fruit. And it's so sad. Because I know I'm doing everything wrong. I want to live long. But I am putting trash on my body. But it's like you have to do the physical thing to keep the emotional balance." (HBM_37, non-PHBC, female, <25 years, Other ethnicity)

While role-modelling played a vital role in facilitating the practice of healthy behaviours (Section 3.3.3.3), on the flipside, primary homemakers conveyed how familial obligations and putting the needs of children first limited time to nurture themselves and prioritise their own physical/mental health. These participants were primarily >35 year old, Caucasian and female (60%).

> "I please other people and I tend to put them ahead of myself. So if I've got something I know I've got to do for one of the neighbours, so, I'm running in and out of there and cooking the meals. Mom and Dad live in Napier. So I'm on the phone to them and running down to Napier to see what's going on. I've got a husband; I've got two children, but I feel like I'd run around after everybody else. And I probably don't look after myself as much as I should or put the time into myself that I should." (HBM_25, non-PHBC, female, >55 years, Caucasian)

Anti-PHBC social and familial norms made it difficult for participants to enact PHBCs (50% 25–34-year-olds, 25% Māori and Pasifika and 50% students). There was an irresistible urge to engage in risk behaviours when they were actively being practised in front of participants or they were encouraged by peers.

> "I'm in Porirua. And smoking is sort of linked with areas that are you know, like, low socioeconomic. It does trigger, when someone says, 'I'm gonna pop out for a cigarette.' I'm like, 'Oh, I'll come out with you.'" (HBM_31, non-PHBC, female, 25–34 years, Pasifika)

For young participants in particular, risk behaviours were an integral part of their peer interactions and interwoven into their social identities. By declining to actively participate in risk behaviours, they feared that they would not meet peer expectations which could lead to missed opportunities for socialising or exclusion from social gatherings.

> "We go in groups, so I have to join them as well. To have a chit chat together. They will be like, 'Let's go to McDonalds'… If I refuse to do it maybe they will feel like, 'Oh why are you refusing, why have you suddenly stopped joining us?' So, I don't want to disappoint them." (HBM_36, non-PHBC, male, <25 years, Other ethnicity)

For most of these participants, self-efficacy to perform PHBC was high, provided optimal conditions for engagement were met (e.g., time, physical environment, mental preparation). These participants drew on past endeavours in undertaking PHBC and their self-capacity for change. This concept mirrored the confidence of participants who conveyed that they may undertake PHBC at a future moment and would be successful on the first go (Section 3.3.4.2).

> "I'm in another town at the moment, and... it's like freezing down here. So I can't wait to come back to Auckland where it's a little bit warmer and when stressful things arrive, there's more things to divert me from smoking in Auckland. Every time I pick up that cigarette, it's not forever. Cos I've seen myself without it… I know I can do it again. It will go away. It doesn't have that much of an attachment anymore." (HBM_30, non-PHBC, female, 25–34 years, Māori)

While these participants unwilfully postponed PHBCs to meet other demands, another sub-group of participants purposefully delayed PHBCs without a particular reason for doing so.

3.3.4.2 Sub-theme 2: The procrastinator (non-PHBC participants)

Several non-PHBC participants postponed performing PHBCs but could not identify a singular reason for doing so. This sub-theme is not to be confused with the 'mental push-pull dynamic' where those participants had only transient moments of PHBC readiness. Most of these participants desired and had a clear idea on how they would enforce PHBCs. Nonetheless, they were non-committal, often put off by the emotional/physical effort required or lacked the motivational drive to put their strategies into practice (>35 year old and employed, 75% female and 88% Caucasian).

> "I need to do exercise. I was looking at joining a gym – maybe getting a wind trainer for

my bike or something. I haven't done anything yet. It's always 'Oh, next month, I'll start', you know, sort of thing… I always have in the back of my mind something's gotta change. So, no, I'm absolutely willing to change. It's just hard putting it into practice." (HBM_20, non-PHBC, female, 35–54 years, Caucasian)

Some participants (female, 67% 35–54-year-old and 33% Pasifika, Caucasian and other ethnicity) expressed that they would much rather do something else than perform PHBCs. Excuses were found to delay implementing PHBCs, and some participants indicated it was because they lacked a genuine enjoyment for health behaviours.

"My husband says to the kids, 'Take mum out for a walk, you two go for a walk.' And then I say, 'But I have to do this and that.' I just always have something else better to do or I see it as, 'Well, you know, I can't be bothered with that now because I have to do this'". (HBM_23, non-PHBC, female, 35–54 years, Other ethnicity)

Not all participants felt supported in their attempts for PHBC, furthering hindering their capability to carry out PHBCs (60% female, less than secondary education, earning <$30–50,000 p/a, 20% Māori and Pasifika and 40% Caucasian). Having sufficient support during PHBC efforts was deemed important as a way to motivate and encourage participants. The feeling of doing it by themselves was often off-putting. Any verbal encouragement received was undermined if their supporters performed risk behaviours themselves.

"My partner was never someone who went to the gym with me, so I think that's possibly why the gym failed. I don't want to do it by myself [going to the gym]. And I sure as hell don't want to get off the couch to do it by myself." (HBM_26, non-PHBC, female, 25–34 years, Caucasian)

Some participants mindfully made efforts that were not always consistent and occurred only if the situation (extrinsic and intrinsic) was favourable for change (25–34-year-old and >55 year old, 50% Caucasian, 75% female). For example, some participants forewent risk behaviours for a short time following a period of excessive engagement so as to allow their bodies to recuperate. For others, PHBC tended to occur if it coincided with their normal routines. Rather than an effortful activity, PHBC happened 'if it happened', so to speak.

"I do sometimes feel like, 'Oh sh** I'm drinking too much; I need some break.' It's probably draining. I'll get away with 1, 2, 3 weeks and then feel like my body's back up now and I'm feeling normal again. Then I'll get back to it again 'til my body's giving up on me again." (HBM_28, non-PHBC, female, 25–34 years, Other ethnicity)

In summary, procrastinators purposefully found opportunities to postpone PHBCs by prioritising other factors or attributing procrastination to a lack of enjoyment or insufficient support. However, those who prioritised PHBCs had high self-regulatory capacity, knowledge on how to enact PHBCs and adequate support, as discussed in the next sub-theme.

3.3.4.3 Sub-theme 3: Mindful action planning (PHBC participants)

Participants in the PHBC group had clarity on how they would enact PHBCs, engaged support systems and had high self-regulatory capacity to perform PHBC regardless of situational/personal barriers. Implementing PHBC was of utmost importance for participants who were driven by long-term health and wellness. These participants found methods to fulfil both obligations and PHBCs, sometimes converting a potential barrier into a trigger for PHBC. They were not hindered by time or situational barriers, or the level of difficulty or discomfort associated with PHBCs.

"My 30-minute walks I do either in the middle of the day, and I have a walking meeting. So I'm in a meeting with someone, so I'm like, 'We're going to do a walking meeting.'" (HBM_9, PHBC, female, 35–54 years, Caucasian)

A number of methods were employed to instigate smoking- and alcohol-associated PHBCs. For smokers and chronic alcohol consumers, risk behaviours were discontinued using 'unaided' or 'cold turkey' methods (smokers, 75% alcohol consumers, male and other ethnicity, 50% 35–54-year-old). These participants believed the only way to undertake PHBC was to eliminate the risk behaviour completely rather than reduce its intensity. Participants reported that if the behaviour was continued even in moderation, its addictive impact would make relapse (to prior levels) likely.

"I probably did use to drink more during the week. The easiest way to cut back was to actually drop those ones. I find it easier to not have something rather than reduce the volume. Just the same thing with food. I don't do well with restricted portions. So if I don't see it, I can go without it. But as soon as I see it, I'm gonna eat it". (HBM_3, non-PHBC, male, 35–54 years, Caucasian)

On the other hand, some participants believed in performing PHBC within capabilities (55% > 55 year olds, 9% Māori, 64% Caucasian). Those who were physically limited or generally did not enjoy physical activity, exercise-related PHBCs were adopted in ways that met their capacity. Diet-related PHBCs were achieved by consciously incorporating as many healthy ingredients as possible in day-to-day meals or reducing processed food intake (although fruit/vegetable intake may be low). Smokers and alcohol consumers cut down frequency of behaviours slowly and in moderation rather than going 'cold turkey'.

> "Now as I'm older I find my bum gets more sore [if cycling]. But I do enjoy bush walking… I would never go to a gym. I like being outside in fresh air. I'd rather save my knees for something that I enjoy more. But I do a lot of stuff outside, there's about 5 hectares and lots of tree planting and all other stuff to do." (HBM_2, PHBC, female, >55 years, Caucasian).

Following a specific programme or intervention provided direction for participants to successfully perform PHBCs (71% male and Caucasian, 86% > 35-year-olds). These included support services for smoking cessation, health coaches, meal planning or a programme designed by family/friends (e.g., marathon training). These strategies minimized the burden on participants to develop impromptu ideas on how to implement PHBCs.

> "We've now moved into planning for the meals again, and we've actually gone to get one of those 'My Food Bag', you know, three nights a week… everything's really balanced… we would do a plan of our meals at the beginning of the week and write down a menu and order everything. Get a good shot up front. So we weren't sort of going on, you know, shopping on the fly or anything. So I think you do tend to get balance." (HBM_22, PHBC, male, 35–54 years, Caucasian)

For 75% female, 50% 25–34-year-olds, 25% Māori and 50% other ethnicity and Caucasian, risk behaviours were replaced with alternatives that provided the same benefits (such as stress management). These replacements were either healthier options (e.g., vaping, eating carrot sticks instead of cake) or another risk behaviour that they perceived they could control better (e.g., alcohol intake rather than smoking). The former was typically seen in participants who reported that they genuinely enjoyed health behaviours and did not consider it effortful.

> "If I can get out enough, I can run, I'm always much more positive. So normally, I could go out and go for a run and clear my head. But what I find is that it gives me an opportunity to turn my brain off and not worry about things for a while. You know, because you can think about them properly later." (HBM_12, PHBC, female, 35–54 years, Māori)

Once PHBC is initiated, it needs to be sustained long-term for effective stroke risk reduction. Factors influencing long-term PHBC maintenance in study 1 participants were also evaluated and is described in the next theme.

3.3.5 Theme 3: PHBCs are maintained through original motivations, benefits accrued, self-efficacy and self-regulation

Sustaining PHBCs long-term and the likelihood of relapse were dictated by (1) the significance of the original motivator and benefits incurred after change, (2) self-affirmations and support systems that encouraged self-efficacy for PHBCs, and (2) self-regulatory strength. These concepts form the sub-themes in this section.

3.3.5.1 Sub-theme 1: Significance of the original motivator and PHBC benefits (PHBC participants)

There were significant disparities in how long PHBC was maintained across participants, and significance of the original motivator played a key role. Some participants who chose to undertake diet- or exercise-related PHBCs (Caucasian, 50% male) had a short-term weight management or fitness goal they were working towards, as opposed to maintaining a long-term, consistent routine (Section 3.3.3.3). These participants were focussed and persevered to maintain PHBCs until their goal was achieved. Nonetheless, once these intentions were met, participants lacked motivation to sustain PHBCs and permanently relapsed back to risk behaviours.

> "I was training for half marathons. And I got strong, I got fast. And I did a half marathon and three months after the half marathon I was like 'Hang on, I haven't been running for

a while and I'm unfit again.' So, I find it very hard to shift my lifestyle, to make that a permanent change." (HBM_15, non-PHBC, male, >55 years, Caucasian)

Similarly, short-term PHBCs were observed in those motivated by peer pressure or familial expectations, in particular those <35-year-olds (75%). Once such expectations diminished, participants were inclined to fall back into risk behaviours as the pressure to behave in a particular manner ceased.

> "My ex-girlfriend, she actually hated smoke. She said to me actually that 'If you smoke, I really can't be in a relationship with you, because it's affecting your lungs.' So I really, even though I did not believe it, I had to leave it. And then after we broke up, I went back to smoking again." (HBM_29, PHBC, male, 25–34 years, Other ethnicity)

Alternatively, participants whose PHBC motivations were based on future benefits (e.g., long-term fitness, managing health concerns, role-modelling for children) were more inclined to maintain PHBCs (75% > 35-year-olds, 25% Māori and 50% Caucasian). These participants knew changes needed to be sustained as it not only impacted themselves but people of value to them. Those who wanted to promote health behaviours among family members were constantly reminded of the importance of being a positive role-model, reinforcing motivation to maintain PHBC.

> "My goal is not to run for the purpose of completing a particular event. I want to be a lifetime runner. I want to be running in 10 years, 20 years, 30 years' time." (HBM_12, PHBC, female, 35–54 years, Māori/Caucasian)

Those who had long-term health concerns or felt they were more susceptible to illness also recognised that risk factor management should be maintained long-term (primarily Caucasian and >55-year-olds). These participants felt their health suffered from the adverse impacts of risk behaviours and as a result felt it more beneficial to sustain PHBC.

> "We sort of keep an eye on the diet, you know, because I still think that there's a risk, you know, with stroke and heart problems, because is in the history of our family." (HBM_4, PHBC, male, >55 years, Caucasian)

The desire to sustain PHBCs were in part mediated by the benefits accrued with the change, self-reinforcing participants' resolve to continue practising healthy behaviours. These included improved mental and physical health, better social relationships, greater financial stability (e.g., cost saved on cigarettes), longevity, stress management, and reassurances of lowered risk for future illnesses. A number of participants conveyed how they had begun to enjoy healthier alternatives.

> "When I started to see myself not smoking and managed to manifest that in my life, it's quite liberating and motivating, and helps me to build my confidence, self-esteem and resilience that any habitual addictions that I do face in my life. And I practise that, and I know I can do it [maintain smoking cessation]." (HBM_12, PHBC, female, 35–54 years, Māori)

While a robust motivational reason and the benefits accrued substantiated participants' drive to maintain PHBCs, self-efficacy dictated participants' confidence to maintain PHBCs. Ongoing support systems and affirming oneself to maintain PHBC efforts were tools used to reinforce self-efficacy.

3.3.5.2 Sub-theme 2: Self-affirmations and support systems promote self-efficacy (PHBC participants)

Participants who were able to maintain PHBCs long enough (over six months) reported that they eventually built resistance to temptations and were confident to resist relapse.

> "I'm mentally strong. I've done Outward Bound… teaches you that you can achieve anything you put your mind to. And thinking like even one puff [of smoke], I don't even need that. Because you let up in your head that you can do it." (HBM_27, PHBC, male, 35–54 years, Māori)

For employed participants, 57% male, 43% 35–54-year-olds, 14% Māori and 57% Caucasian, ongoing support from family and peers were crucial to strengthening their self-efficacy for maintaining PHBCs. These included receiving verbal encouragement and witnessing others successfully performing PHBCs, allowing participants to feel they were supported during PHBCs. For some, healthy nutrition was ensured by having their partner/spouse prepare meals, reducing burden on themselves to maintain diet-related PHBCs.

> “I’m helped there because, really, my wife is driving what we eat. So, yeah, I'm just a passenger there. She's doing all we can. That's the key thing that helps me be motivated. I think if it was just me, I’d be stopping at the fish and chip shop on the way home bit more regularly.” (HBM_15, PHBC, male, >55 years, Caucasian)

Some participants described that a pro-PHBC culture (e.g., greater opportunities for physical activity such as exercise programmes) and difficulties in performing risk behaviours (e.g., higher costs for cigarettes) increased their confidence to maintain PHBCs. Two <25 year old participants who had migrated to NZ from countries highly permissive of smoking found the NZ environment more in favour of healthier lifestyles.

> “I saw many people after they come back from work, they go to gym, also like not smoking in public. So I liked their lifestyle. I have a gym membership because I want to see how they do their lifestyle. I have that willingness to change myself into more healthier habits. Most of my friends here are not smoking. And I live with people not smoking in my apartment as well. So it makes me feel like, if I smoke, they will not be comfortable with me.” (HBM_36, PHBC, male, <25 years, Other ethnicity)

Participants also engaged in positive self-talk to reinforce their confidence to bypass temptations to relapse and motivate themselves to maintain PHBCs (75% female, 25–34-year-olds, 25% Māori and 50% other ethnicity). Self-affirmations were used to remind participants that they have successfully resisted prior temptations and to minimize the impact of risk behaviour triggers (e.g., stress). Some participants recalled the reason for having initiated PHBCs in the first place (e.g., negative effects of risk behaviours) for this purpose. Such self-affirmations also helped participants to curtail any difficulties in performing PHBCs.

> “When I do exercise, I tend to get quite exhausted; I tend to get quite puffed. I actually feel quite rubbish now that I've done all that exercise. But I know it's just that using my mind, it's just saying, ‘I need to be doing this [exercise] for my health.’ You know, the doctor says I need to be exercising, I'll have reduced risk if I exercise. You know, medication can only do so much. For the family I need to be healthier.” (HBM_22, PHBC, male, 35–54 years, Caucasian)

75% of participants who were employed part-time stated that they had conditions more conducive of PHBC (e.g., greater affordability of fruits and vegetables, time to exercise). This encouraged self-efficacy to maintain PHBCs and an appreciation and enjoyment for health behaviours.

> “I have an incredibly privileged life, I don't have to work full-time. The work that I do have I choose, and I enjoy it. I can spend time outside. I have time to exercise, to go to Tai Chi to go to yoga, to, to, you know, to cook – I have the time to cook meals, nice meals.” (HBM_11, PHBC, female, >55 years, Māori)

While high self-efficacy improved the ability to maintain PHBCs, self-regulatory strength was critical to face the challenges posed by the new behavioural pattern and conditions that opposed PHBC. This trait dictated whether relapse into risk behaviours occurred and the next sub-theme explores this further.

3.3.5.3 Sub-theme 3: Self-regulation dictates likelihood of relapse (PHBC and non-PHBC participants)

Even if participants expressed high self-efficacy, relapse was much more likely to occur if they did not have a robust self-regulatory reserve. Optimal conditions were not always available for PHBC to occur and those with a high self-regulatory reserve were successful in ensuring PHBC was performed regardless. These participants demonstrated adaptability to challenging situations as they prioritised their PHBC goals (males, >35-year-olds and 20% Māori and 60% Caucasian, 80% employed).

> “In the cold and given we’re in the middle of winter, I’ve just had to adapt to it. I wear sweatshirts for my first lap and then I take it off and finish my run. I try to do my best.” (HBM_32, PHBC, male, <25 years, Other ethnicity)

Self-regulatory strength was in part mediated by self-discipline, anticipating situations that could potentially cause a lapse in PHBC maintenance and planning in advance (employed participants, 80% 35–54-year-olds, 20% Māori and 80% Caucasian).

> “I'm pretty rigid in what I buy at the supermarket. There's just things I just don't put in the trolley. I've got a lot of discipline over food.” (HBM_19, PHBC, female, >55 years, Caucasian).

For some participants (60% female, 40% Māori and Caucasian), risk behaviours were habitually associated with a range of contexts, behaviours and social interactions. In order to maintain PHBCs, participants ‘eliminated the enabler’ in that they either: (1) separated themselves from situational cues, social norms and peer pressure that triggered risk behaviours, or (2) interacted with those who did not engage in risk behaviours.

> “It's just that the moment you see someone having a glass of wine you immediately want to have one. So I'd have to say I struggle with the 'going out and not drinking', I would find that hard to do. So I'd rather just not go out.” (HBM_8, PHBC, female, >55 years, Caucasian)

While most participants were able to transcend situations that invoked relapse, some were not always successful, and participants relapsed at least once, particularly during the early stages of PHBCs. Smokers were more inclined to completely cease the behaviour while binge drinking; reduced fruit/vegetable intake and/or fast food consumption and sedentary activity would probably re-occur. Relapse typically occurred in response to a specific event or situation and the intensity of the trigger dictated whether relapse was permanent or temporary. Participants occasionally resorted to risk behaviours when self-regulatory reserves were drained (67% female, 25–54-year-olds, 22% Māori and 56% other ethnicity). These circumstances often incurred high stress, emotional distress and tiredness, promoting cravings and a desire for relaxation and rewarding oneself. For participants who had to conscientiously engage in PHBC, PHBCs were perceived as the “last thing they felt like doing” when tired or stressed (80% female, 60% <25-year-olds, 20% Māori and 60% other ethnicity). During such instances, risk behaviours that quickly resolved cognitive imbalance and allowed an immediate escape from the stressor were sought.

> “Alcohol is so effective, and so immediate, that within five minutes of having your first two or three sips, you just feel like everything's gonna be fine. It was completely giving up to, ‘I'm doing this now.’ And it wasn't me drinking on my own. It was a group of us taking care of somebody and that was the way for us to not fall apart really. It was the way to be together and to, you know, take just take the tension away.” (HBM_11, PHBC, female, >55 years, Māori)

The intention for most participants was to engage in risk behaviours in a controlled manner (e.g., one glass of wine). However, more intense triggers caused some participants to unintentionally go overboard, followed by guilt over the lack of control (83% female, 40% Māori, Caucasian and other ethnicities).

> "If it's a work pressure, if it's a really difficult week, or we're just balancing work, family and social commitments, that there's just too much on. I'm as guilty as anybody of sitting down with a glass of wine. And my weak point is sitting down with a glass of wine to relax, and then I have one glass too many. If I have drunk a little bit too much, even just slightly feeling a little bit dusty the next day, then I might have a piece of cake or buy a slice from a cafe and I normally don't eat that stuff. I actually love eating healthy food. But it goes all out the window the next day, because I'm just craving sugar and stuff like that." (HBM_8, PHBC, female, >55 years, Caucasian)

For ex-smokers and alcohol consumers, cognitively challenging circumstances (stress, tiredness, grief) elicited the habitual, addictive nature of these risk behaviours. These participants reverted to risk behaviours if they were the body's automated and dominant response to such challenges. In the first few months of PHBC, these participants were also highly prone to relapse due to cravings imbued by addiction withdrawal (<25–34-year-olds, 75% other ethnicities).

> "It's a hindsight thing that I noticed that being stressed and I fall back to smoking. Because I don't notice at the time, like I'm stressed, I'm smoking. And suddenly it's like, 'Oh, my sixth cigarette of the day' and normally I wouldn't even notice." (HBM_36, PHBC, male, <25 years, Other ethnicity)

Alternatively, difficult conditions (e.g., poor weather) and exposure to anti-PHBC social norms also promoted temporary relapse. Engaging in one risk behaviour also prompted other risk behaviours for some participants (e.g., smoking during alcohol consumption).

> "Sometimes [low motivation to go for a walk]. I'm not so strong, so if I'm tired or weather is not good or if I have kind of passive state of mind. I might definitely say no walk today and stay home." (HBM_24, PHBC, male, >55 years, Other ethnicity)

Relapse for some participants (60% female and 25–34-year-olds, 20% Māori and 60% other ethnicities) occurred by simply witnessing the physical manifestation of the behaviour they were trying to avoid. Similarly, being exposed to its aesthetic aspects such as visual or sensory cues (e.g., smelling a cake being caked) set off cravings and triggered relapse.

> “Could be just seeing it or smelling it [trigger to eat carb rich foods]. Like where I live, I walk past these places.” (HBM_9, PHBC, female, 35–54 years, Caucasian)

Travelling often made it difficult for participants to maintain PHBCs due to limited access to resources that helped sustain PHBC (e.g., access to gym, kitchen). Additionally, as alcohol intake is typically associated with reward and relaxation, celebratory occasions incorporated alcohol consumption as a status quo and prompted relapse.

> “I just got married. And we had lots of people here and lots of friends here… So … you know, like I would, we'd have a drink every night. Whereas normally I wouldn't drink, you know, probably only drink maybe have a glass of wine during the week.” (HBM_11, PHBC, female, >55 years, Māori)

For most participants, these were temporary relapses. Participants described that they recalled their original motivations and were able to re-initiate PHBC once the relapse trigger surpassed. They reported that over time, it became easier to resist cravings by consistently maintaining PHBCs and they eventually felt less dependent on risk behaviours. The guilt associated with succumbing to temptations also reinforced participants’ motivation to resist future temptations.

> “I eat things not so great and I go ‘This is not good.’ And go back and then fight your way back. But what I noticed is that each time I do that, and get back to the better way of eating, it becomes easier not to give in in the first place.” (HBM_2, PHBC, female, >55 years, Caucasian).

On the other hand, some participants discontinued PHBCs and permanently reverted to risk behaviours in response to: (1) ongoing dissonance (e.g., sustained negative affect due to chronic work stressors, a traumatic, life-changing event) (<25–34-year-olds, 50% Pasifika), or (2) shifting priorities with over-commitment to other activities and not having sufficient time to dedicate to PHBC (>55 year olds, Caucasians and employed).

> “Recently I had given up [smoking] for ages, months. And then I just started a new part

time job. And it was a little bit different. I started smoking cigarettes again.” (HBM_30, non-PHBC, male, <25 years, Other ethnicity)

3.4 DISCUSSION

Three main themes emerged from the findings of this qualitative study. The first theme established that an individual must first have a *readiness to perform PHBC*. The second theme summarised the variables that influenced a determined attempt for PHBC, if that readiness exists. The final theme described participants’ abilities to maintain PHBC long-term and establish healthy behaviours as the new norm. These themes closely aligned with the Transtheoretical model’s continuum of stages of change (italicized in the following sentences) developed by Prochaska and DiClemente in the late 1970s (S. Choi & Duffy, 2017; New Zealand Guidelines Group, 2012; Zuckoff, 2012). From Theme 1, a reluctance to implement change (Sub-theme 1) can be likened to the model’s first stage of *pre-contemplation* (not thinking about change). Alternatively, the mental push-pull dynamic and value for future gains (Sub-themes 2 and 3) is analogous to the model’s *contemplation* of PHBC stages. Experience of ambivalence (wishes v. possibility of change) or the perspectives, values and goals that enabled readiness were captured within this theme. Nonetheless, for some participants, ambivalence was not resolved as PHBC was conceived to be beyond voluntary control (Theme 2, Sub-theme 1) or participants procrastinated (Theme 2, Sub-theme 2).

However, if the necessity for PHBC were above uncertainties, participants next considered the ways they would implement PHBCs, akin to the *preparation (for action)* stage. Study participants who made a determined attempt for PHBCs (mindful action planning, Theme 2, Sub-theme 3) could be categorised into the *action* phase of the Transtheoretical model. Knowledge (on performing PHBC) and self-regulation were key considerations for this stage. The final theme can be likened to the *maintenance* stage of the Transtheoretical model. The significance of the original motivators and benefits accrued justified the effort necessary to sustain PHBC (Theme 3, Sub-theme 1). Sufficient resolve needs to exist in the weeks and months following the first implementation of PHBC to surmount powerful urges to relapse. In this respect, self-efficacy (Theme 3, Sub-theme 2) and self-regulatory capacity (Theme 3, Sub-theme 3) were essential contributors. The study conclusions also indicated that participants often alternate between stages rather than linearly progress through them (Zuckoff, 2012). Due to a particular interest to understand Māori and Pasifika perspectives on health beliefs, the following sections will also discuss these findings compared to current evidence.

3.4.1 Validation of HBM constructs in predicting PHBCs in participants

The HBM outlines 4 key constructs (italicized in the following sentences) in facilitating PHBC. PHBCs are prone to occur when *perceived susceptibility* and fear of the *severity* of an illness is high and the *perceived barriers* to PHBC are outweighed by the potential benefits (Hardcastle et al., 2015; Mohammadi et al., 2017; Sulat et al., 2018; Villar et al., 2017). The literature documents that high *self-efficacy* and *cues to action* are also critical for PHBCs. All these constructs had an essential role in the readiness for PHBC stage (Theme 1) as they either acted to inhibit or invoke PHBC. Nonetheless, *perceived susceptibility and severity* of stroke as a disease was not a critical PHBC motivator. *Self-efficacy* was an essential contributor for PHBC maintenance (Theme 3) which was also facilitated by *perceived susceptibility* and *benefits of change* or inhibited by *perceived barriers* (contributors towards relapse). Such observations concurred with existing maintenance models which highlight the importance of continuing motivation and self-efficacy (Norman & Conner, 2015).

While HBM constructs did contribute towards the emerging themes in this study, these constructs alone did not necessarily translate into PHBC readiness, implementation and maintenance. The model does not consider physiological (e.g., cravings and addiction) and socio-environmental influences upon PHBCs (S. Choi & Duffy, 2017). Additionally, the HBM was originally developed to determine PHBC in a disease prevention context and may be limited in predicting PHBCs among individuals unconcerned about their health (S. Choi & Duffy, 2017). The process flow for these themes and their relation to HBM constructs are summarised in Figure 3.2.

3.4.2 Readiness for PHBC

More often than not, performing risk behaviours defy rational explanation where, despite the recognition of the health harms of risk behaviours, risk behaviours are still actively pursued (Ussher et al., 2013; West, 2017). Readiness to undertake PHBC is critical, with interventional studies reporting that those who desire PHBC demonstrate greater PHBC success than those disinclined to change (Appleton et al., 2010). Participants existed at different stages across the readiness continuum, ranging from those who were outright resistant to those who were willing. However, it is essential to also acknowledge participants in the middle ground. This research demonstrated that cognitive dissonance (short-term pleasures v. long-term health goals) and its outcome predicted PHBC likelihood and was accompanied by feelings of guilt. Such findings have been replicated in previous studies (Pescud & Pettigrew, 2014). The mental push-pull that participants experienced due to competing values and priorities and the ambivalence experienced when considering whether PHBC was needed has been previously reported by Zuckoff (2012). Participants who undertook at least two out of four of the PHBCs of interest over 12 months in the sample were primarily >55 years of age (42%), male (58%), Caucasian (68%) and were employed. Conversely, participants who did not undertake any PHBCs were also predominantly >55 years of age (44%), Caucasian (56%) and employed (61%), but differed in that they were female (67%). While these trends could be attributed to the predominance of these demographic groups in the sample, the following sections aim to describe other contributors and study similarities to current evidence.

3.4.2.1 Knowledge and perceptions on stroke risk and severity, lifestyle risk factors and PHBCs

Health literacy was quite variable across the dataset. Both severity and susceptibility of a future stroke event were acknowledged, particularly if participants recognised, they had a family history and cardiovascular issues. Greater awareness of stroke risk and lifestyle risk factors in males, older adults, those of high socioeconomic status and tertiary education have been replicated in previous research (Bay et al., 2015; Krishnamurthi, Barker-Collo, et al., 2020; Marx et al., 2010; Webster & Heeley, 2010). Prior evidence suggest females are prone to minimize the threat of vascular disease, even those with a strong family history, and detain seeking medical attention following indications of myocardial infarction (Marx et al., 2010).

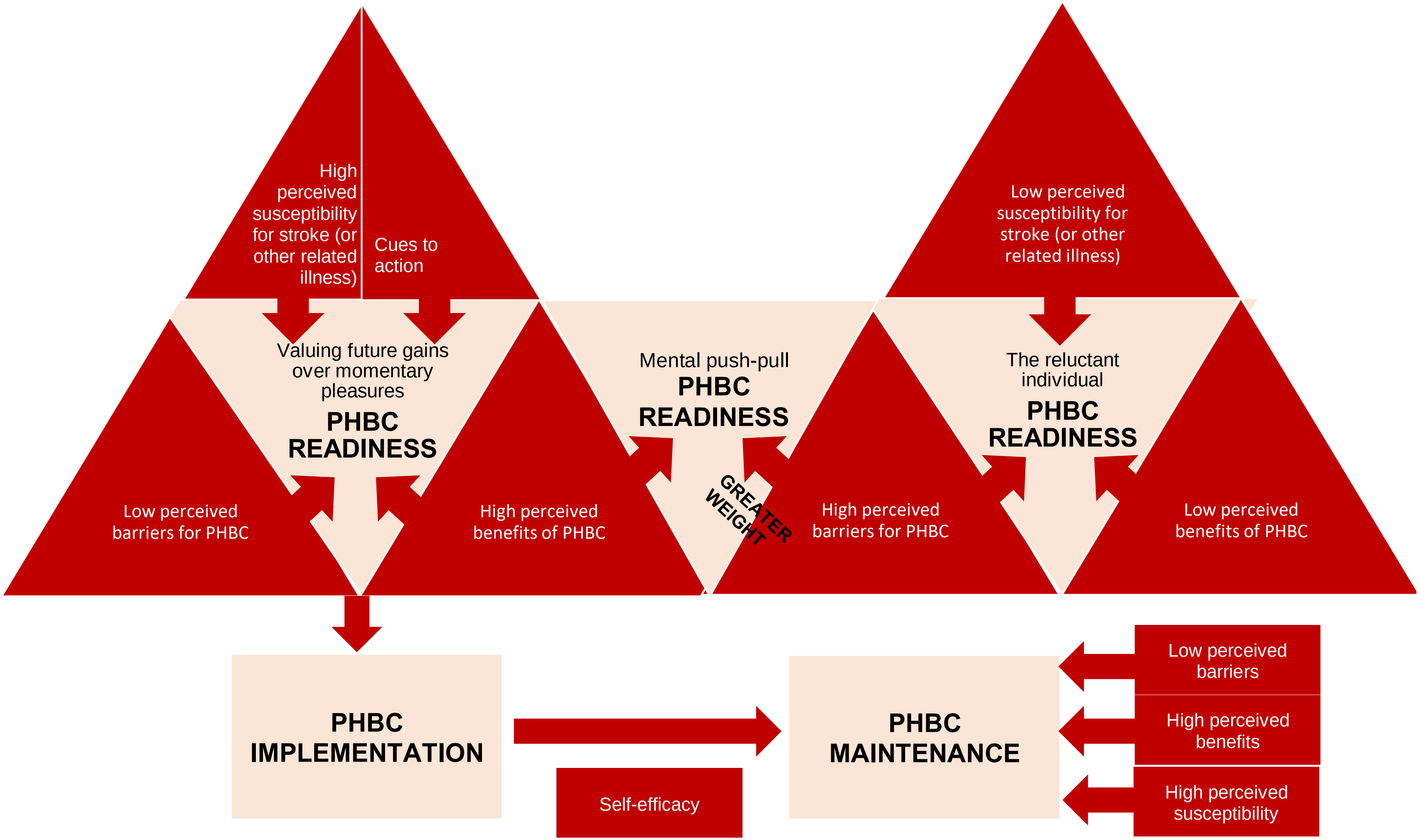

Figure 3.2 Incorporation of the HBM constructs (in red) with relevance to the three stages of PHBC (readiness, implementation and maintenance) generated from this study.

Krishnamurthi and colleagues (2019) demonstrated that users of the SR demonstrated an 0.36 point increase in cardiovascular health score compared to non-users. Therefore, it was expected that users of the SR would be motivated to undertake changes in risk behaviours due to a greater understanding of their 5–10 year stroke risk. Nonetheless, study participants reported that they were not motivated to enact PHBCs despite obtaining this knowledge. While SR users in this study were relatively low in numbers, it is possible that awareness of one's stroke risk probability maybe only one of the several contributors in the positive trends seen in the 2019 study. Identification of risk factors were also similar whether participants were users or non-users of the SR.

Commonly reporting hypertension, smoking and diet as risk factors was also observed in another NZ-based study (Krishnamurthi, Barker-Collo, et al., 2020), although study participants also emphasised the influences of family history and age similar to a review by Webster and Heeley (Webster & Heeley, 2010). Unlike previous reports (Bay et al., 2015; Krishnamurthi, Barker-Collo, et al., 2020), 60% of Māori participants could identify at least two or more lifestyle risk factors compared to 54% of Caucasians. Nonetheless it is important to acknowledge that the current study observations were only based on the accounts of less than 5 participants. Other studies utilised larger sample sizes and also more objective measures to assess stroke knowledge. Secondly, the interview question sought to identify the presence of existing risk factors that could contribute towards a potential stroke. Therefore, better identification among Māori may be due to more lifestyle risk factors present in these participants as opposed to Caucasians. Future studies therefore must account for such factors in a more quantitative setting.

For some non-PHBC participants, however, the role of lifestyle risk factors in stroke development was either underestimated or unknown across most participants, also observed previously (Zuckoff, 2012). Younger participants (<25 years) underestimated their risk for a stroke or associated health issues and attributed this to their youth. As chronic illness is uncommon among young populations, such individuals felt less threatened and unconcerned about future illnesses, in keeping with a 2012 study (H.-S. Kim et al., 2012). In contrast, older participants with pre-existing conditions had greater risk factor awareness as part of the diagnosis of the condition. Regardless, PHBC readiness was limited in this group, partially due to: (1) overall good health, (2) better control of more pertinent risk factors (e.g., hypertension medication) or (3) absence of family history or metabolic risk factors, corroborated by findings by Kuriakose et al. (2020). Perceived low risk susceptibility was also reinforced by compensatory health beliefs[21] in which participants felt that performing health behaviours compensated for maintaining other risk behaviours of value (e.g., having pizza after exercise). Such a concept has also been illustrated in other studies (Alm & Olsen, 2017; Khorsandi et al., 2017; Radtke et al., 2014). This strategy is pursued to minimize an individual's internal conflict between pursuing a desire for immediate gratification and long-term health goals (Radtke et al., 2014). As such, disinclination to adopt PHBCs (e.g., reduce alcohol consumption) due to good overall fitness was observed.

Some participants did not have a clear conception of what recommended PHBC practices entailed (i.e., how many fruits/vegetables/day, how much alcohol is harmful), in line with earlier conclusions (Glasson et al., 2011). For example, consumption of fruits/vegetables as low as one or two portions per day was considered adequate to acquire health benefits (Glasson et al., 2011). An 'everything in moderation' attitude endorsed a lack of concern and rationalised risk behaviours among those disinclined to PHBC. This finding contributes to existing evidence of high-frequency, low-quantity drinking patterns observed in >55 year olds, males and non-minority groups (Chaiyasong et al., 2018; Wilsnack et al., 2009). Intermittent engagement in risk behaviours also did not constitute being health-harmful to necessitate PHBC, both in this study and previous research (Glover et al., 2010; Martínez-Ramos et al., 2015). Such age and gender patterns may be reflective of social and cultural drinking norms and rationalising the health benefits accrued from daily but moderate alcohol consumption (Wilsnack et al., 2009). Older study participants stated that they did not engage in hazardous alcohol intake. Older participants may be likely to view heavy drinking as habits of reckless youth which diminish as individuals age and assume more responsibilities or experience health concerns (Wilsnack et al., 2009).

[21] See glossary

A perceived barrier for PHBC was a general dislike for PHBC that stemmed from the effort involved or having a history of unsuccessful PHBCs, in agreement with earlier conclusions (Burgess et al., 2017; Hardcastle et al., 2015; Leone & Ward, 2013; McMorrow et al., 2017; Piana et al., 2013; Zuckoff, 2012). For exercise-related PHBCs, existing health conditions contributed towards injury and physical incapacity to modify the lifestyle that was causing it, resulting in a vicious cycle. Such findings have been reported previously (Egger et al., 2017; Leone & Ward, 2013). Those who were outright resistant to PHBC did not acquiesce to peer encouragement for PHBCs, even eliminating relationships with those peers who were not in favour of participants' choices. Therefore simply acknowledging potential risk for a future illness, its associated severity and the health benefits of PHBC did not motivate PHBC readiness. These findings contribute to the growing body of evidence regarding the ineffectiveness of education-based strategies in motivating PHBCs (Carpenter, 2010; Jones et al., 2014; Martínez-Ramos et al., 2015; Perrin, 2020). These indications are in contrast to two empirical studies which demonstrated that a higher perceived risk of a stroke predicted exercise and weight-loss intentions among >55-year-olds and geriatrics (Karen et al., 2008; Sullivan et al., 2009). The conclusions also explain why the empowering, motivational intentions upon which the SR was originally developed may be undermined.

Instead, readiness for PHBC was indicated when study participants reached a pivotal point in their lives where the need for PHBC became imperative (perceived benefits outweighed perceived barriers). There was a shift in value for long-term, future rewards of PHBCs as opposed to the momentary benefits of risk behaviours. Four key areas that dictated readiness emerged from the dataset including: (1) health, wellness and longevity, (2) influence of social norms and role-modelling, (3) the economic impact of PHBC, and (4) habits.

3.4.2.2 Health, wellness and longevity

The finding that a desire for improved health and wellness, circumvent worsening health, fear of future illness and reduced longevity fuelled PHBC readiness complements other study findings (Khorsandi et al., 2017; Kuriakose et al., 2020; Vangeli et al., 2011). The expectation and belief that undertaking PHBCs could address these concerns (perceived benefits) promotes readiness (Rhodes et al., 2017). In line with previous conclusions (Glover et al., 2010; Paul et al., 2010), PHBC readiness was fostered by the perceived benefit of eliminating the aversive hedonic aspects of risk behaviours. This was particularly salient in young people although its limited relevance to Māori has been noted previously (Glover et al., 2013). The most common aversions noted were the lingering smell of cigarettes and its impact on facial features such as teeth.

Some participants developed a health issue that reduced their quality of life or limited activities that they enjoyed. Such concerns were either attributed directly to the negative symptomatic manifestations of risk behaviours or were an independent, newly developed health condition. This triggered a re-evaluation of their priorities and a need for PHBC to stall worsening of the condition. Salience of such factors in older people, Caucasians and females have been described previously (Glover et al., 2013; Hernandez et al., 2018; Margolis, 2013; Ministry of Health, 2009) Such adverse health developments act as a 'wakeup call' and directed attention to health (Margolis, 2013). Conversely, older participants disinclined to PHBC and not reporting any notable health concerns demonstrated fatalistic attitudes, similar to another cohort (Glover & Thornley, 2010) and have also been reported by young people (Glenn et al., 2017). Fatalism refers to being resigned to the inevitability of death and the high risk for age-related illnesses regardless of whether PHBC is performed. Consequently, these individuals did not consider any benefit in adopting PHBC for health improvements and sought immediate behavioural utilities, evidenced previously (Alvarado, Murphy, & Guell, 2015a, Glover et al., 2010). These participants also demanded evidence of their health being adversely impacted by their lifestyle before they were willing to consider adopting PHBCs.

Young, single participants (<25 years of age) were influenced by everyday behavioural consequences as opposed to those with long-term health impacts, corroborated by other work (H.-S. Kim et al., 2012). Interestingly however, 25–34-year-old participants with no existing health conditions were anxious about future implications of risk behaviours. These included reduced longevity and the risk in not achieving imminent goals such as having children. Such fears were more salient in those with strong family orientations and promoted perceived benefits of PHBC and PHBC readiness in this demographic, dissimilar to other conclusions (Glover et al., 2010).

3.4.2.3 Social norms and behaviour role-modelling

One's social environment creates norms which outlines what is acceptable behaviour and is based on early family traditions and, later in life, peer influences (De Ridder et al., 2017; Higgs, 2015b). Family upbringing, values and expectations, social acceptance and public identity were potent and pervasive moderators of PHBC intentions, similar to that seen in other studies (Alvarado et al., 2015; Leone & Ward, 2013; Robinson et al., 2013; Venditti et al., 2014). Norms governed behaviours by modifying self-perceptions and evaluation of behaviours and PHBCs (Higgs, 2015b). The impact of family and social norms upon PHBC readiness was paradoxical, depending on whether the norm was anti or pro-PHBC.

Participants were affected by social judgement and engaged in impression management when others modelled how they should behave, reported previously (De Ridder et al., 2017; Higgs, 2015b). Humans are designed to learn from behaviours of others, and the need for affiliation underpins the impact of normative influences on behaviours (Higgs, 2015b). This is dictated by an individual's orientation for social approval/disapproval (Higgs, 2015b). A perceived PHBC barrier for young participants was undue pressure to behave in ways that were socially acceptable. Following norms allow individuals to feel a sense of kinship and camaraderie with peers and strengthen social interactions, linking to affiliation needs such as self-esteem and empathy (Higgs, 2015b). The culture of intoxication has become more prominent in Western societies in the last decade (Hutton et al., 2013). Smoking and alcohol consumption were pervasively interwoven into youth culture as part of the status quo for (1) social and intimate connections (letting loose, catching up with peers and networking) (2) search for emotional pleasures and calculated hedonism (fun, happiness, excitement, enjoyment) and (3) celebratory occasions. These findings were observed particularly among 18–34-year-old study participants and have also been observed previously (Haydon et al., 2016; Hutton et al., 2013). Such practices were also highly permissive in Māori and Pasifika as seen in this study and others (Glover et al., 2010). The literature also suggests that store accessibility, high alcohol tolerance, and norms embodied by particular venues (e.g., clubs/pubs where drinking is inherent) also promotes bingeing in this age group (Haydon et al., 2016; Hutton et al., 2013). When strong social norms that endorsed risk behaviours existed, those who valued social engagement resisted thoughts of PHBC fearing social exclusion. Permissive familial and neighbourhood norms (e.g., low socioeconomic status) also enabled risk behaviours and limited PHBC readiness in study participants, in line with the literature (Burgess et al., 2017; Glenn et al., 2017). While more males stated such barriers in this study, Higgs (2015b) suggests females are more likely to confirm to social norms to promote positive relationships.

On the other hand, interacting with peers who engaged in PHBCs and being part of mainstream social norms and relationships which stigmatised risk behaviours were cues to action, also observed by Kuriakose et al. (2020). Supporting betterment of a family member's health condition was particularly salient in older, married study participants, corroborated by other studies (Margolis, 2013). Older couples are often integrated into each other's routines due to having been together for many years (Margolis, 2013). Illness in one affects the lives of both, especially if routines such as eating habits are changed to comply with treatment (Margolis, 2013). Witnessing disease development in family members or friends allowed individuals to envision how health would be without PHBC, acting as cues to action. Such experiences tapped into participants' emotional state (due to their relationships to affected members) and inspired changes in priorities, value for PHBC and intent to implement change. These concepts were corroborated in a 2017 study showing increased exercise levels in those with a family history of Type 2 diabetes (Amuta et al., 2017). Those who wanted acceptance from family/ peers, driven by an eagerness to please and maintain a good public impression, responded to encouragement and/or pressure to modify risk behaviours.

Children were cues to action for PHBC readiness, particularly in Māori participants. Parents desired to improve their own health to be able to see their children grow (perceived benefits) and prioritised children's health (e.g., minimizing second-hand smoke exposure), consistent with previous literature (Edvardsson et al., 2011; Glover et al., 2013; Kanis et al., 2014; Rosen et al., 2012). Being a parent instilled a desire to create a healthy environment and role-model healthy behaviours due to the belief that children replicate what they observe, supported by Edvardsson et al. (2011). Such motivations may also be culturally mediated in ethnic groups with expectations of duty to one's family, tribe and community (Glover et al., 2013). Nonetheless, participants who persevered to retain risk behaviours overcame the dissonance caused by family stigmatisation by concealing behaviours from others, also demonstrated by Glenn and colleagues (2017).

3.4.2.4 The economics of PHBC

The complexity and demands associated with PHBCs had integral roles in readiness, in particular scarcity of income and time. The cost of risk behaviours/PHBCs were a core determinant of whether readiness for PHBCs existed or not. The impact of cigarette costs on the likelihood of smoking cessation or reducing the number of cigarettes smoked was a double-edged sword. In line with other research (Glover et al., 2010; Karalus et al., 2010; Sieminska et al., 2008; Soliman et al., 2014; West, 2017), the increasing cost of cigarettes was a cue for smoking cessation particularly in individuals who were full-time students, young and/or had a family. Participants reported being unable to afford cigarettes and commented on the money they could save not buying cigarettes. This concurs with other empirical findings which describe participants' perceived burdens on household budget from buying cigarettes (Karalus et al., 2010).

On the other hand, smokers resistant to PHBC did not consider cigarette costs or having financial difficulties a deterrent for smoking or prompting a desire to quit, in tandem with conclusions by Caleyachetty et al. (2012) and Karalus et al (2010). To offset unaffordability, participants would forego buying groceries. These participants were likely to have: (1) sufficient income to afford cigarettes, (2) an altogether general disinterest for PHBC, (3) limited understanding of post-quit benefits, and/or (4) cravings to smoke during financial difficulty, also reported previously (Caleyachetty et al., 2012). Therefore, singularly relying on cost as a trigger for PHBC is likely to be insufficient to endorsing PHBC implementation without other motivational triggers.

Perceived costliness associated with vegetables and fruits and affordability of nutrient-poor, calorie-dense processed foods was a perceived barrier for healthy food intake, corroborated by other research (Bukman et al., 2014; Venn & Strazdins, 2017; Zuckoff, 2012), although evidence to the contrary has also been demonstrated (McMorrow et al., 2017). There was a common perception among young study participants that fruits and vegetables were expensive. In lieu with other research (Dimitri & Rogus, 2014), this study demonstrates that better income does not necessarily improve food expenditure or fruit/vegetable consumption, reflecting a general unwillingness to change dietary practices that goes beyond cost.

The effort and time associated with enacting diet- and exercise-related PHBC were perceived barriers and often off-putting for individuals, similar to that seen in previous studies (Martínez-Ramos et al., 2015; McMorrow et al., 2017; Venditti et al., 2014; Zuckoff, 2012). For females and those who were students/employed, committing to PHBCs were problematic due to time scarcity and such trends have been replicated previously (K. Bauer et al., 2012; Djupegot et al., 2017; Escoto et al., 2012; Sonnentag & Jelden, 2009; Venditti et al., 2014; Welch et al., 2009). Long working hours and busy lifestyles limited leisure time, promoted fatigue and reduced energy. As a result, the willpower to exercise and prepare healthy meals, especially if these activities were effortful, going to a recreational facility or shopping for groceries was reduced. These observations have also been widely reported hitherto (Djupegot et al., 2017; Leone & Ward, 2013; Martínez-Ramos et al., 2015; Middleton et al., 2013; Piana et al., 2013; Sonnentag & Jelden, 2009; Venn & Strazdins, 2017). Under such circumstances, risk behaviours that were effortless, required minimal time and energy expenditure were considered logical and PHBC readiness was minimal. There was an inherent preference for energy-dense, convenience foods and sedentariness, as also observed in previous work (K. Bauer et al., 2012; Bukman et al., 2014; Burgess et al., 2017; Djupegot et al., 2017; Escoto et al., 2012; Martínez-Ramos et al., 2015; McMorrow et al., 2017; Venn & Strazdins, 2017). Time constraints were particularly high in females with families, due to managing caregiving, housework and employed work. This promoted an inability to prioritise their own health and well-being, similar to that seen in other studies (Alm & Olsen, 2017; Bukman et al., 2014; Burgess et al., 2017; Venditti et al., 2014; Venn & Strazdins, 2017).

3.4.2.5 Habits are difficult to give up

A number of cognitive processes that dictate behaviours are automatic (Hollands et al., 2016). Within the domain of health psychology, habits are automatically prompted (without conscious control, cognitive effort or deliberation) under specific situational cues due to its constant repetition (Gardner, 2015; Verhoeven et al., 2012). Longstanding risk behaviours part of normative habits became inherent to participants' automatic processing system and formed a context-behaviour association. This constituted a perceived barrier for PHBC and has also been observed previously (De Ridder et al., 2017; Gardner, 2015). Gardner (2015) characterises three different types of habitual behaviours where were also observed in this study: (1) initiated and performed habitually (e.g., smoking right after waking up), (2) initiated habitually but consciously performed (e.g., smoking daily but consciously controlling how many cigarettes are smoked) and (3) initiated consciously but habitually performed (e.g., consciously deciding to have alcohol on certain evenings but having a cut-off based on habit). Everyday alcohol intake was resolutely justified by older participants as a well-deserved reward or for relaxation. Due to the pleasurable reactions evoked by such behaviours, participants were generally disinclined to find other alternatives (perceived PHBC barrier). The latter two types of habitual behaviours limited PHBC readiness due to a sense of security based on the perception that occasional or low-intensity risk behaviour engagement was not health-harmful. Although some research conclusions classify smoking as a self-determined lifestyle, others characterise this behaviour as a medical addiction (Breitling et al., 2009). Sustained nicotine intake modifies functioning of brain pathways such that when nicotine levels are low, cravings are triggered to restore normal functioning (West, 2017; West & Shiffman, 2016). Some participants also experienced unexplained cravings for cigarettes at particular times of day that were not driven by affect.

The present study adds to existing evidence on the impact of habits and addictions upon PHBC readiness, seen primarily in smokers and alcohol consumers, males, older people, Māori and Pasifika (Bukman et al., 2014; De Ridder et al., 2017; Karalus et al., 2010; Van Bree et al., 2013; Verhoeven et al., 2012). Among study participants, habits persisted and habitual impulses manifested unless they were inhibited by stronger opposing forces (e.g., conscious decision to do something different). For participants who were prepared to modify habitual risk behaviours, PHBC readiness reflected a cognitive mental state that could override earlier decision-making and identity processes. Participants ready to undertake PHBCs perceived that PHBC benefits outweighed perceived barriers. On the other hand, unwilling participants described that the decision to undertake PHBC will be made at the 'optimal time' and they don't respond to coerciveness. Such perceptions have also been previously reported by clinicians during consultations with patients and patients reactions to a discussion around PHBCs (Zuckoff, 2012).

The results of the study indicate a clear need to have a foundational desire to undertake PHBC although this does not necessarily assure success (further discussed in Section 3.4.3), challenging previous understandings (Balmford & Borland, 2008). The more one experienced doubts and inhibition about PHBCs (such as the effort and the worth), the less prone individuals were to perform PHBC. Therefore, PHBC-promotion may need to focus more on resolving such ambivalences and stabilising motivations for implementing PHBC. However, there is some evidence to suggest that successful smoking cessation still occurs despite uncertainty on the value of quitting (Segan et al., 2002). Nonetheless, such attempts are short-lived, indicating that PHBC attempts based on precarious beliefs of its worth do not endure.

3.4.3 Implementation of PHBC

Once readiness for PHBC was established, practically implementing PHBCs was the next stage. Within the dataset, three salient influences were critical to successfully execute PHBCs. These include including, knowledge (on how to successfully enact PHBC), intention to carry out PHBCs and self-regulation.

3.4.3.1 Knowledge and intention

Prerequisites for successful PHBC implementation is not only having the means and methods but also explicit plans to do so (intention) (Conner & Norman, 2017). Participants who were committed to putting PHBCs into practice had a clear idea how they would achieve this. Rigorous planning and preparatory actions for PHBC were highly correlated with successful PHBC attempts, corroborated by other studies (Alm & Olsen, 2017; De Ridder et al., 2017). An example was meal planning to ensure healthy meals during a busy week, particularly among >35-year-olds. Individuals in this age group are likely to be parents and meal planning is typically used to save time on busy days and to have greater control over family mealtimes as reported by Alm & Olsen (2017). Health programmes, support services and aids were helpful for some participants in performing PHBCs, predominantly in males and >35-year-olds as also observed in other work (Hung et al., 2011; Kaner et al., 2009). Males were more likely to utilise such services in this study, as also evidenced by a Cochrane review showing males were more responsive to brief alcohol reduction interventions (Kaner et al., 2009). However, evidence to the contrary is also observed (N. Black et al., 2016).

The most common techniques for smoking- and alcohol-related PHBCs were avoidance methods (e.g., cold-turkey, eliminating the enabler to limit their addictive effects). Such methods were popular among males, 35-year-olds and other ethnicities, both in this work and other studies (Coppo et al., 2017; Hung et al., 2011; Jayakumar et al., 2020; Rodda et al., 2020). Some evidence suggests females and young people are more likely to use such methods (Coppo et al., 2017; Hung et al., 2011; Sieminska et al., 2008). Complete cessation of risk behaviours was easy for participants with a purposeful drive for enacting PHBCs, also reported in the review by Burgess and colleagues (2017). Glover et al.(2010) suggests some smokers are capable of quitting without forethought or effort. In this study, such methods were facilitated by a robust self-regulatory capacity informed by the knowledge that these behaviours were addictive. Participants identified that even occasional exposure could impede successful PHBC implementation as willpower to resist was much reduced in light of their addictive effects. This perception has also been evidenced previously among ex-smokers (Glover et al., 2010).

An alternative strategy popular among females, young people, Māori and other ethnicities was substitution (replacing risk behaviours with other alternatives). Vaping was a popular substitutive method for smokers who wanted to quit, both in this study and others (Glover et al., 2010; Hung et al., 2011; Zheng et al., 2015). A number of participants exercised implementation intentions, ‘if-then plans’ in which participants: (1) first identified a situation (when) or motivational cue (why) that prompted risk behaviours and (2) dictated a precise course of PHBC action to be undertaken. This method of PHBC is well-defined (Conner, 2010) and success of such intentions in reducing stress-induced comfort eating has been shown previously (Churchill & Jessop, 2010; O’Connor et al., 2015). The more specific and stable the intention is (i.e., when, where and how), the greater its likelihood of being enacted and reducing PHBC postponement (Bauman et al., 2012; De Ridder et al., 2017; Kroese & De Ridder, 2016). Motivational as opposed to situational cues (e.g., stress v. watching TV) were more effective in breaking habits related to complex risk behaviours and predicted PHBC eventuation, concurring with previous conclusions (Adriaanse et al., 2009). Nonetheless, uptake of healthier alternatives during stress was dictated by one's ability to self-regulate, planning and action and availability/accessibility of such alternatives during triggers. Table 3.5 shows examples of successful PHBC implementation intentions observed in the dataset.

Table 3.5

Examples of implementation intention

If	Then
If I am craving sugar during stress	Then I will eat carrot sticks
If I am anticipating a long working day	Then I will exercise first thing in the morning before going to work
If I feel tempted to smoke at public occasions or with friends	Then I will avoid such situations

Some participants responded to cognitive dissonance in ways that fit their capabilities while still retaining risk behaviours. This was achieved either by controlling frequency/degree of risk behaviours without complete abstinence (tapering), common in >55-year-olds and Māori. Current evidence suggests such methods are more popular in young people (Cheong et al., 2007; Hung et al., 2011). Others used strategies that required minimal effort and fit within existing routines (e.g., taking the stairs instead of the lift). Such strategies minimize abrupt discontinuance of risk behaviours and allow individuals to gradually get used to functioning without risk behaviours (Rodda et al., 2020). Young smokers and alcohol consumers in the study were acquiescent to reducing frequency/quantity of these behaviours but resisted complete cessation, in agreement with earlier conclusions (Finn et al., 2014).

The methods adopted for PHBC execution was a reflection of participants' self-efficacy and self-regulatory capacity. Both these constructs are further explored in the next section.

3.4.3.2 Self-regulation and self-efficacy

While the HBM proposes the critical role of self-efficacy in successful PHBC implementation, the study conclusions emphasise the greater predictive power of self-regulation. Growing evidence on behavioural change shows that poor self-regulation is the primary contributor towards the failure to enact PHBC goals as opposed to a lack of motivation or intention (Rhodes & Dickau, 2012). Even if readiness and confidence for executing PHBCs existed, the execution often incurred a mental and physical capacity beyond just that of the original motivators. Therefore, participants who conveyed intent and knowledge on how to perform PHBCs differed in their volitional preparation to go through with their intentions. Intentions were often evolving and even at times set aside either wilfully or unwilfully (due to limited resources such as time and cost or impulsivity), similar to that seen in other studies (Burgess et al., 2017; De Ridder et al., 2017; Piana et al., 2013; Venditti et al., 2014).

3.4.3.2.1 Unwilful postponement of PHBC goals

Participants did not necessarily always carry forward their PHBC intentions, despite experiences of cognitive dissonance and guilt about succumbing to risk behaviours. The guilt experienced when individuals fail to behave ‘correctly’ should theoretically incentivise individuals to mitigate the dissonance (Pescud & Pettigrew, 2014; Stone & Fernandez, 2008). NZ and international evidence suggests there is a widespread intention to quit among smokers who experience negative thoughts about smoking and express regret for having started (Balmford & Borland, 2008; Karalus et al., 2010). However, these studies also indicated smokers were likely to quit if it wasn’t perceived as too effortful, mirroring study findings that guilt did not necessarily compel one to execute PHBC intentions.

Similar to this study, several reports emphasise how low self-regulation and perceived behavioural control often results in postponing PHBC intentions (Bauman et al., 2012; Cheung et al., 2016; Conner & Norman, 2017; Fitzgerald et al., 2013; Rhodes et al., 2017). A conducive social/situational and cognitive capacity predicted whether participants with low self-regulatory capacity implemented PHBCs, in tandem with previous findings (Burgess et al., 2017; Piana et al., 2013; Venditti et al., 2014; Wingo et al., 2011). Motivation to commit to PHBC under less than ideal conditions was poor. These participants shifted the blame to causes beyond their control, a common psychological adaptation utilised to downplay guilt experiences after indulging in risk behaviours (Burgess et al., 2017; Conner & Norman, 2017; Kroese & De Ridder, 2016; Venditti et al., 2014; Wingo et al., 2011). Misattribution of dissonance to sources beyond their control allows individuals to feel sufficiently justified in pursuing impulsive, health-harmful choices, despite knowing their adverse effects (Kroese & de Ridder, 2016b, Stone & Fernandez, 2008). Figure *3.3* presents the distinction between participants with low and high self-regulatory resources for performing PHBC goals. These habits drained participants' self-regulatory capacity for implementing and sustaining PHBC, particularly during negative affect (further discussed in Sections 3.4.3.2 and 3.4.4). An example seen in this study was binge eating on sweets when stress was experienced. When cognitive resources are occupied with other activities (e.g., work, stress) and effortful processing is unavailable, recognising and deliberately modifying an almost involuntary behaviour can become problematic (De Ridder et al., 2017).

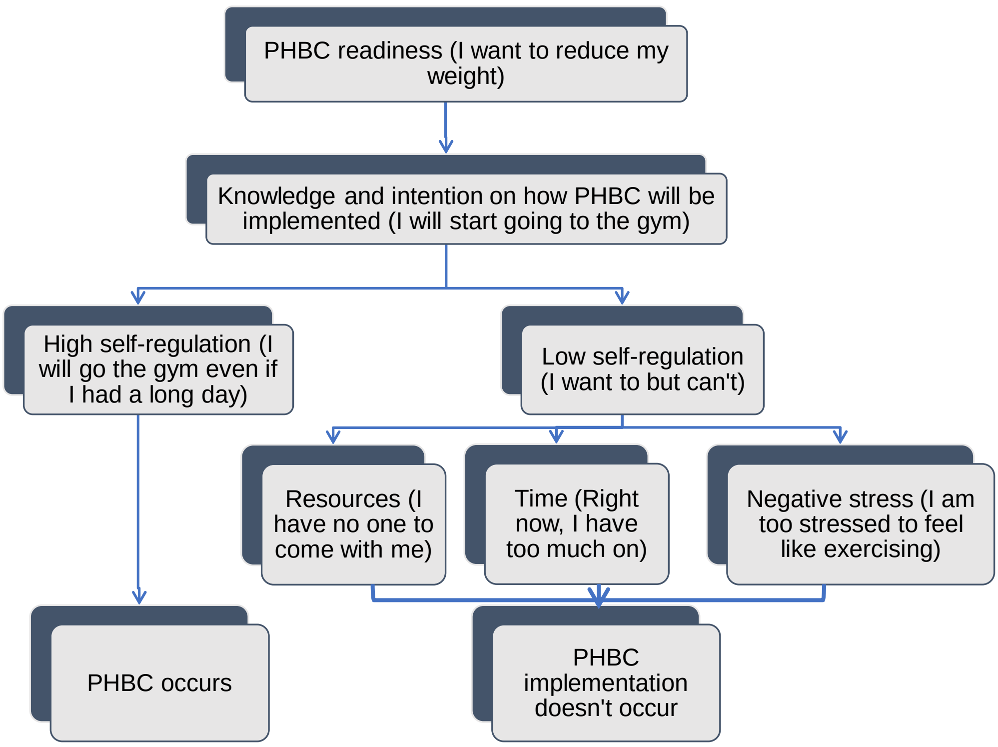

Figure 3.3 The role of self-regulation in the cognitive pathway from having a desire (to increase fitness) to actually implementing exercise goals.

Similar to participants who lacked PHBC readiness (Section 3.4.2.4), time constraints and situational barriers (inadequate resources, anti-PHBC norms) were perceived barriers also for those ready for PHBC. Inadequate time management, prioritisation or organisational difficulties de-motivated participants to perform diet- and exercise-related PHBCs, which is also well classified in the literature (Leone & Ward, 2013; Martínez-Ramos et al., 2015; Piana et al., 2013; Venditti et al., 2014) (see Section 3.4.2.4 on the costs of PHBC). Commonly reported were busy schedules due to work/other commitments. Consequently, participants were too tired, had leisure time restrictions or other barriers (e.g., too late in the evening to go for a walk), both in this study and others (Alvarado et al., 2015; Martínez-Ramos et al., 2015; Venditti et al., 2014). Exercise related barriers due to weather and access (e.g., to a gym) were prominent among females, earning <$30–50,000 p/a, employed/student populations and non-Caucasians, corroborated by other studies (Cleland & Walton, 2004; Venditti et al., 2014).

An unaccommodating social environment and poor affirmational support were perceived barriers limiting self-regulatory capacity to enact PHBC intentions among females, those earning <$30–50,000 p/a, Māori, Pasifika and Caucasians. Such findings have also been replicated previously (Bryant et al., 2011; M. W. Chang et al., 2008; Soler & Ruiz, 2010; Stewart et al., 2011; Twyman et al., 2014). Participants experienced difficulties in performing PHBC by themselves and needed support (e.g., not having someone to go for a walk with or quit smoking with). Subjective cravings were triggered when witnessing others engaging in risk behaviours (cue-driven cravings such as food imagery, sight and smell of cigarettes). This created a sense of alienation for participants desiring to implement PHBCs and reduced cognitive resources (Section 3.4.2.5). Such findings were prominent among 25–34-year-olds, students, Māori and Pasifika, in line with prior conclusions (Glover et al., 2010; Karalus et al., 2010; Robinson et al., 2013, 2014; Saladin et al., 2012; Tiggemann & Kemps, 2005). The intensity of cue reactivity is dependent on the relationship between the cue and the subjective reward of the risk behaviour, commonly known as Pavlovian associative learning processes (Saladin et al., 2012). Alternatively, having peers actively undertaking PHBCs or exposure to pro-PHBC social settings that minimized the self-regulatory burden participants needed to implement their goals.

For several participants, primarily females, <34-year-olds, Māori, Pasifika, student/employed, exposure to motivationally-salient risk behaviour stimuli (negative affect, hunger, cravings) overrode rational decision-making. Instead, cravings based on implicit preferences shaped by habits, norms, culture and upbringing were compelled (Figure *3.4*). These demographic patterns have also been previously reported (Appelhans et al., 2012; Glover et al., 2010, 2013; Hofmann et al., 2012; Karalus et al., 2010; S. Lim et al., 2020; Sonnentag & Jelden, 2009; West, 2017). During negative affect and fatigue, activities of the prefrontal cortex which is responsible for repressing temptation, curbing impulses and anticipating future outcomes is transiently disrupted (Appelhans et al., 2016). Instead, if participants implicitly favoured risk behaviours (e.g., sedentarism), feelings imbued by these behaviours were recalled and prompted during negative affect. This constituted a perceived barrier for PHBC, comparable to other studies (Cheung et al., 2016; De Ridder et al., 2017; West, 2017).

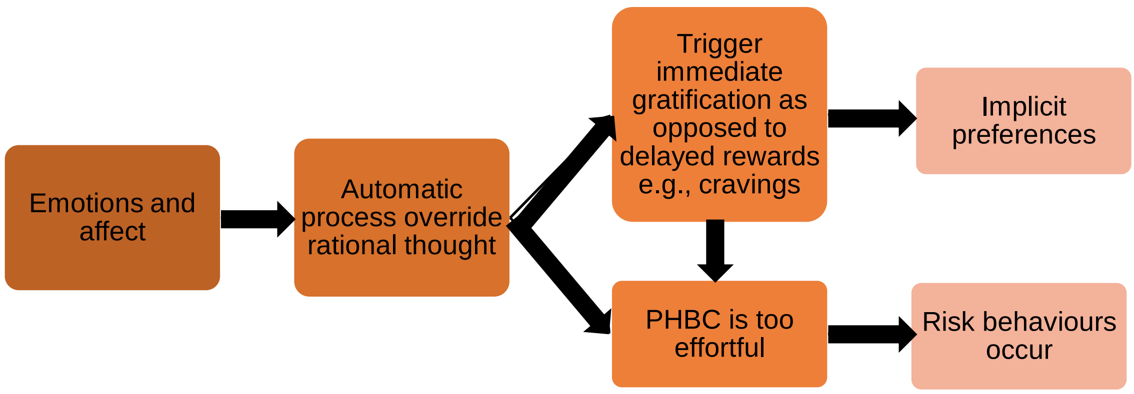

Figure 3.4 Process flowchart depicting how emotions and affect can facilitate risk behaviour continuance despite intent for performing PHBC.

When such strong urges are invoked, rational thoughts about its health impacts and resolve to undertake PHBC is overridden, making long-term health inconsequential (Kroese & De Ridder, 2016). Instead, participants resorted to temporal discounting, whereby future health goals were deliberately put aside for impulsive risk behaviours. This compensatory process is well defined in the review by Kroese and de Ridder (2016) and has been observed in other cohorts (Kuntsche & Bruno, 2015; Paul et al., 2010; Stewart et al., 2011; Ulrich-Lai et al., 2015). Risk behaviours in this context were typically associated with immediate gratification, relaxation or rewarding oneself, making such behaviours irresistible in the face of adversity. The instantaneous impact of such behaviours was highly sought after, when participants needed to re-establish equilibrium quickly following stressor exposure. Glover and colleagues (2013, 2010) demonstrated the 'energy boosting' effects of smoking and improving stamina to conduct day-to-day activities. The latter was indicated by study participants who resorted to smoking to improve concentration while studying. High negative affect also overwhelmed participants' normal reserves for risk behaviours and fostered overindulging in participants. Binge drinking occasions are planned and executed purposefully by young individuals to achieve a 'determined drunkenness' and an intentional loss of control (Hutton et al., 2013). While PHBC disclination due to stress and negative affect was only briefly explored in this study, Chapter 5 explores this phenomenon in greater detail. Temporal discounting of healthy eating in pursuit of hedonically-appealing foods during stress has been previously associated with weight gain and emotional eating (Appelhans et al., 2011; Epstein et al., 2014; Kishinevsky et al., 2012). This is further exacerbated by the addictive components of risk behaviours, both chemical and behavioural (West, 2017).

Most of these participants reported a futuristic plan for PHBCs when circumstances were conducive. Confidence that PHBC efforts would be successful on the first go was indicated by participants, similar to that seen in other studies (Glover et al., 2010; Stone & Fernandez, 2008). The role of willpower and personal choice in PHBC readiness has been well characterised (Balmford & Borland, 2008; Burgess et al., 2017; Glover et al., 2010). Nonetheless, these traits are only one 'spoke of the wheel' that promotes successful PHBC and shouldn't be overestimated. Individuals often undermine the effort associated with changing long-term risk behaviours. The reliance on willpower is problematic as it overlooks the complications of addiction/habits, and devalues the role of support for performing PHBC (Glover et al., 2010).

Therefore, PHBCs are more likely to occur when behaviours resulting from reflective thought *and* automatic processes are aligned (De Ridder et al., 2017). However, another subset of participants wilfully postponed executing PHBCs, as they lacked the motivational drive, which is further discussed in the next section.

3.4.3.2.2 Wilful postponement of PHBC goals

Reasoned procrastination, a relatively novel concept in the field of understanding PHBCs (De Ridder et al., 2017; Kroese & De Ridder, 2016), was indicated whereby PHBC goals were postponed knowingly in a wilful process as opposed to unwilful impulses. Procrastinators were still committed to performing PHBCs and did not abandon the original PHBC goal but simply put them aside for another moment. PHBC intentions are voluntarily but needlessly (i.e., without any actual constraints or justification) delayed despite knowing such setbacks do not have favourable outcomes (Kroese & De Ridder, 2016). A study example included postponing exercising despite receiving encouragement from family and intentionally seeking other things to do. The decision to deliberately postpone PHBCs and prioritise immediate rewards indicated rational behavioural regulation and justifying risk behaviours even with the opportunity to reflect and plan behaviours (Kroese & De Ridder, 2016).

Procrastination was strongly linked to perceived barriers such as: (1) PHBC aversion (e.g., dislike for exercise), and (2) a lack of autonomy, where PHBC was prescribed by others rather than their own desires. The former has shown to be predictive of limited success of health behaviour changes over a six-month period in a study by Sirois and Giguère (2018). Procrastinators often reprioritised PHBCs, displaying low self-control and impulse inhibition when in a less than amicable mood (low positive affect/high negative affect), as reported by Sirois and Pychyl (2013). These individuals were also vulnerable to the allure of activities that compete PHBC. This was salient if they struggled to find PHBCs enjoyable or meaningful and immediate mood regulation was sought, similar to that reported previously (Sirois & Giguère, 2018; Sirois & Pychyl, 2013). This study indicated procrastinators were typically female, >35 years of age and employed. Steel (2007) however reports there are no gender disparities and describes procrastination as a phenomenon that reduces with age. The disparity in these findings could be attributed to the small sample size in this study. The 2007 study did not account for other factors such as motivation levels or the impact of stress and situational constraints. Participants who either wilfully or unwilfully postponed PHBC planned to enact their goals in a futuristic, more ‘PHBC conducive’ moment. Therefore, postponement may be strategically used to ease feelings of failure associated with not executing PHBCs when there was intent to implement it later (Kroese & De Ridder, 2016).

Once PHBC was successfully implemented, the next stage towards successful stroke risk reduction was to maintain these changes long-term. The next section reviews the: (1) techniques study participants used to sustain PHBCs, (2) the cognitive tools that were integral to long-term PHBC maintenance and (3) situations that promoted relapse (into risk behaviours).

3.4.4 Maintaining PHBCs

The study findings illustrated the life cycle that began from implementation of PHBCs into the maintenance stages (Figure *3.5*). Some authors argue that determinants of initiating PHBC should be distinct from PHBC maintenance (e.g., attitudes and norms v. benefits from PHBC) (Fjeldsoe et al., 2011; Rothman et al., 2009). This was corroborated to some extent by the study findings. Nonetheless, similar cognitive tools and environmental motivators were interspersed between stages. For example, the habitual nature of risk behaviours had an impact both on readiness for PHBC and affected self-regulatory capacity to resist relapsing (during maintenance).

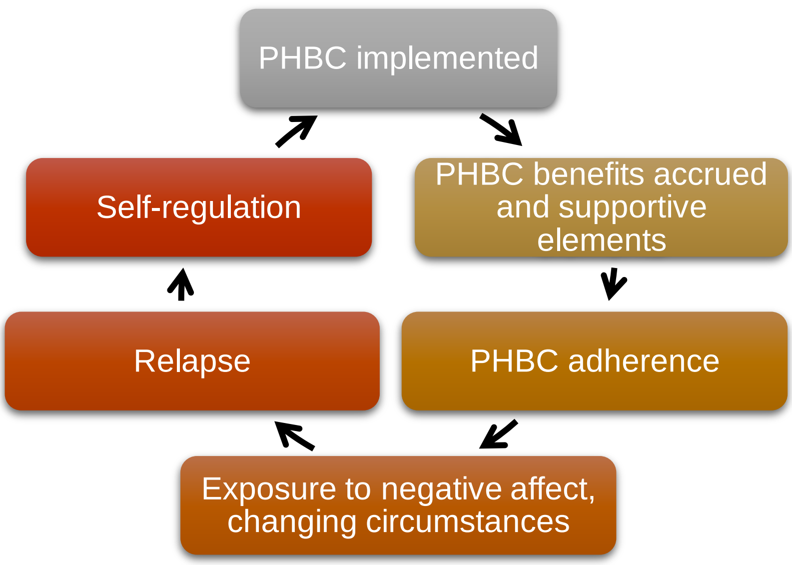

Figure 3.5 PHBCs transitioning from implementation to maintenance experienced by study participants

PHBC maintenance was achieved when: (1) participants' values, goals and priorities aligned with perceived benefits of PHBCs, (2) self-efficacy was robust, strengthened by socio-environmental support and positive self-affirmations, and (3) participants have a tenacious self-regulatory capacity, including the ability to deal with adversity and resisting automatic responses to risk behaviour cues. These also involved monitoring relapse situations and enacting measures to address them, similar to that seen in other studies (Conner & Norman, 2017; Teixeira & Marques, 2017). Such conclusions resonated with the review conducted by Kwasnicka, Dombrowski, White, and Sniehotta (2016) on the theories of behaviour change maintenance. The authors emphasised the differential impact of motivations, routines, self-regulation and socio-environmental influences in maintaining PHBCs. Self-regulation is critical in maintaining goal-consistent behaviour (e.g., eating well to achieve weight loss) and avoid deviating triggers (e.g., a calorific desert), as emphasised by J. Bauer and Reisch (2019).

3.4.4.1 Motivation to sustain PHBCs is based accumulated PHBC benefits and original motivations

During the PHBC maintenance phase, participants shifted from concentrating on what they expected to be obtained from PHBCs to evaluating the benefits they had accrued. This was possible as sufficient time had surpassed since the onset of PHBC for some participants. The consequences of change and whether it was worth the costs incurred can help one evaluate the value of sustaining PHBCs (Voils et al., 2014). Participants, particularly female, >35-year-old and Māori, who amassed PHBC benefits and felt they were better off since the change chose to sustain the new behaviour. These findings were congruent with prior research on determinants of adherence to PHBC interventions (Glover et al., 2010; I. Greenberg et al., 2009; Hadžiabdić et al., 2015; Teixeira & Marques, 2017). Benefits included but were not limited to: better quality of life, positive affect, improved social relationships, stress management, energy, fitness, mobility, performance and self-confidence. Reduction of one risk behaviour encouraged participants to undertake multiple PHBCs. For example, smoking cessation was associated with better energy and stamina for undertaking exercise, aiding and endorsing ongoing cessation, similar to that seen in other studies (S. Choi & Duffy, 2017). PHBC-associated improvements fostered negative thoughts and disdain towards risk behaviours among participants. Ex-smokers who had improved health, functioning and better sensitivities (e.g., food taste) after quitting described a vehement distaste for smoking and aversion to its hedonic properties. Such aversions preserved their ongoing motivation for cessation, similar to findings seen in other studies (Glover et al., 2010, 2013). However, habituation to the pleasures obtained from PHBCs can occur where initial health and social rewards decline in impact over time and are no longer sufficient to sustain PHBC (Jeffery, 2012; Voils et al., 2014). Habituation wasn't evident among participants in this study, indicating such effects may take longer to become evident.

According to the PRIME theory of motivation (West & Brown, 2013), expectations about health and quality of life following PHBCs will not have a direct impact on sustaining PHBC unless a primary motivation (e.g., needs) doesn't exist. Participants recalled original PHBC motivations, in particular perceived susceptibility for illness development, to self-motivate PHBC maintenance. This technique was popular among in females, students, 25–34-year-olds, Māori and other ethnicities, similar to that seen in other studies (Appelhans et al., 2016; Epton et al., 2015; O'Brien Cousins & Gillis, 2005). PHBCs motivated by long-term health, family well-being and role-modelling was associated with better PHBC adherence. These participants recognised the necessity for long-term risk factor management and valued PHBCs as they holistically improved not only the health of themselves but also others of importance. Alternatively, PHBCs initiated for short-term goals (e.g., an immediate health concern, increasing stamina for travel) were abandoned once intentions were fulfilled and original risk behaviours re-adopted. Such findings have also been indicated previously (Glover et al., 2010; Veenhof et al., 2006). Indeed, weight loss management for health promotion is a much greater challenge compared to just achieving weight loss (Kruegle, 2012). Nonetheless, Woolley and Fishbach (2017) report that immediate, as opposed to delayed, rewards were predictive of greater adherence to PHBC goals. According to these authors, short-term goals have more pertinent value than delayed goals, as they produce more immediate rewards and reduce the costs of persistence. Important distinctions also need to be made between intended and unintended PHBCs. PHBCs undertaken in response to external pressures such as peer pressure/family expectations were unlikely to be initiated or maintained over time as these were externally motivated desires. These observations were similar to that seen in other studies (Egger et al., 2017; Glover et al., 2010; Samdal et al., 2017) Participants who had to omit risk behaviours to address such concerns stated that PHBCs were undertaken reluctantly, not because they wanted to but because they had to.

While original motivations and accumulated PHBC benefits affected participants' drive to maintain PHBCs, self-efficacy was an important determinant of how participants achieved PHBC adherence. The following section discusses the tools that participants used to reinforce their self-efficacy.

3.4.4.2 Socio-environmental support and positive self-affirmations improves self-efficacy

Defined as the belief in oneself to perform an intended behaviour, self-efficacy was a central determinant in sustaining PHBCs (Fitzgerald et al., 2013). Socio-environmental factors and support systems had an indirect role in PHBC maintenance by strengthening participants' self-efficacy. Both the independent and synergistic effects of a positive socio-environmental context, pro-PHBC social norms and active peer support fortified PHBC maintenance particularly in males, older participants, Māori and employed participants. These findings have also been replicated in other studies (Burgess et al., 2017; Glover et al., 2010; McAuley et al., 2003; Middleton et al., 2013; Piana et al., 2013; Rhodes et al., 2017). Family members provided social support to maintain PHBCs through: (1) emotional means (verbal encouragement), (2) instrumental support (e.g., provision of healthy meals), and (3) affirmational support (enlisting peers who engaged in these behaviours themselves). Additionally, perceptions about one's self-efficacy among young participants were enhanced by witnessing the PHBC success of relevant peers (e.g., friends successfully vaping instead of smoking). Such conclusions are corroborated by other intervention studies that utilised social support as a behavioural change technique to improve long-term maintenance of physical activity (Harvey & Alexander, 2012), smoking cessation (West, 2017), and increased fruit and vegetable intake (Lara et al., 2014; Shaikh et al., 2008) On the contrary, a recent meta-analytic review by Tang and colleagues (2019) demonstrated that social support may actually decrease self-efficacy. Lack of such a finding in this study may be partially attributed to the fact that the researcher did not extensively probe the nature of interactions between participants and support networks.

Another technique used to facilitate self-efficacy was self-affirmation and positive self-talk. Self-affirmation was the capacity for participants to remind themselves of their competence in maintaining PHBCs during challenging circumstances such as stress, indicated in the review by Cohen and Sherman (Cohen & Sherman, 2014). This method was exercised repeatedly to improve confidence in the ability to navigate through future adversity and strengthening resilience in a self-reinforcing loop.

Lastly, self-regulatory strength was integral in reducing relapses into risk behaviours. This construct has been a longstanding endeavour in prevention initiatives (J. P. Connor et al., 2011).

3.4.4.3 Self-regulation limits relapse

Self-regulation was a tenuous capacity for some participants and dictated the likelihood of relapse. High self-regulatory capacity (particularly among males, >35-year-olds, Māori and employed individuals) limited relapse during social, environmental and lifestyle pressures, corroborated by other findings (Anderson-Bill et al., 2011; Burke et al., 2008; Delahanty et al., 2006). Conversely, those with reduced capacity either permanently or temporarily relapsed into risk behaviours. Motivational state, in particular stress, was one of the most common causes for temporary relapse (prominently in females, <25-year-olds, Māori and other ethnicities). One of the most cited reasons for permanent relapse was ongoing stress and its management (young participants, Pasifika). This was particularly salient if PHBC was considered effortful, inconvenient, and/or was not effective in managing negative affect, similar to that seen in other studies (Glover et al., 2010; Venditti et al., 2014; Zuckoff, 2012), although Fidler and West contested this in their study (2009). Indeed, depression, stress and anxiety have previously been found to reduce adherence to weight management programmes (Colombo et al., 2014; Michelini et al., 2014).

Alternatively, peer and family influences that practised anti-PHBC were perceived barriers for PHBC maintenance, active inducers of relapse and drained self-regulatory capacity. Similar findings have also been observed in other studies (Burgess et al., 2017; Conner & Norman, 2017; Glover et al., 2010). Upon confronting anti-PHBC social norms, young participants in both this study and other cohorts (West, 2017; West & Shiffman, 2016) grappled with cue-driven cravings and the pressure to fit in. Instead a people-pleasing state was adopted and participants engaged in temporal discounting. Consequently, a strategy utilised by those motivated to maintain PHBCs was to wholly avoid situations or relationships that participants associated directly with performing risk behaviours. Commonly known as relapse prevention, such methods were popular among females and Māori participants, in line with previous research (Butryn et al., 2011; Glover et al., 2010). This involved prospective thinking to identify motivational and situational cues that prompted risk behaviours and either remove oneself from such situations, or plan strategies in advance to manage relapse.

Figure *3.6* summarises the cognitive pathway that is triggered when individuals are exposed to the sensory and visual cues of risk behaviours and experience temptation-induced lapses in PHBC adherence (Appelhans et al., 2016, 2011; J. Bauer & Reisch, 2019; Glover et al., 2010; Pool, Brosch, Delplanque, & Sander, 2014; West, 2017; West & Shiffman, 2016).

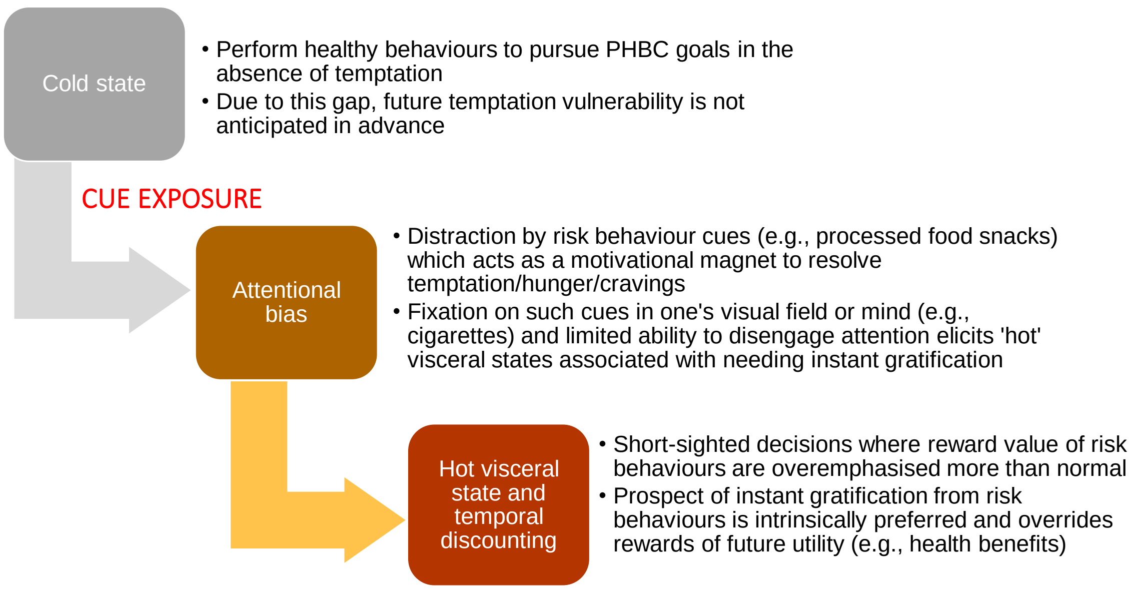

Figure 3.6 Cognitive processing in response to temptation from risk behaviour cues

Resisting cravings in the midst of a ‘hot’ state is reliant on effortful inhibition, requiring willpower to actively suppress temptations (Appelhans et al., 2016). Temptation circumvention techniques that were enacted in the cold state (eliminating the enabler, cold-turkey methods, implementation intentions) were popular (Section 3.4.3.1). This strategy utilises working memory and cognitive flexibility (brain areas involved in problem-solving and goal setting), allowing individuals to limit temptation without overworking executive functions (Appelhans et al., 2016; Hofmann et al., 2012). Congruent with the literature (Conner & Norman, 2017; Glover et al., 2010), this study showed that risk behaviours often did not transpire alone. In particular, smoking is highly expected to co-occur with drinking behaviour. Therefore, relapse prevention also included understanding risk behaviour associations, i.e., avoiding other risk behaviours habitually associated with the one they were trying to eliminate. Therefore, participants who used cold-turkey methods were successful in maintaining PHBCs long-term compared to those who gradually reduced risk behaviours incidence, corroborated by other findings (Lindson-Hawley et al., 2016). However, young study participants of other ethnicities who employed 'cold turkey' methods experienced addiction withdrawal symptoms in the initial months, as observed previously (Glover et al., 2010; Zhou et al., 2009). The ability to surpass such cravings were dependent on participants' self-regulatory capacity and the utilisation of skills such as self-affirmation and reflecting on the benefits of PHBC. The literature indicates that only 5% who quit smoking unaided remain abstinent a year later, dictated by an unambivalent desire to quit, original motivations and self-efficacy (Balmford & Borland, 2008; Breitling et al., 2009; Businelle et al., 2010).

While cue-driven cravings were automatic as opposed to volitional choices, some participants allowed themselves to relapse and temporarily discarded their PHBC goals in response to one-off occasions (celebratory events and travelling). Such findings have been observed previously (Burgess et al., 2017; S. Choi & Duffy, 2017; West, 2017; Zuckoff, 2012). This was particularly salient in participants who acquired a socialising benefit from risk behaviours, in contrast to other literature findings (Fidler et al., 2011). The affective (as opposed to the rational) cognitive pathway is activated during such situations, lowering one's discipline for PHBC adherence and prompting a desire to treat oneself (Binkley, 2018). Compensatory health beliefs were also used to rationalise occasional splurges with participants justifying that any resulting adverse health impacts were countered by otherwise enacting PHBCs. Instead of concern/guilt as observed with impulsive choices, there was an underlying acceptability for such behaviours during such situations and high self-efficacy to re-implement PHBC. Nonetheless, another commonly-cited reason for permanent relapse among study participants was the inability to dedicate sufficient time/resources to PHBCs (older participants and those employed). In this instance, PHBCs were wilfully sacrificed to address more pertinent concerns.

3.4.5 Study strengths

Despite the aforementioned limitations, the study provided important insights into the attitudes towards PHBCs and the needs and values that either deter or motivate individuals towards them. A corresponding strength of the small sample size is the large body of rich data obtained through the interview process. Strengths of the study include notable observations such as: (1) understanding of how stroke risk awareness influences one's motivation to undertake PHBCs, (2) the complex interplay between stages of PHBC readiness, implementation and maintenance and how an individual often alternates between stages, (3) comparable similarities in existing stroke risk factor recognition between Māori and Caucasians, and (4) Māori and Pasifika perspectives and views on PHBCs other than smoking. This study is a first step towards understanding attitudes in two 'hard-to-reach' groups (Māori and Pasifika) that suffer the highest stroke burden and risk factor prevalence in NZ. The study added further value to existing research by exploring time-specific intentions (e.g., intentions to undertake PHBC over the next 6 months) as opposed to general intention. Such intentions are more likely to lead to successful PHBCs as it incorporates more action planning and comprehensive intentions for implementation (Karen et al., 2008). Participants who clearly specified a time when they planned to undertake PHBC (e.g., quit smoking at the end of work secondment) were more likely to action their goals.

3.4.6 Study limitations

The qualitative design itself held certain inherent limitations due to the researcher's subjectivity at all phases of the study (literature review, design of the interview scripts and data analysis). As such, personal bias and the idiosyncrasies of the researcher could have impacted research quality (Anderson, 2010). However, the systematic transcription of interviews, prior acknowledgement of the researcher's assumptions and performing triangulation during the data analysis contributed to control this effect. Additionally, social desirability bias in how participants presented their narratives may have been further exacerbated by the researcher's presence during the interviews (Anderson, 2010). The non-Māori and non-Pasifika ethnic background of the researcher may have been another potential limitation of the interview process. Such participants may have experienced a sense of discomfort to share their experiences with someone of a different ethnic background. Nonetheless, this was minimized by the cultural mentorship provided on the study design, development of interview questions and interview conduct received by the Taupua Waiora Centre for Māori Health Research and the Office of Pacific Advancement. Such guidance ensured cultural protocols and perspectives were respected and the researcher felt confident conducting interviews.

The study observations were based on the experiences and perspectives of less than or equal to 20 participants who did or did not undertake PHBCs. Therefore, it can be argued that the sample size can limit the generalisability of study findings. The debate about sample size calculations in qualitative research is ongoing. However, as outlined in Section 3.2.1.6, it is the researcher's belief that the study achieved a sufficient level of power as the final sample size met the criterion for information power and thematic saturation. Nevertheless, saturation may not be easy to determine with such a small sub-sample of non-Caucasian participants. Future studies should persevere to obtain more Māori, Pasifika and Asian perspectives on the research questions.

The age and ethnic distribution of participants who did or did not undertake each type of PHBC (e.g., smoking, alcohol intake) were not equal. For example, those who did or did not undertake smoking related PHBCs were <35-years-old in this sample. Older people who choose to quit or not quit smoking may have very different experiences, priorities or motivations for PHBCs. Therefore, future investigations should highlight age- and ethnicity-specific determinants on specific kinds of PHBCs. Section 6.3.1 further details other limitations that were commonplace with the other two studies in this research, including those due to the selective recruitment methods.

3.5 CHAPTER SUMMARY

Long-term PHBCs for successful stroke risk reduction are dictated by the synchrony between an individual’s readiness to undertake PHBC, means and methods for performing PHBCs and the cognitive capacity to maintain PHBCs. The success of each stage is mediated by both intra- and inter-individual constructs. These included, but were not limited to, core values and beliefs, motivational stability, emotions and affect, socio-environmental influences, self-regulatory capacity and self-efficacy. Inability of educational or PHBC-based interventions to maintain PHBCs could be due to their singular focus on facets of PHBCs, without considering other corresponding influences. The ‘waxing and waning’ of behavioural intentions are often not accounted for. PHBC adherence is a truly an ongoing process, where simply initiating it does not guarantee long-term maintenance. There is no ‘one for all’ method that works best as determinants of PHBCs vary vastly across different demographic and cultural groups. Based on study conclusions, Chapter 6 discusses the practical implications of applying these principles for future prevention strategies and further directions of research in this area.

Chapter 4 Food choices of socioeconomically-deprived individuals and their impact on diet quality (Study 2)

4.1 INTRODUCTION AND STUDY OBJECTIVE

An unhealthy diet is a prominent risk factor for stroke and is often a drawback of socioeconomic deprivation (SEDep). Lower adherence to evidence- based dietary recommendations is often observed in individuals with high individual SEDep and community SEDep (Dijkstra et al., 2014; Pacheco et al., 2018).

In order to inform interventions that aim to modify such behaviours, the *objectives* of study 2 were three fold: (1) determine whether community and individual level SEDep influenced intake of stroke risk reducing and risk increasing foods and overall diet quality, (2) determine the differences in food choice motivations according to deprivation status and whether these moderated the association between diet quality and SEDep (3) investigate whether community and individual SEDep was associated with differences in nutrition knowledge. Lastly, current empirical findings emphasise the impact of education and income upon diet quality and food choice motivations (Backholer et al., 2016; De Mestral et al., 2019). As such, the use of the NZiDep as a measure of SEDep is relatively sparse in NZ health research. Therefore, it was also of interest to determine if the NZiDep had greater predictive capacity of outcome measures than traditional proxies for individual socioeconomic position (education and income). To address these aims, the following hypotheses were investigated in Study 2:

Primary research hypothesis: Participants with high NZiDep scores (measure of individual SEDep) and/or residing in areas of high NZDep2018 scores will have a lower prevalence of stroke risk-reducing food intake, higher consumption of risk-increasing foods and overall poorer diet quality (primary outcome).

Secondary research hypothesis: Participants with high NZiDep scores and/or residing in areas with high NZDep2018 scores will demonstrate (1) food choices based on mood, sensory appeal, familiarity, convenience and price and low priority for food choices based on health, ethical concern or natural content (secondary outcomes), and (2) poor nutrition knowledge (tertiary outcome). As NZiDep is a relatively novel index used in association with food choice motivations, the hypothesis was based on income and education trends in the literature (Allès et al., 2017; Baudry et al., 2017; Burns et al., 2013; Fotopoulos et al., 2009; Konttinen et al., 2013; Locher et al., 2009). It was also hypothesized that food choice motivations significantly associated with NZiDep and NZDep2018 status would moderate its association with the three diet quality outcomes.

Tertiary research hypothesis: NZiDep as a measure of individual SEDep is a stronger predictor of diet quality, food choice motivations and nutrition knowledge than education and income.

4.2 METHODS

4.2.1 Recruitment and consenting procedures for participants

The intention of Study 2 was not to identify what proportion of the population provides a particular response, but to explore the motivations and nutritional knowledge of deprived and non-deprived individuals. Therefore, convenience sampling was deemed more appropriate than a random recruitment method. (Section 3.2.1.6). RIBURST participants who were contacted for Study 1 were also invited to participate in this study, provided that they met the inclusion and exclusion criteria (the potential implications of common participants across both studies and its limitations are discussed in Section 6.1). The SR app educates users on the impact of diet upon stroke risk and provides recommendations on eating healthily. Therefore, inclusion of SR users would have allowed the researcher to systematically assess the impact of SEDep on study outcomes, beyond education and awareness. This was an additional objective in the original study design. However, recruitment from the RIBURST pool was less than 20-30% over the months of recruitment. Subsequently, a sufficient number of RIBURST participants could not be acquired for performing this analysis. Moreover, enrolled RIBURST participants were of low

NZiDep status (92%) and residing in areas of low-medium NZDep2018 (83%) (data not shown).

Regardless of this, recruitment from the RIBURST sample pool had two additional advantages. Firstly, the sample provided a readily available pool of participants to recruit from. Secondly the SR algorithm captured whether participants have six or more servings of fruits and/or vegetables per day. Current literature indicates SEDep has the greatest impact on fruit and vegetable consumption due to concerns around cost of produce and food accessibility (Section 2.8.2.1). As such, the researcher followed a guided approach to recruiting equal numbers of participants who did and did not consume six or more servings of fruits and/or vegetables.

To meet the threshold of sample size requirement, alternative recruitment through advertisement was pursued. Venues for advertising have been previously outlined in Section 3.2.1.4 and advertising fliers are displayed in Appendix 8 containing the REDcap link to the information sheet (Appendix 7) and online questionnaires. Ethics approval was sought prior to all study procedures (Appendix 1) and participants who met criteria were provided a REDcap link for the information sheet (Appendix 6) and online questionnaires.

4.2.2 Inclusion/exclusion criteria

Participants for Study 2 were eligible to participate if they:

- Had no history of stroke, heart attack or a chronic health condition (such as diabetes) that affects their diet.
    - (This was to exclude participants who ate healthily primarily to manage their condition or following a clinician-advised dietary plan)
- Resided in Auckland, NZ
    - (This criteria was chosen due to two primary reasons. Firstly, it is NZ's largest city with an ethnically and socioeconomically diverse group; approximately 33.5% of NZers are concentrated in Auckland]. According to the 2013 NZ Census, the highest and lowest income areas in Auckland often lie in close

proximity to each other]. This allowed the researcher to explore in detail the impact of community SEDep, diet quality and food choice motivations. Secondly, in 2018, approximately two thirds of NZ Pasifika and 28% of NZ's 15% of Asians resided in Auckland and it was of interest to maximize the number of participants of these minority groups recruited in this study)

- Over 20 years of age
- Were primary food shoppers
    - (Or equally share this responsibility with someone else). Participants had to carry out bulk of the food shopping/food choice decisions in their household. This helped minimize the influence of chance being a determinant in participants' food choice motivations. For example, a participant may consume a dietary component because it is what the principal food shopper purchases for them
- Were contactable by residential telephone or had a valid email address and able to complete the questionnaires online
- Able to communicate verbally in conversational English.

4.2.3 Sample size

The formula for case-control sample size calculation was considered appropriate to calculate the sample size for the NZiDep groups. The calculation was relevant as the objective was to compare diet quality in participants that have high SEDep (the case) with those who have low SEDep (the control). To determine the sample size for this study, conclusions from prior research were examined as the reference. The G* power software Version 3.1.9.6 (Bonn, 2020) was utilised for the sample size calculation. For this study, NZiDep scores dichotomised into 'high SEDep' if scoring 0-2 on the scale, or else 'low SEDep'. The sample size required for determining diet quality differences between low and high NZiDep groups was first established. As there is a lack of literature evidence utilising a unique individual SEDep index, more conventional proxies of socioeconomic status (i.e., income) were used. To detect a minimally important difference in unhealthy diet, the quality of 1.54 odds ratio between low- and high-income monthly household income-earners as observed in the Swiss study by Mestral et al. (2019), 107 participants per group was needed to attain 80% power with alpha set at 0.05. The equation: effective sample size/ (1- anticipated non-response rate) was used to account for 25% non-response and dropout rate. After accounting for non-response and dropout rate, 143 participants (for each NZiDep decile) needed to be approached to meet sample size requirement.

Secondly, the sample size required to detect diet quality differences between residents living in areas of high and low NZDep2018 was established. The sample NZDep2018 scores were categorised into tertiles in which 'low SEDep' comprised scores ranging from 1–3, 'medium SEDep' included scores ranging from 4–7 and 'high SEDep' comprised scores ranging from 8–10. To detect a statistically-significant effect size of 0.350 in diet quality score between residents of low and high SEDep based on evidence by Wong and colleagues (2017), a minimum sample size of 40 participants per group was needed to attain 80% power with alpha set at 0.05. As such, to account for 25% non-response/dropout rate, a total of 53 participants needed to be approached per NZDep2018 group. Sampling ensured a balance of prognostic factors between the groups for gender, age and ethnicity to facilitate comprehensive understandings. The recruitment strategy sought to closely reflect the demographic distribution reported in the current NZ Census data (Statistics New Zealand, 2018).

4.2.4 Data collection

Despite being given the option to complete the outcome measures by computer-assisted telephone interview, all participants in the study opted to complete outcome measures as an online survey. After completing the online informed consent form, both RIBURST and advertisement responders were guided through a set of screening questions outlining the eligibility criteria of the study. If these were met, participants completed a demographics questionnaire where they selected their appropriate gender, age, ethnic, professional and income status. Participants were then administered the NZiDep, dietary habits, food choice motivations and nutrition knowledge in a survey format. Surveys have several benefits including cost-effectiveness, lower administrative efforts, reduced non-response rates and better accuracy (N. Fielding et al., 2012). To mitigate the likelihood of missing values, each questionnaire was formatted in a way such that if participants missed answering an item, they were prompted to complete the item before continuing onto the next item. The outcomes measures are outlined in detail in the following sections.

4.2.4.1 Cultural consultation for recruitment and study design

Cultural appropriateness of the outcome measurements used in this study for Māori and Pasifika participants were conducted as specified in Section 3.2.1.5.

4.2.4.2 NZ measures of community and individual deprivation

The NZDep2018 index was used to identify the community SEDep status of study participants. The index is a measure of SEDep small areas that have demonstrated high utility in health research, including describing the association between SEDep and health outcomes (J. Atkinson et al., 2019). The NZDep2018 combines eight dimensions of deprivation (income, home ownership, employment, qualifications, family structure, housing, access to transport and communications) from the 2018 Census of Population and Dwellings (J. Atkinson et al., 2019). A unique deprivation score is then allocated for each small area (one or two standard Statistics NZ mesh blocks of at least 100 usually resident persons) (J. Atkinson et al., 2019). To calculate the NZDep2018 score for the communities that participants resided in, their full residential addresses were used to identify the corresponding 6-digit census area unit code through the Statistics NZ data finder website (Statistics NZ: Tatauranga Aotearoa, 2018). Next, the NZDep2018 Census area Unit data (University of Otago, 2018) was utilised to identify the average NZDep2018 score allocated to each census area unit. Scores range on an ordinal scale from 1 (a census area unit in the 10% least deprived census area units in NZ) to 10 (census area unit in the 10% most deprived census area unit (J. Atkinson et al., 2019). For statistical analysis, the sample NZDep2018 scores were categorised into tertiles in which 'low SEDep' comprised scores ranging from 1–3, 'medium SEDep' included scores ranging from 4–7 and 'high SEDep' comprised scores ranging from 8–10. Such categorisations have been previously used to study food outlet distribution in the study by Egli and colleagues (2020).

It was also of interest to determine the associations of individual-level deprivation on diet quality and food choice motivations. However, using the NZDep2018 census area unit index values to infer individual level SEDep within that unit incurs *ecological fallacy* [22](P. White et al., 2008). An area being holistically considered as deprived does not mean that every resident is deprived due to the natural heterogeneity of people in an area (Salmond et al., 2005). The non-occupational NZiDep index is a cost-effective tool developed by the Wellington School of Medicine and Social policy research unit to explicitly address these issues and accompany existing deprivation measures (Salmond et al., 2005). The NZiDep obtains a composite score from 8 items (use of food grants, being on a government benefit, support of community organisations, purchase of cheap foods, saving on heating costs, fruits and vegetables, unemployment >1 month and wearing worn shoes) (Salmond et al., 2005) (Appendix 9). Advantages over existing measures include: (1) applicability to employed and retired adults, (2) statistically equal representation of Māori and Pasifika to general population during index development, (3) ease of administration, (4) utility, criterion and external validity and (5) relevance to the current NZ context (Salmond et al., 2005). Upon completion of the NZiDep questionnaire, participants were allocated a NZiDep score based on their responses. As per the standardised scoring protocol, positive responses were summed to produce a score from 1 to 5 (1 = no SEDep characteristics, 2 =1 SEDep characteristic, 3 = 2 SEDep characteristics, 4 = 3 or 4 SEDep characteristics and 5 = 5 or more SEDep characteristics). The NZiDep index was dichotomised into 'high SEDep' if scoring two or more SEDep characteristics, or else 'low SEDep'. NZiDep has been used as a binary variable for outcome comparisons in previous research (Collings et al., 2014; Gunasekara et al., 2013; Hobbs et al., 2019).

4.2.5 Outcome measures

4.2.5.1 Primary outcome measure: Determining dietary habits

A novel, semi-qualitative Dietary Habits Questionnaire (Appendix 10) was developed and included food items which met the following two criteria based on literature evidence:

- Dietary elements that differed significantly between NZ's socioeconomically

[22] See glossary

deprived groups, Māori (v. non-Māori) and Pasifika (v. non-Pasifika) groups (Haslett et al., 2017; Metcalf et al., 2014; Ministry of Health, 2011, 2012)

- From the prior list, dietary elements capable of increasing or reducing stroke risk (foods or foods containing specific nutrients that met this criteria) (Estruch et al., 2013; Hankey, 2012; Larsson et al., 2009; Mahe et al., 2010; Meschia et al., 2014; Probstfield et al., 2012).

Table 4.1 displays a summary of the serving sizes for each food item that is stroke risk-increasing/-reducing based on literature evidence. Participants were asked to identify how often and how many servings they ate of each listed food type. Options for serving sizes were based on amounts outlined in the NZ food composition tables (Sivakumaran et al., 2016). Participants selected the frequency category best describing their intake from five options ranging from ‘never’ to ‘two or more times per day’.

Having a maximum recall period of ‘once a month’ was used to ensure a reasonable time period in which participants could accurately recall their usual eating habits (Parnell et al., 2011). Given that some vegetables and fruits are seasonal, reporting frequency can vary with some items consumed frequently in season and not at all at other times (Cade et al., 2003). To capture this, participants were asked how often they ate this item when in season and the analysis was adjusted to reflect the length of time in season. Three scoring formats were used to develop three separate indexes from this measure: a stroke risk-increasing food intake index score, a stroke risk-reducing food intake index score, and an overall diet quality index score. For the stroke risk-increasing food index score, participants’ g/day intake of each food item was matched against the threshold servings indicated in Table 4.1. Appendix 10 details the scoring for each index. Risk-increasing food index scores ranged from 0 to nine while risk-reducing food index scores ranged from 0 to 12. The higher the score, the greater number of items consumed for each risk category. Overall diet quality score included combined intake of both risk-increasing and risk-reducing foods and scores ranged from 0 to 21 where a higher score indicated a healthier diet quality.

Table 4.1

Food types included in the Dietary Habits Questionnaire and threshold servings that increase and reduce stroke risk.

Food type	Threshold serving	Stroke risk impact (total, IS and haemorrhagic stroke)	References
Fruits and vegetables	Fruits: >=2 servings/day Vegetables: >= 3 servings/day	Risk-reducing	(Hu et al., 2014; Sherzai et al., 2012)
Alcohol (1 standard drink: ~12 g of ethanol)	<12-20 g/day	Risk-reducing	(Christensen et al., 2018; De Gaetano et al., 2016; Larsson et al., 2016; C. Zhang et al., 2014)
Alcohol (1 drink: 12g of ethanol)	Complete abstainers and >40 g/day	Risk-increasing	(De Gaetano et al., 2016; Larsson et al., 2016; C. Zhang et al., 2014)
Tea	≥3 cups/day	Risk-reducing	(Deng et al., 2018; Iacoviello et al., 2018)
Coffee	≥3cups/day	Risk-reducing	(Deng et al., 2018; Liebeskind et al., 2016)
Non-fermented low-fat milk (milk with a fat content <2 g/100 g (skimmed or semi-skimmed milk products) or (low-fat milk (0.5% fat)	Benefits from ≥125 g/day onwards with maximum benefit at 200 ml/day	Risk-reducing	(De Goede et al., 2016; Deng et al., 2018; Larsson et al., 2012a; Qin et al., 2015; Sonestedt et al., 2011; Wang et al., 2013)
Non-fermented high-fat milk (milk and milk products with a fat content ≥2g/100 g (whole milk products)	≥200 g/day	Risk-increasing	(De Goede et al., 2016; Larsson et al., 2009; Soedamah-Muthu & De Goede, 2018)
Low-fat yoghurt or low-fat sour milk/yogurt (<0.5% fat)	≥90 g/day	Risk-increasing	(Larsson et al., 2009; Laursen et al., 2019)
Full fat yoghurt products (regular and drink yoghurt, ≥ 3 % fat)	≥70g/day	Risk-reducing	(Larsson et al., 2009; Laursen et al., 2018, 2019; L. Wu & Sun, 2017)
Cheese (all types of cheese except for curd)	25 g/day with 3% lower risk of stroke per 40 g/day increase	Risk-reducing	(De Goede et al., 2016; Goldbohm et al., 2011; Soedamah-Muthu & De Goede, 2018; Sonestedt et al., 2011)
Fermented full fat milk (buttermilk, sour cream)	≥125 g/day	Risk-reducing	(Dalmeijer et al., 2013; De Goede et al., 2016; Goldbohm et al., 2011; Laursen et al., 2018)
Soy (tofu, soymilk, soybean)	≥300 g/week (42.8 g/day)	Risk-reducing	(Binns et al., 2009; Lou et al., 2016)

Food type	Threshold serving	Stroke risk impact (total, IS and haemorrhagic stroke)	References
Fried chicken or fish	≥1 serving /week (0.14 serves/day)	Risk-increasing	(Nahab et al., 2016; O'Donnell et al., 2010; Sherzai et al., 2012; Y. Sun et al., 2019; Wallin et al., 2018)
Unprocessed red meat (beef, pork, lamb)	≥100 g/day	Risk-increasing	(Bernstein et al., 2012; G. C. Chen et al., 2013; Iacoviello et al., 2018; Kaluza et al., 2012; Pan et al., 2016)
Processed meat (meat preserved by smoking, curing or salting or addition of chemical preservatives)	≥50 g/day	Risk-increasing	(Bernstein et al., 2012; G. C. Chen et al., 2013; Iacoviello et al., 2018; Kaluza et al., 2012; Pan et al., 2016)
Artificially-sweetened soft drinks (sugar-free carbonated beverages, such as diet cola- diet coke or diet fruit drinks)	≥200 ml/day	Risk-increasing	(Mossavar-Rahmani et al., 2019; Narain et al., 2016; Pase et al., 2017)
Sugar-sweetened beverages (high-sugar carbonated beverages)	≥200 ml/day	Risk-increasing	(Bechthold et al., 2019; Larsson et al., 2014; Micha et al., 2017; Narain et al., 2016; Willett et al., 2012)
Cocoa-containing foods	9.5 g/day	Risk-reducing	(Buijsse et al., 2010; Dong et al., 2017; J. A. Greenberg et al., 2018; Kwok et al., 2015; Larsson et al., 2011, 2012b)
Glycaemic load • Artificial sweeteners • Fried foods (chips, crisps, French fries) • Bagels, English muffins (savoury, low-fat and bran), muffins, cornbread, cake, cupcakes, doughnuts, pastries, crumpets, half a scone, pancakes, waffles, half slice of cake, regular and low-fat cookies, sweet pies, half a pasty/meat pie, crackers)	>203	Risk-increasing	(Cai et al., 2015; Fan et al., 2012; Sieri et al., 2013)
Wholegrain foods (bread, wholegrain breakfast cereal with 25% or more wholegrain or bran content by weight), cooked oatmeal, wheatgerm, brown rice, bran and other grains (e.g., bulgur, buckwheat and couscous)	90 g or >3 servings/day	Risk-reducing	(Aune et al., 2016; J. Chen et al., 2016; Q. Sun et al., 2017; Tighe et al., 2010)

4.2.5.2 Secondary outcome measure: Determining motivations for food choices

Participants were asked to outline their general motives for food consumption by completing the Food Choice Questionnaire (Appendix 11). Developed by Steptoe and colleagues (1995), the questionnaire is based on the conclusion that food choice selection is multi-dimensional. The Food Choice Questionnaire has been adopted internationally as part of research analysing general food selection determinants (Markovina et al., 2015). The questionnaire consists of 36 items that explore the intrinsic and extrinsic food attributes that motivate participants' food choices. The items are categorised into nine motivational dimensions: health, mood, convenience, sensory appeal, natural content, price, weight control, familiarity and ethical concern. The absolute importance of each motive factor (for each participant) was calculated as the un-weighted average score of its items ranging from 0 to five. A higher score indicated higher perceived importance of that motivation. While differences in *absolute* importance of food choices between groups have been well characterised, very little is known regarding the differences in the relative importance attached to specific food choices between groups (Kamphuis et al., 2015). Relative importance acknowledges that food choice motivations compete against one other during the decision-making process (Clarke & Best, 2019). The *relative* importance score of each motive (for each participant) ranged from 0 to 2 and was computed by dividing each participant's absolute rating of it by his/her mean score on all 37 items. Increasing higher motivation scores reflected higher importance placed on that particular food choice motive relative to their average score across all items.

The Food Choice Questionnaire has robust internal validity, high internal consistency and reliability and has been previously applied to determine food motives in a number of cultural and environmental settings (Markovina et al., 2015; Rankin et al., 2018). An additional item was added to the questionnaire to determine influences of family/whānau beliefs (e.g., if family as a whole like to eat healthy or prefer junk foods) (Item number 37 in Appendix 11). Household composition is an integral determinant of food choice where the presence of other household members such as partners and children can differentially influence these choices (Dimitri & Rogus, 2014). As the addition of the item to the questionnaire was unique and as the

Study 2 was purely exploratory, the item was scored and analysed separately. Items for the convenience food choice motive could be broken into two distinct dimensions of food preparation time and food access. As relatively little is known about the SEDep impact on value for food preparation time, statistical analysis of scores for items that fell under these two pathways (Items 1, 15 and 28-*food preparation* and Items 11 and 35-*accessibility*) were individually evaluated. Absolute and relative importance scores for these additional items ranged the same as the other food choice motivations.

4.2.5.3 Tertiary outcome measure: Determining food nutrition knowledge

Respondents' food and nutrition knowledge was measured using a pre-coded, structured Dietary Knowledge Index comprising 20 'True', 'False' or 'Don't know' food health statements. The statements pertained to participants' knowledge of the interrelationships between food, nutrition and health (Appendix 12). The index was developed by an expert panel of dietitians and nutritionists for the study by Turrell and Kavanagh (2006) to assess general food knowledge likely to impact food-purchasing behaviours. Items were presented in a random order in order to minimize response acquiescence. For each participant, each statement was either coded 1(for a correct response) or 0 (for an incorrect or 'don't know' response). The item codes were summed to generate an overall score ranging between 0–20 with higher scores indicating greater nutrition knowledge. Both incorrect and 'don't know' answers were seen to be equally indicative of a lack of knowledge.

4.2.6 Statistical considerations

Unless specified otherwise, data were analysed using IBM SPSS Software (IBM Corp., 2013). Questionnaire data were entered into an SPSS spreadsheet and double-checked to ensure that the data were correct.

4.2.6.1 Descriptive characteristics and comparisons of outcome measures

Univariate descriptive statistics were used to characterise Study 2 sample and to distinguish demographic characteristics of the groups. Continuous variable data were explored for normality. Chi square tests of homogeneity were performed to determine significant differences between categorical outcomes (demographics, intake of each food item in Dietary Habits Questionnaire) across tertiles of NZDep2018 and deciles of NZiDep. For small sample sizes (expected cell count <5), Fisher's exact tests were run. Kruskal-Wallis tests were performed to examine the differences in outcomes (each diet quality index score, food choice motivation and nutrition knowledge scores) across demographic and SEDep categories. The Shapiro-Wilk normality test demonstrated that data was not normally distributed between groups. Additionally, the relatively small and unequal group sizes devalues the use of parametric measures like ANOVA for assessing differences (Schmider et al., 2010). Hence, the non-parametric Kruskal-Wallis test was deemed a more appropriate procedure for comparing differences in data between variables of more than two categories (e.g., age). Post hoc analysis involved pairwise comparisons using Dunn's (1964) procedure with a Bonferroni correction when overall statistically significant differences were found. Alternatively, the Mann Whitney test for trend was used to compare differences in outcomes between groups of 2 levels (i.e., gender and NZiDep). All tests were two-sided. For variables that demonstrated similar distribution of scores between categories based on visual inspection of boxplots, inferences about differences in medians between groups are reported while mean ranks are reported for dissimilar distributions.

4.2.6.2 Regression modelling

For the regression model to yield statistically robust prediction data, a number of assumptions must be satisfied (Jeong & Jung, 2016). Table 4.2 outlines how these assumptions were assessed prior to undertaking the regression analyses. The benefits of regression analyses include: (1) statistically describing relationships between outcome and predictor variables, (2) estimating values of the outcome variable from observed predictor data, and (3) identifying confounding influences that can impact the outcome variables (Kilic, 2013). Multivariable regression allows the researcher to explore the effects of multiple, independent predictors at the same time as a means of statistical control, and for examining incremental validity (Lewis, 2007). Table *4.3* outlines the modelling strategies performed for the hierarchical regression analyses. Education categories included school-only, undergraduate, postgraduate and other education (i.e., those with schooling but no prominent tertiary qualification, for example, trace certificate).

Table 4.2

Assumptions for performing hierarchical regression

Assumption	**Assessed by**
The assumption of independence of observations testing for 1st-order autocorrelation	Durbin-Watson statistic of ~ 2
Linearity between dependent variable and each predictor variable, and (b) the dependent variable and the predictor variables collectively	Partial regression plots and a plot of studentised residuals against the predicted values
Homoscedasticity (equality among residuals for all values of the outcome variable)	Plot of studentised residuals versus unstandardized predicted values
No multicollinearity (i.e., two or more predictor variables should not be correlated with each other)	Predictor pairs had correlation coefficient <0.7 and variance inflation factor value tolerance value > 0.1.
Normality (residual errors are normally distributed)	Normal Q-Q Plot of studentised residuals
No outliers, leverage points or influential points	Studentised deleted residuals <±3 standard deviations, leverage value, <0.2 and Cook's distance value <1

Income categories included <$30,000 per/annum (p/a), $30–50,000 p/a, $50–70,000 p/a, $70–90,000 p/a and >$90,000 p/a. The ordering of the covariates (age (<25 years, 25–34 years of age, 35–54 years of age and >55 years of age), gender and ethnicity ((Māori, Pasifika, Caucasian, Asian and other ethnicities)) into the models ensured that the relationships tested were less likely to be biased by confounding. Covariates were selected based on their clinical relevance to the outcome of interest as described from other studies. The final regression model examining the relationship between NZDep2018 scores and each outcome measure included individual measures of SEDep as potential confounders as it was assumed that these measures were predictors of NZDep2018 (which is logical as the index accounts for these measures).

To determine whether particular food choice motivations moderated the association between SEDep and diet quality, a hierarchical multiple regression was also run to assess the impact of an interaction term between: (1) individual measures of SEDep (income, education, NZiDep) and food choice motivation scores, and (2) and food choice motivation scores on food index scores (Model 7 in Table *4.3*).

Table 4.3

Modelling strategies used for regression analysis of outcome measures

Outcome measure	**Models tested**
Dietary habits	• Model 1a-e: association between predictors and stroke risk-reducing food index score with each successive model adjusting for the predictor in the previous models. Model a displays association between covariates and scores, Model b displays association between education and scores, Model c displays association between income and scores, Model d displays association between categories of NZiDep and scores, Model e displays association between categories of NZDep2018 and scores. • Model 2a-e: Identical to Model 1a-e except the outcome measure was stroke risk-increasing food index score. • Model 3a-e: Identical to Model 1a-e except the outcome measure was overall diet index scores.
FCM	• Model 4 (a-i): final model association between categories of NZiDep and NZDep2018 and each FCM absolute importance scores after adjusting for covariates, education and income. Only significant associations are displayed in the Results. • Model 5 (a-i): final model association between categories of NZiDep and NZDep2018 and each FCM relative importance scores after adjusting for covariates, education and income. Only significant associations are displayed in the Results. • Model 6a: final model association between FCM and risk-reducing food index scores after adjusting for covariates. Only significant associations are displayed in the Results. • Model 6b: final model association between FCM and risk-increasing food index score after adjusting for covariates. Only significant associations are displayed in the Results. • Model 6C: final model association between FCM and overall diet quality index score after adjusting for covariates. Only significant associations are displayed in the Results. • Model 7: Interaction effects of NZiDep and NZDep2018 categories and absolute FCM importance scores on stroke risk-increasing food index score, stroke risk-reducing food index score and overall diet scores after adjusting for covariates. Only significant interactions are displayed in Results.
Nutrition knowledge	• Model 8a-e: association between predictors and nutrition knowledge scores with each successive model adjusting for the predictor in the previous models. Model a displays association between covariates and scores, Model b displays association between education and scores, Model c displays association between income and scores, Model d displays association between categories of NZiDep and scores, Model e displays association between categories of NZDep2018 and scores. • Model 9a: association between nutrition knowledge and stroke risk-reducing food index score after adjusting for covariates. • Model 9b: association between nutrition knowledge and stroke risk-increasing food index score after adjusting for covariates. • Model 9c: association between nutrition knowledge and overall diet index scores after adjusting for covariates

As there were more than 2 categories for age and ethnicity, the variables were dummy-coded prior to inputting into the regression equation. Results from the multi-level analysis were expressed as regression coefficients (which dictates if the model significantly predicts the outcome based on p≤ .05) and adjusted regression coefficient (R^2 value). The R^2 value for each model indicates the proportion of variance in the outcome variable that can be accounted for by predictors in that model (i.e., its direct effect on the outcome) above and beyond the predictors in preceding models (Kilic, 2013). At each stage, tests for improvements in model fit were assessed using the deviance statistic. All tests of statistical significance were based on 2-sided probability.

4.3 RESULTS

4.3.1 Study 2 sample

Recruitment rates for participants enrolled from the RIBURST sample pool and via advertising platforms are summarised in Figure *4.1*. Participants were primarily ineligible as they were either not residents of Auckland, or they were not primary food shoppers. Participants excluded from the data analysis were those who did not provide complete responses to the questionnaires or could not be contacted to complete the questionnaires. A total of 179 participants who met the inclusion and exclusion criteria were recruited into the study, of which 78% were advertisement responders and 22% were RIBURST participants. Participants were primarily females (52%), 25–34 years of age (29%), 35–54 years (26%), Caucasian ethnicity (40%), earned <$30,000 p/a (38%) and were of 'other' category of education (36%). Thirty percent (30%) of participants were in the low NZDep2018 tertiles; 37% were in the medium NZDep2018 tertile; while 33% were in the high NZDep2018 tertile. Of the participants, 54% had low NZiDep scores while 46% had high NZiDep scores.

Table 4.4 displays the chi-square comparisons of participant proportion in each category of NZiDep and NZDep2018 according to age, gender, ethnicity and education groupings. Significantly fewer females had high NZiDep scores compared to males. Significantly more <25-year-olds had high NZiDep scores compared to low; while the proportion of >55-year-olds with low NZiDep scores was significantly greater than those with high scores. Proportion of Caucasians in the low NZiDep decile and NZDep2018 tertile were significantly higher compared to the high NZiDep decile and medium and high NZDep2018 tertiles. Conversely, the proportion of Asians in the high NZDep2018 tertile was significantly higher compared to the medium and low NZDep2018 tertiles. The proportion of participants who earned <$30,000 p/a were also significantly higher in the high NZDep2018 and NZiDep groups. Alternatively, more $50–70,000 p/a earners were in the low NZiDep decile compared to the high.

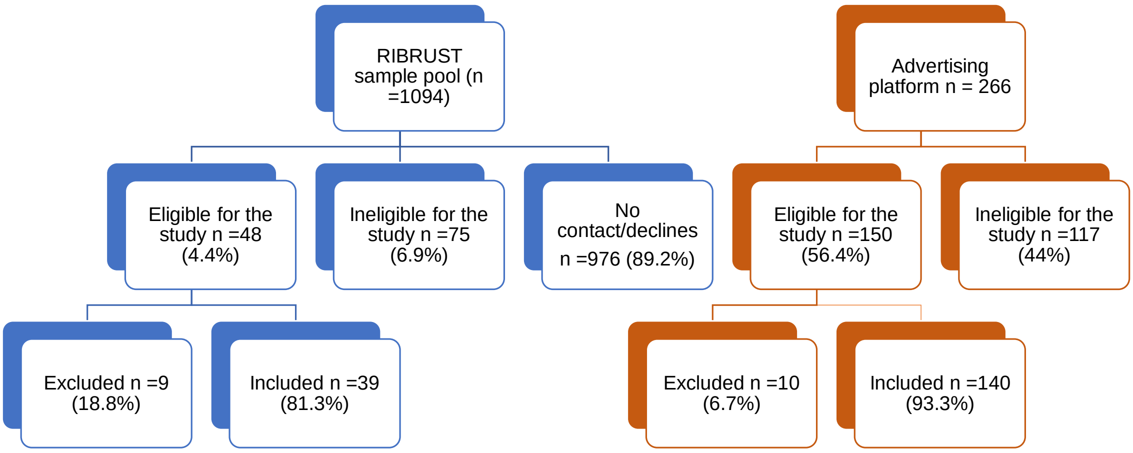

Figure 4.1 Recruitment rates of participants enrolled through the RIBURST pool and advertising

4.3.2 Primary outcome measure: Diet quality

4.3.2.1 Differences in intake of food items in the Dietary Habits Questionnaire

Intake of each food item was analysed as categorical data (i.e., yes/no) in terms of whether the stroke risk-reducing or increasing serve of each item was consumed daily (as per threshold servings in Table 4.1). Results of the chi-square test to assess differences in intake across SEDep categories is depicted in Table 4.5. Intake of stroke risk-increasing serves of fried meat, sugar-sweetened drinks and alcohol was significantly more prevalent in high NZDep2018 participants compared to low and medium SEDep tertiles.

Compared to the medium NZDep2018 tertile, intake of risk-increasing serves of artificially-sweetened drinks was more prevalent in the high NZDep2018 tertile. Significantly more participants in the low NZDep2018 tertile consumed risk-reducing serves of full-fat cheese and alcohol compared to medium and high NZDep2018 tertiles.

Table 4.4

Distribution of sample (n, %) across tertiles of NZDep2018 score and deciles of NZiDep scores

	Tertiles of NZDep2018 score						Decile of NZiDep score		
Variables	Low[a] (n =53)		Medium[b] (n =65)		High[c] (n =59)		Low[d] (n =97)	High[e] (n =82)	
Age		***P^a***		***P^a***		***P^a***			***P^c***
<25 (n =39)	10 (18.9)	.55	9 (14.1)	.06	19 (33.3)	.01	9 (9.6)	29 (35.4)	**<.001**
25–34 (n =51)	13 (24.5)	.42	18 (28.1)	.92	19 (33.3)	.37	26 (27.7)	26 (31.7)	.55
35-54 (n =46)	17 (32.1)	.32	20 (31.3)	.32	10 (17.5)	.05	28 (29.8)	19 (23.2)	.32
>55(n =39)	13 (24.5)	.69	17 (26.6)	.32	9 (15.8)	.13	31 (33)	8 (9.8)	**<.001**
Gender		***P***		***P***		***P***			***P***
Females, (n =92)	32 (56.6)	.368	35(56.9)	.271	26 (40.7)	.046	60 (61.9)	33 (40.2)	**.004**
Males, (n =86)	21 (43.4)		30 (43.1)		33 (59.6)		37 (38.1)	49 (59.8)	
Ethnicity		***P^b***		***P^b***		***P^b***			***P^d***
Caucasian (n =71)	29 (55)	.01	32 (50.8)	.06	10 (27.1)	**<.001**	52 (5.6)	20 (24.4)	**<.001**
Māori (n =17)	5 (11)	.92	5(4.6)	.48	7 (11.9)	.48	6 (6.2)	11 (13.4)	.11
Pasifika (n =16)	5 (5.7)	.92	4 (7.7)	.32	7(11.9)	.37	4 (4.1)	12 (14.6)	.01
Asian (n =60)	11 (21)	.03	18 (24.6)	.27	29 (39)	**<.001**	28 (28.9)	31 (37.8)	.19
Other (n =14)	3 (7.5)	.37	6 (12.3)	.76	6 (10.2)	.55	7 (7.2)	8 (9.8)	.55
Education		***P^a***		***P^a***		***P^a***			***P^c***
School (n =44)	15 (29)	.48	13 (20)	.23	16 (28.1)	.55	19 (19.8)	26 (32.5)	.06
Other education. (n =64)	17 (33)	.62	21 (32.3)	.48	24 (42.1)	.23	33 (34.4)	30 (37.5)	.69
Undergrad. (n =53)	14 (27)	.48	26 (40)	.04	13 (22.8)	.13	34 (35.4)	19 (23.8)	.09
Postgrad (n =14)	6 (12)	.37	5 (7.7)	.76	4 (7)	.62	10 (10.4)	5 (6.3)	.32
Income		***P^b***		***P^b***		***P^b***			***P^d***
<$30,000 (n =68)	12 (25.5)	.01	21(36.2)	.27	33 (63.5)	**<.001**	16 (16.5)	52 (63.4)	**<.001**
$30–50,000 (n =24)	8 (17)	.69	9 (15.5)	.92	7 (13.5)	.69	13 (16.3)	11 (13.9)	.69
$50–70,000 (n =31)	13 (27.7)	.11	10 (17.2)	.55	8 (15.4)	.32	23 (28.7)	8 (10.1)	**.003**
$70–90,000 (n =22)	7 (14.9)	.84	12 (20.7)	.07	3 (5.8)	.04	17 (21.3)	5 (6.3)	.01
>$90,000 (n =14)	7 (14.9)	.09	6 (10.3)	.62	1 (1.9)	.03	11 (13.8)	3(3.8)	.03

All values are in n (%). Significance assessed by chi square test for homogeneity and post hoc tests with Bonferroni adjustment. After Bonferroni correction, statistical significance was accepted at new alpha levels.

[a]Bonferroni p value: 0.0042
[b]Bonferroni p value: 0.003
[c]Bonferroni p value: 0.006
[d]Bonferroni p value: 0.005

Table 4.5

Chi square comparisons to determine SEDep differences in the consumption of recommended intakes of stroke risk-reducing foods and evidence-based intakes of stroke risk-increasing foods

		NZDep2018				**NZiDep**		
		Low	Medium	High	χ^2	Low	High	χ^2
Stroke risk-reducing food items	Wholegrains	7 (13.2)	4(6.2)	9(14.8)	2.66	12(12.5)	9(11.1)	.08
	Low-fat milk	16 (30.2)	12 (18.5)	15 (24.6)	2.22	29(30.2)	15(18.5)	3.21
	Soy	12 (23.1)	10 (15.6)	8 (13.6)	1.98	18(18.8)	12(14.8)	.48
	Full fat yoghurt	18(34.6)	17(26.6)	19(32.2)	.948	36(37.5)	17(21)	5.710**
	Tea	5(9.6)	7(10.9)	3(5.1)	.630	11(11.5)	2(2.5)	5.217*
	Cocoa	32(60.4)	36(55.4)	35(57.4)	.299	53(55.2)	47(58)	.142
	Fermented milk	0	0	0		0	0	
	Coffee	5(9.4)	3(4.6)	4(6.6)	.568	8(8.3)	5(6.2)	.301
	Full -fat cheese	15(28.8)	7(10.9)	8(13.6)	7.28*	22(22.9)	8(9.9)	5.307*
	Alcohol intake	15(28.8)	13(20.3)	5(8.5)	7.64*	23(24)	9(11.1)	4.896*
	Fruits	20(38.5)	13(20.3)	14(23.7)	5.25	33(34.4)	14(17.3)	6.580**
	Vegetables	13(24.5)	14(21.5)	7(11.5)	3.570	24(25)	7(8.6)	9.016**
Stroke risk-increasing food items	Low-fat yoghurt	3 (5.8)	7(10.8)	5(8.2)	.629	9(9.1)	6(6.9)	.229
	Glycaemic load	37(71.2)	41(64.1)	38(64.4)	.786	67(69.8)	50(53.5)	1.275
	Fried meat	13(25)	19(29.7)	27(45.8)	6.068*	25(6)	34(42)	5.019*
	Full fat milk	10(19.2)	14(21.9)	9(15.3)	.579	16(16.7)	17(21)	.541
	Sugar drinks	12(23.1)	15(23.4)	29(49.2)	12.04**	19(19.8)	36(44.4)	12.466***
	Artificial drinks	12(23.1)	9(14.1)	21(35.6)	7.84*	18(18.8)	24(29.6)	2.873
	Unprocessed meat	12(22.6)	8(12.3)	18(29.5)	5.657	21(21.9)	14(17.3)	.584
	Processed meat	8(15.4)	9(14.1)	10(16.9)	.196	15(15.6)	11(13.6)	.147
	Alcohol intake	13(25)	18(28.1)	32(54.2)	12.97**	30(31.3)	35(43.2)	2.704

$^*p < .05$, $^{**}p < .01$, $^{***}p < .001$

A risk-reducing intake of tea, full-fat yoghurt, full-fat cheese, alcohol, fruits and vegetables was significantly more prevalent in the low NZiDep decile compared to the high NZiDep decile. In the high NZiDep decile, risk-increasing intake of fried meat and sugar-sweetened drinks was significantly greater compared to the low NZiDep decile.

4.3.2.2 Risk-reducing food index scores across demographic and SEDep categories

The food index score described henceforth in the following section refers to the number of foods that are consumed at threshold levels indicated in Table 4.1. In this section, higher risk-reducing food index scores indicate consumption of more risk-reducing food items in the Dietary Habits Questionnaire.

The Kruskal Wallis analysis evidenced median scores were significantly different across tertiles of NZDep2018, $\chi^2(2) = 13.845$, $p < .001$. Post hoc comparisons after Bonferroni correction (significant difference accepted at corrected alpha level of .017) demonstrated significantly higher scores in the low NZDep2018 tertiles (*Mdn* = 3) compared to medium (*Mdn* = 2), $p = .001$ and high (*Mdn* = 2), $p = .002$. Median scores were also significantly different across income categories, $\chi^2(4) = 17.524$, $p = .015$. For income comparisons, significant differences (accepted at corrected *alpha* level of <.005 after Bonferroni correction) were observed between <$30,000 p/a earners (*Mdn* = 2) and >$90,000 p/a earners (*Mdn* = 4), $p < .001$. Significant differences were also observed between $70–90,000 p/a earners (*Mdn* = 2) and >$90,000 p/a earners, $p = .002$. As the scores were not similar across age, ethnicity and education categories, values for these comparisons are in mean ranks unless otherwise stated. Scores were significantly different across age groups, $\chi^2(3) = 19.625$, $p < .001$. For age comparisons, significant differences (accepted at corrected alpha level of < .0083) were observed in scores between <25 (68.14) and >55 year olds (114.05), $p < .001$. Significant differences were also observed between 25–35-year-olds (77.94) and >55 year olds, $p < .001$, but not between any other group combinations. The mean ranks of stroke risk-reducing food index scores were significantly across ethnic groups, $\chi^2(4) = 30.239$, $p < .001$. For ethnic comparisons, significant differences (accepted at corrected alpha level of < .005) were observed in scores between Asians (61.98) and Caucasians (110.08), $p < .001$ but not between any other group combinations. While mean rank of scores differed across education categories, these differences were not significant, $p = .855$.

Independent samples Mann-Whitney U tests were run to determine if there were differences in scores between males and females, as well as high and low NZiDep deciles. Distributions of the scores across gender and NZiDep categories were similar, as assessed by visual inspection of boxplots. Scores were significantly higher in the low NZiDep decile (*Mdn* = 3) compared to high (*Mdn* = 2), $U = 2457$, $z = -4.289$, $p < .001$. However, scores for males (*Mdn* =2) were not significantly different to females (*Mdn* = 2), $p = .062$.

4.3.2.3 Risk-increasing food index scores across demographic and SEDep categories

Kruskal Wallis test results showed scores were significantly different between age groups, $\chi^2(3) = 20.168$, $p < .001$. Post hoc analysis revealed significant differences (at Bonferroni corrected alpha level of .008) in scores between <25 (*Mdn* = 3) and >55 year olds (*Mdn* = 2), $p < .001$; between 25–35 (*Mdn* = 3) and >55 year olds, $p < .001$; between 35–54 (*Mdn* = 2) and 25–34 year olds, $p = .002$; between 35–54 and <25-year-olds, $p = .003$. No other group combinations were significant. Similarly, median scores were significantly different across tertiles of NZDep2018, $\chi^2(2) = 15.019$, $p = .001$. Significant differences (at corrected alpha level of < .017) were observed in scores between medium (*Mdn* = 2) and high NZDep2018 tertiles (*Mdn* = 3), $p < .001$ and between high and low (*Mdn* = 2) NZDep2018 tertiles, $p < .001$.

Scores differed across categories of education, but the differences were not significant, $p = .176$. As distribution of scores were not similar across ethnicity categories, values for these comparisons are in mean ranks unless otherwise stated. Scores were significantly different across ethnic groups, $\chi^2(4) = 13.158$, $p = .011$. Significant differences (at corrected alpha level of < .005) were observed in scores between Asians (102.15) and Caucasians (72.79), $p < .001$; but not between any other group pairs.

While the scores between income categories differed significantly, $\chi^2(4) = 11.273$, $p = .024$, none of the pairwise comparisons were significant at the $p < .005$ level. Based on Mann-Whitney U results, scores were significantly lower in the low NZiDep decile (*Mdn* = 2) compared to high (*Mdn* = 3), $U = 4632$, $z = 2.232$, $p = .026$. Nonetheless, median index scores for males (*Mdn* =3) and females (*Mdn* =2) were not significantly different, $p = .157$.

4.3.2.4 Overall diet quality index scores across demographic and SEDep categories

Kruskal Wallis test results showed median scores of overall diet quality were significantly different across age groups, $\chi^2(3) = 37.702$, $p < .001$. Post hoc analysis revealed significant differences (at Bonferroni corrected alpha level of < .0083) in scores between <25 (*Mdn* = 8) and >55-year-olds (*Mdn* = 10), $p < .001$; between 25–35 (*Mdn* = 8) and >55-year-olds, $p < .001$; between 35–54 (*Mdn* = 9) and 25–34-year-olds, $p < .001$; and between 35–54 and <25-year-olds, $p < .001$. However no other group combinations were significant.

Similarly, scores were significantly different across tertiles of NZDep2018, $\chi^2(2) = 19.169$, $p < .001$. Post hoc analysis revealed significant difference (at corrected alpha level of <.017) in scores between high (*Mdn* = 8) and low (*Mdn* = 10) NZDep2018 tertiles, $p < .001$; but not between other category combinations. Scores were also significantly different across income categories, $\chi^2(4) = 17.708$, $p < .001$. Significant differences in scores (at corrected alpha level of < .005) were seen between <$30,000 p/a earners (*Mdn* = 8) and >$90,000 p/a earners (*Mdn* = 11), $p < .001$; between $30–50,000 p/a earners (*Mdn* = 9) and >$90,000 p/a earners, $p = .004$; and between $50–70,000 (*Mdn* = 9) and >$90,000 p/a earners, $p = .005$.

Scores across education categories were not significant, $p = .317$. As distribution of scores were not similar across ethnicity categories, values for these comparisons are in mean ranks unless otherwise stated. Scores were significantly different across ethnic groups, $\chi^2(4) = 39.760$, $p < .001$. Post hoc analysis revealed significant difference (at corrected alpha level of < .00) in scores between Asians (61.18) and Caucasians (116.65), $p < .001$; but not between any other group combinations. Based on Mann-Whitney U results, scores were significantly higher in the low NZiDep decile (*Mdn* = 9) compared to high (*Mdn* = 8), $U = 2206$, $z = -5.008$, $p < .001$. Scores were also significantly higher for females (*Mdn* = 9) compared to males (*Mdn* = 8), $U = 3056$ $z = -2.648$, $p = .008$.

4.3.2.5 Hierarchical regression pre-test diagnostics and model fit

Prior to running the regression analyses, assumptions for performing the test were assessed for each dietary habit index score distribution (Section 4.2.6.2). All assumptions were met for performing the regression. One outlier was identified that had a studentised deleted residual >±3. However, as this observation was not due to data entry errors and a genuine observation that was extreme from the norm, the outlier was retained in the data analysis. This point did not have a leverage value >0.2)/ Cook's value above 1.

A hierarchical multiple regression was performed to determine if the stepwise addition of individual measures of SEDep (NZiDep, income and education), followed by NZDep2018 improved the prediction of *stroke risk-reducing food index scores* over and above covariates alone. The full model of covariates, education, income, NZiDep and NZDep2018 scores to predict risk-reducing food index scores (Table 4.6) was significant (Model 1d). In model 1a, covariates contributed significantly to the regression model. Education (Model 1b) and income (Model 1c) did not significantly add to prediction of the index scores. Change in R^2 upon introducing the NZiDep variable (Model 1d) was significant. The predicted score for the high NZiDep decile was .803 units significantly lower than that predicted for the low NZiDep decile (with all values of all other predictor variables being held constant). Furthermore, change in R^2 upon adding the NZDep2018 variable to the regression model (Model 1e) was significant. The predicted score for the medium NZDep2018 tertile was 1.02 units significantly lower, and for the high NZDep2018 tertile was .603 units significantly lower compared to that predicted for the low NZDep2018 tertile.

Table 4.6

Summary of Hierarchical Regression Analysis for Variables Predicting Stroke risk-reducing food index scores

		Model 1a		Model 1b		Model 1c		Model 1d		Model 1e	
		B	β	B	β	B	β	B	β	B	B
	Constant	9.006		8.956		9.061		9.856		10.353	
	Gender	.130	.041	.132	.042	.071	.023	.194	.062	.191	.061
Age	25–34 vs others	.242	.070	.337	.098	.305	.089	.201	.058	.280	.081
	34–54 vs others	.602	.175	.748	.218*	.712	.207	.658	.191	.691	.201
	>55 vs others	.937	.230	1.083	.266**	1.001	.246*	.761	.187	.954	.234*
Ethnicity	Māori vs Caucasian	-.224	-.045	-.275	-.056	-.159	-.032	.023	.005	-.049	-.010
	Pasifika vs Caucasian	-.672	-.125	-.728	-.135	-.598	-.111	-.454	-.084	-.532	-.099
	Asian vs Caucasian	-1.21	-.353***	-1.214	-.356***	-.938	-.275**	-.965	-.283**	-.922	-.270**
	Other vs Caucasian	-.423	-.079	-.394	-.073	-.108	-.020	-.150	-.028	-.155	-.029
Education	Other education. vs school			.081	.025	-.035	-.011	-.053	-.016	-.007	-.002
	Undergrad. vs school			-.345	-.101	-.459	-.135	-.530	-.155	-.365	-.107
	Postgrad vs school			-.649	-.113	-.759	-.132	-.731	-.127	-.791	-.137
Income	$30–50,000 vs <$30,000					.382	.090	.193	.045	.156	.036
	$50–70,000 vs <$30,000					.117	.029	-.171	-.043	-.225	-.057
	$70–90,000 vs <$30,000					-.127	-.028	-.460	-.102	-.350	-.078
	>$90,000 vs <$30,000					1.126	.209*	.783	.146	.715	.133
	NZiDep							-.803	-.256**	-.594	-.190*
	NZDep2018										
	Medium vs Low									-1.024	-.316***
	High vs Low									-.603	-.182*
	R^2	.195		.217		.257		.303		.366	
	F	4.279***		3.468***		3.095***		3.609***		4.204***	
	ΔR^2	.195		.021		.041		.045		.063	
	ΔF	4.279***		1.245		1.838		8.663**		6.552**	

Note: Age, ethnicity, education and income and NZDep2018 was represented as three dummy variables with <25 years serving as the reference group (for age), Caucasian as the reference group (ethnicity), school as reference for education, <$30,000 p/a as reference for income and low NZDep2018 as the reference group.*p < .05. **p < .01, ***p < .001

The next stage was to perform hierarchical multiple regression to determine if the stepwise addition of individual measures of SEDep (NZiDep, income and education), followed by NZDep2018 improved the prediction *of stroke risk-increasing food index scores* over and above covariates alone. Table 4.7 provides full details on each regression model. The full model of covariates, individual and NZDep2018 to predict scores (Model 2e) was significant. In model 2a, covariates contributed significantly to the regression model. Introducing the education variable (Model 2b), income variable (Model 2c) and NZiDep variable (Model 2d) did not account for any significant variation in index scores. Change in R^2 upon addition of the NZDep2018 variable (Model 2e) was significant. The predicted score for the high NZDep2018 tertile was .719 units significantly higher than that for low NZDep2018 tertile.

Table 4.8 provides full details on the hierarchical regression performed to determine if stepwise addition of individual measures of SEDep (NZiDep, income and education), followed by NZDep2018 improved the prediction of *overall diet quality score* over and above covariates alone. The full model (Model 3e) to predict scores was significant. In model 3a, covariates contributed significantly to the regression model. While education (Model 3b) did not account for a significant variation in index scores, change in in R^2 upon introducing the income variable (Model 3c) was significant. Introducing the NZiDep variable (Model 3d) explained an additional 3.9% of variation in index scores and this change in R^2 was significant. The predicted score for the high NZiDep decile was .819 units significantly lower than that predicted for the low NZiDep decile (with all values of all other predictor variables being held constant). Change in R^2 upon adding the NZDep2018 variable to the regression model (Model 3e) was significant. Predicted scores for the medium NZDep2018 tertile was 1.02 units significantly lower, and for the high NZDep2018 tertile was 1.334 units significantly lower than that predicted for the low NZDep2018 tertile.

Table 4.7

Summary of Hierarchical Regression Analysis for Variables Predicting Stroke risk-increasing food index scores

		Model 2a		Model 2b		Model 2c		Model 2d		Model 2e	
		B	β	B	β	B	β	B	β	B	β
	Constant	2.304		2.394		2.123		1.932		1.801	
	Gender	.052	.016	.019	.006	.204	.063	.164	.050	.105	.032
Age	25–34 vs others	.369	.104	.516	.145	.437	.123	.471	.132	.499	.140
	34–54 vs others	-.571	-.160	-.378	-.106	-.270	-.076	-.253	-.071	-.220	-.062
	>55 vs others	-.468	-.111	-.455	-.108	-.580	-.137	-.502	-.119	-.552	-.131
Ethnicity	Māori vs Caucasian	.730	.143	.735	.144	.727	.142	.668	.131	.526	.103
	Pasifika vs Caucasian	1.071	.192*	.976	.175*	.946	.170	.899	.161	.772	.138
	Asian vs Caucasian	.555	.157	.633	.179	.742	.210	.751	.212*	.554	.157
	Other vs Caucasian	.279	.050	.463	.083	.517	.093	.531	.095	.376	.067
Education	Other education. vs school			-.156	-.046	-.147	-.044	-.141	-.042	-.194	-.057
	Undergrad. vs school			-.555	-.157	-.686	-.194	-.663	-.187	-.664	-.188
	Postgrad vs school			.169	.028	.195	.033	.186	.031	.171	.029
Income	$30–50,000 vs <$30,000					.491	.111	.552	.125	.654	.148
	$50–70,000 vs <$30,000					.869	.212*	.962	.234*	.979	.238
	$70–90,000 vs <$30,000					-.213	-.046	-.106	-.023	.052	.011*
	>$90,000 vs <$30,000					-.181	-.033	-.071	-.013	.070	.013
	NZiDep							.259	.080	.207	.064
	NZDep2018										
	Medium vs Low									.007	.002
	High vs Low									.719	.209*
	R^2	.123		.141		.191		.195		.231	
	F	2.464*		2.056*		2.108**		2.017*		2.181**	
	ΔR^2	.123		.018		.050		.004		.035	
	ΔF	2.464*		.973		2.073		.726		3.002*	

Note: Age, ethnicity, education and income and NZDep2018 was represented as three dummy variables with <25 years serving as the reference group (for age), Caucasian as the reference group (ethnicity), school as reference for education, <$30,000 p/a as reference for income and low NZDep2018 as the reference group.*p < .05. **p < .01, ***p < .001

Table 4.8

Summary of Hierarchical Regression Analysis for Variables Predicting overall diet quality scores

		Model 3a		Model 3b		Model 3c		Model 3d		Model 3e	
		B	β	B	β	B	β	B	β	B	β
	Constant	9.006		8.956		9.061		9.856		10.353	
	Gender	.100	.022	.136	.030	-.106	-.023	.060	.013	.117	.026
Age	25–34 vs others	-.153	-.031	-.207	-.042	-.167	-.034	-.307	-.062	-.257	-.052
	34–54 vs others	1.168	.235*	1.117	.225*	.964	.194	.890	.179	.891	.179
	>55 vs others	1.395	.237**	1.526	.259**	1.559	.265**	1.237	.210*	1.480	.252**
Ethnicity	Māori vs Caucasian	-.951	-.133	-1.007	-.141	-.879	-.123	-.635	-.089	-.561	-.079
	Pasifika vs Caucasian	-1.750	-.225**	-1.711	-.220	-1.548	-.199*	-1.354	-.174*	-1.302	-.168*
	Asian vs Caucasian	-1.791	-.363***	-1.876	-.381***	-1.706	-.346***	-1.742	-.353***	-1.498	-.304**
	Other vs Caucasian	-.708	-.091	-.864	-.111	-.627	-.081	-.683	-.088	-.529	-.068
Education	Other education. vs school			.229	.049	.102	.022	.079	.017	.177	.038
	Undergrad. vs school			.221	.045	.233	.047	.137	.028	.302	.061
	Postgrad vs school			-.815	-.098	-.952	-.114	-.915	-.110	-.958	-.115
Income	$30–50,000 vs <$30,000					-.090	-.015	-.345	-.056	-.486	-.079
	$50–70,000 vs <$30,000					-.727	-.127	-1.114	-.195	-1.185	-.207
	$70–90,000 vs <$30,000					.111	.017	-.336	-.052*	-.389	-.060*
	>$90,000 vs <$30,000					1.324	.170*	.862	.111	.651	.084
	NZiDep							-1.079	-.239**	-.819	-.181*
	NZDep2018										
	Medium vs Low									-1.024	-.22**
	High vs Low									-1.334	-.28**
	R^2	.274		.288		.336		.375		.424	
	F	6.656***		5.074***		4.516***		4.990***		5.363***	
	ΔR^2	.274		.014		.048		.039		.049	
	ΔF	6.656***		.894		2.412*		8.371**		5.592**	

Note: Age, ethnicity, education and income and NZDep2018 was represented as three dummy variables with <25 years serving as the reference group (for age), Caucasian as the reference group (ethnicity), school as reference for education, <$30,000 p/a as reference for income and low NZDep2018 as the reference group.*p < .05. **p < .01, ***p < 0.001

4.3.3 Secondary outcome measure: Food choice motivations

4.3.3.1 Spearman's rank order correlations

Spearman's rank-order correlations were run to assess the relationship between food choice motivation scores (nine categories from the Food Choice Questionnaire) in the sample. Preliminary analysis showed the relationships to be linear as assessed by visual inspection of scatterplots. However, due to non-normal distributions as assessed by the Shapiro Wilk test, Spearman's correlations as opposed to Pearson's correlations were run.

Table 4.9 displays these correlations and their significance. There were significant, positive correlations in absolute importance scores driven by the following pairs of food choice motivations: (1) health and all other food choices except convenience, familiarity and price, (2) mood and all food choices except natural content and ethical concern, (3) natural content and ethical concern, (4) convenience and sensory appeal, familiarity, price and family preferences, (5) sensory appeal and ethical concern, familiarity, price and family preferences, (6) familiarity and price and family preferences, and (7) price and family preferences. Ethical concern was negatively correlated with price-based food choices.

In terms of relative importance scores, significant positive correlations were observed between food choice motivations driven by: (1) health and natural content and ethical concern, (2) mood and familiarity, (3) natural content and ethical concern and price, (4) convenience and familiarity, price and family preferences, (5) familiarity and family preference and price, and (6) price and family preference. Negative correlations were observed in relative importance scores between: (1) health and mood, convenience and familiarity, price and family preferences, (2) weight control and mood, convenience, familiarity and price, (3) mood and natural content and ethical concern, (4) natural content and family preference, (5) convenience and sensory appeal and ethical concern, (6) sensory appeal and familiarity, (7) familiarity and ethical concern, and (8) ethical concern and price and family preference.

Table 4.9

Spearman's rank correlations between absolute and relative (shaded) importance scores of food choice motivations

	Health	Weight Control	Mood	Natural Content	Overall Convenience	Sensory Appeal	Familiarity	Ethical Concern	Price	Family
Health		.37***	.30***	.59***	.16*	.38***	.09	.42***	.04	.03
Weight Control			.26***	.23**	.14	.36***	.14	.18*	.11	.15*
Mood				.07	.53***	.56***	.65***	.08	.36***	.42***
Natural Content					-.07	.14	-.05	.44***	-.14	-.09
Overall Convenience						.311**	.58***	-.05	.60***	.46***
Sensory Appeal							.36***	.28***	.23**	.28***
Familiarity								.01	.43***	.66***
Ethical Concern									-.20***	-.07
Price										.48***
	Health	Weight Control	Mood	Natural Content	Overall Convenience	Sensory Appeal	Familiarity	Ethical Concern	Price	Family
Health		.12	-.37***	.51***	-.45***	.001	-.57***	.26***	-.39***	-.42***
Weight Control			-.25***	.07	-.29***	-.06	-.28***	.003	-.21**	-.13
Mood				-.40***	.05	.06	.34***	-.32***	-.01	.11
Natural Content					-.48***	-.11	-.45***	.39***	.40***	-.40***
Overall Convenience						-.23**	.29***	-.43***	.41***	.20**
Sensory Appeal							-.20**	.01	-.14	-.12
Familiarity								-.35***	.16*	.53***
Ethical Concern									-.49***	-.33***
Price										.32***

Note: Correlation coefficients are provided. Negative coefficients indicate a negative correlation
*$p < .05$. **$p < .01$, ***$p < .001$

4.3.3.2 Comparison of food choice scores across demographic and SEDep categories

Table 4.10 and Table 4.11 show the median or mean ranks for absolute and relative importance scores for each food choice motive across demographic and SEDep categories. The following sections report the results of the Kruskal-Wallis H test and post hoc comparisons of the absolute and relative importance scores of food choice motivations across demographic and SEDep variables (Mann-Whitney U tests for dichotomous variables). Significant differences were accepted at new alpha levels after Bonferroni adjustment. Table 4.12 displays the results of post hoc comparisons.

4.3.3.2.1 Gender differences

Absolute importance scores for food choice motivations based on convenience, U = 4826, z = 2.246, p = .025, familiarity U = 4880, z = 2.406, p = .016, price U = 4781, z = 2.133, p = .033 and convenience related to food preparation time U = 4937, z = 2.577, p = .010 significantly differed between males and females. Similarly, median relative importance scores for food choice motivations based on convenience, U = 4799, z = 2.159, p = *.031*, familiarity, U = 4860, z = 2.332, p = .020, and convenience related to food preparation time, U = 4933, z = 2.542, p = .011, differed significantly between males and females.

4.3.3.2.2 Age category differences

Absolute importance scores for food choice motivations based on weight control, $\chi^2(3)$ = 7.970, p = .047, natural content, $\chi^2(3)$ = 14.363, p = .002, ethical concern, $\chi^2(3)$ = 17.633, p = .001 and price, $\chi^2(3)$ = 19.760, p < .001, differed significantly across age groups. Relative scores for food choice motivations based on weight control, $\chi^2(3)$ = 15.254, p = .002, mood, $\chi^2(3)$ = 15.046, p = .002, natural content, $\chi^2(3)$ = 16.847, p = .001, overall convenience, $\chi^2(3)$ = 13.427, p = .004, ethical concern, $\chi^2(3)$ = 21.418, p < .001, price, $\chi^2(3)$ = 31.747, p < .001 and convenience related to food preparation time, $\chi^2(3)$ = 10.680, p = .014, also differed significantly across age groups.

Table 4.10

Nonparametric comparisons of relative importance food choice motivation scores across demographic and SEDep categories

		Health	Weight control	Mood	Natural content	Overall Conv.*	Sensory appeal	Familiarity	Ethical concern	Price	Family preferences	Food prep	Food access
Age	<25	1	0.77	0.98	75.79 [a]	1.14	1.07	0.96	0.8	125.21 [a]	0.96	1.12	1.14
	25–34	1.1	0.87	1.01	85.21 [a]	1.09	1.08	0.99	0.83	90.19 [a]	1.03	1.07	1.15
	35-54	1.1	0.96	0.92	86.05 [a]	1.07	1.09	0.91	0.93	80.01 [a]	0.96	1.04	1.13
	>55	1.1	0.85	0.92	118.04 [a]	1	1.1	0.97	1.02	62.04 [a]	0.85	0.97	1.09
Ethnicity	Māori	62.85 [a]	0.87	0.99	0.99	1.15	1.1	0.99	89.47 [a]	1.12	1.05	1.15	1.16
	Pasifika	86.25 [a]	0.83	1.01	1.04	1.11	1.07	0.99	99.69 [a]	1.08	0.88	1.12	1.07
	Caucasian	105.72 [a]	0.87	0.92	1.04	1.05	1.12	0.89	105.72 [a]	1.01	0.89	1.01	1.11
	Asian	82.93 [a]	0.87	1.01	1.01	1.09	1.06	1	76.91 [a]	1.15	1.02	1.07	1.12
	Other	83.63 [a]	0.94	0.96	0.96	1.12	1.07	0.93	63.20 [a]	1.18	0.93	1.07	1.15
Gender	Females	1.1	3.33	85.77 [a]	1	1.05	1.1	0.91	0.88	1.07	3	80.95[a]	1.11
	Males	1	3	95.55 [a]	1.03	1.1	1.07	0.99	0.85	1.12	4	100.7 [a]	1.12
Education	School	84.18 [a]	77.24 [a]	0.98	1.03	4	80.93 [a]	0.98	0.83	99.36 [a]	1.01	1.12	1.11
	Other education	96.28 [a]	94.22 [a]	0.98	1.04	3.8	82.36 [a]	0.93	0.91	87.27 [a]	0.97	1.01	1.09
	Undergrad	90.16 [a]	93.47 [a]	0.94	0.97	4.2	92.9 [a]	0.93	0.87	87.35 [a]	0.99	1.05	1.17
	Postgrad	68.27 [a]	86.20 [a]	0.93	1.11	3.6	127.77 [a]	1	0.92	71.17 [a]	0.8	0.99	1.13
Income	<$30,000	71.54 [a]	72.04 [a]	1.00	68.50 [a]	4.10	1.09	1.00	0.84	1.19	4.00	1.10	1.12
	$30–50,000	83.46 [a]	76.71 [a]	0.98	89.31 [a]	4.20	1.08	0.96	0.82	1.09	4.00	1	1.14
	$50–70,000	84.80 [a]	82.50 [a]	0.97	81.48 [a]	3.90	1.09	0.94	0.86	1.06	4.00	0.99	1.16
	$70–90,000	84.52 [a]	96.70 [a]	0.95	97 [a]	3.90	1.08	0.90	0.93	1.05	3.00	1.02	1.05
	>$90,000	102.79 [a]	98.07 [a]	0.89	95 [a]	3.80	1.12	0.89	0.96	0.88	3.00	1.10	1.10
NZDep 2018	Low	87.66 [a]	0.9	0.93	1.03	1.09	1.1	0.91	0.91	1.04	89.99 [a]	1.04	1.11
	Medium	95.82 [a]	0.86	0.96	1.01	1.06	1.1	0.93	0.87	1.1	86.02 [a]	1.04	1.13
	High	82.69 [a]	0.85	0.99	1.01	1.09	1.08	1	0.85	1.12	91.40 [a]	1.09	1.11
NZiDep	Low	1.1	0.88	0.94	1.03	1.05	1.1	78.75 [a]	102.49 [a]	1.01	80.89 [a]	0.99	1.12
	High	1	0.86	0.98	0.99	.12	1.07	103.30 [a]	75.22 [a]	1.2	100.77 [a]	1.11	1.11

[a]Values are in mean ranks
*Conv: Overall convenience

Table 4.11

Nonparametric comparisons of absolute importance food choice motivation scores across demographic and SEDep categories

		Health	Weight control	Mood	Natural content	Overall Conv.*	Sensory appeal	Familiarity	Ethical concern	Price	Family preferences	Food prep	Food access
Age	<25	3.8	72.24 [a]	3.67	3.67	104.24 [a]	4	3.67	74.09 [a]	115.97 [a]	87.90	4	97.46 [a]
	25–34	3.8	92.38 [a]	3.83	3.83	95.13 [a]	4	4	79.81 [a]	93.54 [a]	102.44	4	98.19 [a]
	35-54	3.8	102.36 [a]	3.33	3.67	82.07 [a]	4	3.33	87.67 [a]	78.59 [a]	84.43	4	83.77 [a]
	>55	4	86.15 [a]	3.33	4	73.94 [a]	4	3.33	117.77 [a]	68.63 [a]	77.69	3.67	74.59 [a]
Ethnicity	Māori	62.56 [a]	93.03	102.18 [a]	3.83	105.85 [a]	91.29 [a]	102.18 [a]	0.87	90.56 [a]	107.21 [a]	106.29 [a]	102.71 [a]
	Pasifika	105.78 [a]	88.91	98.25 [a]	3.92	108.75 [a]	108.56 [a]	105.78 [a]	0.92	112.25 [a]	92.69 [a]	118.16 [a]	89.53 [a]
	Caucasian	87.88 [a]	81.15	69.83 [a]	3.67	68.9 [a]	82.41 [a]	70.15 [a]	0.94	67.01 [a]	74.41 [a]	68.75 [a]	75.65 [a]
	Asian	103.43 [a]	100.08	112.78 [a]	3.83	109.51 [a]	100.03 [a]	107.91 [a]	0.83	113.09 [a]	105.44 [a]	106.94 [a]	107.05 [a]
	Other	66.73 [a]	95.93	79.57 [a]	3.5	81.3 [a]	71.07 [a]	89 [a]	0.75	89.6 [a]	86.7 [a]	81.73 [a]	82.80 [a]
Gender	Females	3.8	0.88	3.5	3.67	82.11 [a]	4	3.33	3.33	3.67	.944	3.67	4
	Males	3.8	0.86	3.67	3.83	99.47 [a]	4	3.67	3	4.33	1.01	3	4
Education	School	3.8	83.62 [a]	3.33	3.67	1.11	3.75	3.67	3	4.33	88.27 [a]	4	87.53[a]
	Other	3.8	93.95 [a]	3.5	3.83	1.05	4	3.33	3.33	4.17	88.58 [a]	3.67	80.30[a]
	Undergrad	3.8	89.27 [a]	3.67	3.67	1.09	4	3.67	3.33	4	94.24 [a]	4	103.33[a]
	Postgrad	3.5	83.07 [a]	3.33	4	1.09	4.25	3.67	3.33	3.67	74.50	3.67	79.87[a]
Income	<$30,000	3.80	0.84	3.67	70.51 [a]	1.11	4.00	3.67	70.91 [a]	99.38 [a]	81.61 [a]	4	86.46[a]
	$30–50,000	3.90	0.85	3.50	93.16 [a]	1.10	4.00	3.67	85.27 [a]	77.35 [a]	83.52 [a]	3.67	89.46[a]
	$50–70,000	3.80	0.87	3.50	74.05 [a]	1.05	4.00	3.33	86.48 [a]	69.88 [a]	90.41 [a]	3.5	79.48[a]
	$70–90,000	4.00	0.93	3.67	103.11 [a]	1.05	4.00	3.50	91.48 [a]	68.50 [a]	72.30 [a]	4	67.55[a]
	>$90,000	3.80	0.94	3.09	86 [a]	1.10	3.88	3.17	87.96 [a]	37.32 [a]	60.18 [a]	3.67	58.86[a]
NZDep 2018	Low	3.8	90.70 [a]	3.33	3.67	3.8	4	77.68 [a]	3.33	77.01 [a]	0.96	4	4
	Medium	3.8	86.18 [a]	3.5	3.83	4	4	88.29 [a]	3.33	89.01 [a]	0.98	4	4
	High	4	90.58 [a]	3.67	3.83	4.2	4	99.95 [a]	3	99.76 [a]	0.98	4	4
NZiDep	Low	4	3.33	3.5	3.83	3.8	4	79.56 [a]	3.33	67.07 [a]	0.92	79.73 [a]	4
	High	3.7	3	3.67	3.75	4.2	4	102.35 [a]	3	117.12 [a]	1.04	102.15 [a]	4

[a]Values are in mean ranks

*Conv: Overall convenience

4.3.3.2.3 Ethnic category differences

Absolute importance scores for food choice motivations based on health, $\chi^2(4) = 13.385$, $p = .010$, mood, $\chi^2(4) = 24.440$, $p < .001$, overall convenience, $\chi^2(4) = 24.515$, $p < .001$, familiarity, $\chi^2(4) = 20.201$, $p < .001$, price, $\chi^2(4) = 29.466$, $p < .001$, family preferences, $\chi^2(4) = 14.798$, $p = .005$, convenience related to food preparation time, $\chi^2(4) = 25.497$, $p < .001$ and food accessibility, $\chi^2(4) = 13.754$, $p = .008$), significantly differed across groups. Relative importance scores for food choice motivations based on health, $\chi^2(4) = 13.239$, $p = .010$, mood, $\chi^2(4) = 14.160$, $p = .007$, ethical concern, $\chi^2(4) = 14.844$, $p = .005$, price, $\chi^2(4) = 11.551$, $p = .021$, differed significantly across groups.

4.3.3.2.4 Education and income category differences

Absolute importance scores for food choice motivation based on sensory appeal, $\chi^2(4) = 10.437$, $p = .015$, significantly differed across education categories. Similarly median relative importance scores for food choice motivations based on natural content, $\chi^2(3) = 13.679$, $p = .003$, convenience, $\chi^2(3) = 8.162$, $p = .043$ and sensory appeal, $\chi^2(3) = 11.093$, $p = .011$, differed significantly across education categories. Absolute importance scores for food choice motivations based on natural content, $\chi^2(4) = 11.262$, $p = .024$, and price, $\chi^2(4) = 27.489$, $p < .001$, while relative importance scores for food choice motivations based on price, $\chi^2(4) = 30.010$, $p < .001$, differed significantly across income categories.

4.3.3.2.5 NZiDep and NZDep2018 category differences

Neither of the median absolute or relative importance of food choice motivations scores were significantly different between tertiles of NZDep2018. Absolute importance scores for food choice motivations based on health, $U = 3107$, $z = -2.529$, $p = .011$, convenience, $U = 4880$, $z = 2.629$, $p = .009$, familiarity, $U = 4990$, $z = 2.954$, $p = .003$, ethical concern, $U = 3075$, $z = -2.637$, $p = .008$, price, $U = 6201$, $z = 6.522$, $p < .001$, family preferences , $U = 4862$, $z = 2.668$, $p = .008$, and convenience related to food preparation time, $U = 4973.5$, $z = 2.913$, $p = .004$, significantly differed across high and low NZiDep deciles. Relative importance scores for food choice motivations based on health, $U = 2499$, $z = -4.410$, $p < .001$, natural content, $U = 3171$, $z = -2.334$, $p = .020$, convenience, $U = 4965$, $z = 2.861$, $p = .004$, sensory appeal, $U = 3212$, $z = -2.216$, $p = .027$, familiarity, $U = 5068$, $z = 3.159$, $p = .002$, ethical concern, $U = 2765$, $z = -3.509$, $p < .001$, price, $U = 6235$, $z = 6.530$, $p < .001$, family preferences , $U = 4860$, $z = 2.558$, $p = .011$, and convenience related to food preparation time, $U = 5073.5$, $z = 3.175$, $p = .002$, also differed significantly across deciles.

Table 4.12

Post hoc comparisons of significant differences in food choice motivations across covariate, education and income categories

		Absolute Importance	**Relative Importance**
Age	<25 v. >55	Natural content, $p = .0015$[a] Ethical concern, $p < .001$[a] Price, $p < .001$[a]	Natural content, $p < .001$[a] Overall convenience, $p < .001$[a] Ethical concern, $p < .001$[a] Price, $p < .001$[a] Food prep. convenience, $p = .007$[a]
	<25 v. 35-54	Price, $p = .001$[a] Weight control, $p = .006$[a]	Price, $p < .001$[a] Weight control, $p < .001$[a]
	>55 v. 25–35	Ethical concern, $p < .001$[a]	Mood, $p = .001$[a] Ethical concern, $p < .001$[a]
	>55 v. 35-54	Natural content, $p = .001$[a] Ethical concern, $p = .006$[a]	Natural content, $p = .001$[a]
	25–35 vs <25		Price, $p = .001$[a]
	35-54 v. 25–35		Mood, $p = .006$[a]
Ethnicity	Māori v. Asian	Health, $p = .004$[b]	
	Māori v. Caucasian		Health, $p = .002$[b]
	Caucasian v. Asian	Mood, $p < .001$[b] Overall convenience, $p < .001$[b] Familiarity, $p<.001$[b] Price, $p < .001$[b] Family preferences , $p < .001$[b] Food prep. convenience, $p < .001$[b] Access convenience, $p < .001$[b]	Mood, $p =.001$[b] Ethical concern, $p = .002$[b] Price, $p = .002$[b]
	Caucasian v. Pasifika	Convenience, $p = .005$[b] Price, $p =.001$[b] Food prep. convenience, $p = .001$[b]	
	Other v. Caucasian		Ethical concern, $p = .004$[b]
Education	Undergrad. v. other education.		Natural content, $p = .003$[a]
	Undergrad. v. postgrad		Natural content, $p = .002$[a]
	School v. postgrad	Sensory appeal, $p = .008$[a]	Sensory appeal, $p = .002$ [a]
	Other education. v. postgrad		Sensory appeal, $p = .002$[a]
	Other education. v. school		Convenience, $p = .008$[a]
Income	<\$30,000 v. \$50–70,000 ()	Price, $p = .003$[b]	Price, $p = .005$[b]
	<\$30,000 v. >\$90,000	Price, $p < .001$[b]	Price, $p < .001$[b]
	<\$30,000 v. \$70-90,000	Natural content, $p = .004$[b]	Price, $p = .001$[b]

[a] Significance accepted at $p < .0083$ level (after Bonferroni adjustment)
[b] Significance accepted at $p < .005$ level (after Bonferroni adjustment)

4.3.3.3 Hierarchical regression analysis on associations between food choice motivation scores and demographic characteristics

Prior to performing the regression, assumptions for performing the test were assessed (Section 4.2.6.2) and the results are displayed in Table 4.13. While most of the assumptions were met, outliers were identified based on studentised deleted residual >±3. However, as these were not a result of data entry errors and were genuine observations, outliers were retained.

Table 4.13

Regression pre-diagnostics for meeting assumptions

	1st-order autocorrelations	Linearity	Homo-scedasticity	No multi-collinearity	Normality	Outliers
Health[a]	✓	✓	✓	✓	✓	2
Health[r]	✓	✓	✓	✓	✓	2
WC[a]	✓	✓	✓	✓	✓	✓
WC[r]	✓	✓	✓	✓	✓	✓
Mood[a]	✓	✓	✓	✓	✓	✓
Mood[r]	✓	✓	✓	✓	✓	3
Natural content[a]	✓	✓	✓	✓	✓	1
Natural content[r]	✓	✓	✓	✓	✓	1
Convenience[a]	✓	✓	✓	✓	✓	✓
Convenience[r]	✓	✓	✓	✓	✓	1
Sensory appeal[a]	✓	✓	✓	✓	✓	✓
Sensory appeal[r]	✓	✓	✓	✓	✓	✓
Familiarity[a]	✓	✓	✓	✓	✓	✓
Familiarity[r]	✓	✓	✓	✓	✓	✓
EC[a]	✓	✓	✓	✓	✓	✓
EC[r]	✓	✓	✓	✓	✓	✓
Price[a]	✓	✓	✓	✓	✓	2
Price[r]	✓	✓	✓	✓	✓	3
Family preference[a]	✓	✓	✓	✓	✓	✓
Family preferences[r]	✓	✓	✓	✓	✓	✓
Food prep. [a]	✓	✓	✓	✓	✓	1
Food prep. [r]	✓	✓	✓	✓	✓	1
Food access[a]	✓	✓	✓	✓	✓	1
Food access[r]	✓	✓	✓	✓	✓	1

[a]Absolute importance scores
[r] Relative importance scores
WC: Weight control
EC: Ethical concern

Table 4.14 displays the full regression models of significant associations between covariates, individual measures of SEDep (education, income and NZiDep) and NZDep2018, and absolute importance of food choice motivation scores. Similarly, Table 4.15 displays the final regression models for relative importance of food choice motivation scores. The full model of covariates, individual measures of SEDep (education, income and NZiDep) and NZDep2018 was not significant for predicting absolute and relative food choice motivation scores based on weight control, p = .113 and p = .090, mood, p = .101 and p =.687, sensory appeal, p = .277 and p = .617, familiarity, p = .130 and p = .488, and convenience related to food access, p =.110 and p = .189 (data not shown). Similarly, the final regression model did not significantly predict absolute importance scores based on family preferences, p = .101, and relative scores based on convenience and convenience related to food preparation time, p = .113 and p = .057 (data not shown). As the F-test of the model R^2 calculates the average contribution of the overall set of predictors, the few significant predictors found in the model were deemed inconsequential.

The final model was significant in predicting absolute food choice motivation scores based on health, overall convenience, and convenience related to food preparation time. Similarly, the final regression model was significant for predicting absolute and relative importance food choice motivation scores based on natural content and ethical concern. However, both NZiDep and NZDep2018 did not significantly account for a unique amount of variance in these scores, indicating the variance observed was primarily predicted by the covariates or other individual measures of SEDep. The education variable significantly accounted for an additional 7.8% of variation in absolute importance scores for health-based food choice motivation scores, additional 9.5% in absolute importance scores and 4.7% of variation in relative importance scores for the natural-content based food choice motivation, and additional 7.2% in absolute importance scores and 4.2% of variation in relative importance scores for the ethical-concern-based food choice motivation (data not shown).

The full model was significant for predicting absolute importance scores and relative importance scores for the price-based food choice motivation (Model 4e, Table 4.14 and Model 5c, Table 4.15). Covariates significantly accounted for an additional 20.1% of the variation in absolute importance scores and 17.1% of the variation in relative importance scores. Education and income did not significantly account for additional variation in absolute importance scores, *p* = .660 and *p* = .108, respectively. Nonetheless, income explained an additional 5.8% of variation in relative importance scores and this change in R^2 was significant. The addition of the NZiDep variable significantly accounted for an additional 8.9% of variation in absolute importance scores and additional 8.7% of variation in relative importance scores. High NZiDep predicted .644 units significantly higher absolute importance scores and .175 units significantly higher relative importance scores for price -based food choice motivation than that predicted for low NZiDep (with all values of all other predictor variables being held constant). Adding NZDep2018 to the regression model did not significantly account for additional variation in absolute important scores, *p* = .991 nor relative importance scores, *p* = .738.

4.3.3.4 Hierarchical regression analysis on associations between food choice motivation scores and diet quality

All assumptions for performing the regression previously outlined in Section 4.2.6.2 were met. Table 4.16 demonstrates only significant, final regression models and the variances described are those above and beyond demographic factors and other food choice motivations. Introducing mood-based food choice motivation scores to the regression model significantly explained an additional 2.1% of variance in risk-reducing food index scores and 3.1% of variance in overall diet quality index scores. An increase in mood-based scores of 1 unit was associated with a significant decrease in risk-reducing food index score of .54 units and overall diet quality index score of .95 units. Addition of price-based food choice motivation scores to the regression model significantly explained an additional 2.1% of variance in risk-reducing food index scores and 2.3% of variance in overall diet quality index scores. An increase in price-based scores of 1 unit was associated with a significant decrease in risk-reducing food index score of .40 units and overall diet quality index score of .59 units. The addition of natural-content-based food choice motivation scores to the regression model significantly explained an additional 2.6% of variance in risk-increasing food index scores and this change in R^2 was significant. An increase in natural-content-based scores of 1 unit was associated with a significant decrease in risk-increasing food index score of .47 units.

Table 4.14

Significant final model (covariates, individual and NZDep2018) of hierarchical regression analyses for variables predicting absolute importance scores of food choice motivations based on health, natural content, overall convenience, ethical concern, price and food convenience related to food preparation times

		Model 4a: Health		Model 4b: Natural content		Model 4c: Overall convenience		Model 4d: Ethical concern		Model 4e: Price		Model 4f: Food preparation time	
		B	β	B	β	B	β	B	β	B	β	B	β
	Constant	3.476		2.895		3.683		2.750		3.751		3.521	
	Gender	-.026	-.021	.067	.038	.106	.075	.011	.006	-.064	-.036	.150	.094
Age	25–34 vs others	-.038	-.028	-.088	-.046	-.172	-.112	-.237	-.122	-.300	-.154	-.161	-.092
	34–54 vs others	.068	.051	-.072	-.038	-.158	-.102	-.149	-.076	-.349	-.179	-.155	-.089
	>55 vs others	.185	.115	.584	.256*	-.247	-.134	.294	.126	-.406	-.174	-.186	-.089
Ethnicity	Māori vs Caucasian	-.086	-.044	-.107	-.039	.448	.201*	.155	.055	.044	.016	.505	.199*
	Pasifika vs Caucasian	.211	.099	.149	.050	.406	.167	.600	.195*	.153	.050	.649	.235**
	Asian vs Caucasian	.265	.197	.184	.096	.453	.294**	.091	.047	.424	.218*	.529	.302**
	Other vs Caucasian	-.151	-.073	.022	.007	.001	.000	-.442	-.148	.004	.001	.064	.024
Education	Other education. vs school	.294	.229*	.625	.343***	-.077	-.053	.638	.344**	.111	.060	-.144	-.086
	Undergrad. vs school	.370	.276**	.658	.346**	.228	.149	.510	.264*	.369	.191	.114	.066
	Postgrad vs school	-.078	-.035	.324	.104	.061	.024	.350	.110	.160	.050	-.063	-.022
Income	$30–50,000 vs <$30,000	.188	.111	.267	.111	.048	.025	.167	.069	-.121	-.050	.055	.025
	$50–70,000 vs <$30,000	-.021	-.014	-.028	-.013	-.033	-.019	.235	.105	-.025	-.011	-.079	-.039
	$70–90,000 vs <$30,000	.041	.023	.376	.149	-.032	-.016	.196	.076	-.061	-.024	.150	.065
	>$90,000 vs <$30,000	.067	.031	.193	.064	.028	.011	.179	.058	-.485	-.158	.210	.076
	NZiDep	-.226	-.184	-.157	-.090	.108	.077	-.204	-.115	.644	.36***	.141	.088
	NZDep2018												
	Medium vs Low	.095	.075	.100	.055	.059	.041	-.142	-.077	-.019	-.010	.027	.016
	High vs Low	.051	.039	.060	.032	-.066	-.044	-.088	-.047	-.022	-.012	-.043	-.025
	R^2	.197		.233		.187		.191		.342		.197	
	F	1.817*		2.251**		1.694*		1.747*		3.832***		1.815*	
	ΔR^2	.004		.002		.005		.004		.000		.001	
	ΔF	.293		.166		.392		.308		.010		.095	

Note: Age, ethnicity, education and income and NZDep2018 were represented as three dummy variables with <25 years serving as the reference group (for age), Caucasian as the reference group (ethnicity), school as reference for education, <$30,000 p/a as reference for income and low NZDep2018 as the reference group.*p < .05. **p < .01, ***p < .001

Table 4.15

Significant final model (covariates, individual and NZDep2018) of hierarchical regression analyses for variables predicting relative importance scores for food choice motivations based on natural content, ethical concern and price

		Model 5a: Natural content		Model 5b: Ethical concern		Model 5c: Price	
		B	β	B	β	B	β
	Constant	.893		.850		1.190	
	Gender	.032	.069	.004	.009	-.022	-.046
Age	25–34 vs others	-.002	-.005	-.042	-.082	-.077	-.149
	34–54 vs others	.162	.112	-.009	-.017	-.097	-.187
	>55 vs others	.153	.251*	.083	.136	-.162	-.262**
Ethnicity	Māori vs Caucasian	-.075	-.102	-.002	-.003	-.059	-.079
	Pasifika vs Caucasian	-.028	-.035	.102	.126	-.057	-.070
	Asian vs Caucasian	-.038	-.075	-.041	-.080	.010	.018
	Other vs Caucasian	.014	.018	-.116	-.148	.001	.001
Education	Other education. vs school	.126	.258*	.129	.263*	-.038	-.077
	Undergrad. vs school	.095	.188	.052	.102	-.007	-.014
	Postgrad vs school	.050	.060	.053	.064	-.025	-.030
Income	$30–50,000 vs <$30,000	.044	.068	.017	.026	-.069	-.107
	$50–70,000 vs <$30,000	.002	.003	.068	.116	.002	.003
	$70–90,000 vs <$30,000	.062	.092	.008	.012	-.042	-.061
	>$90,000 vs <$30,000	.060	.074	.039	.048	-.147	-.180*
	NZiDep	-.063	-.135	-.075	-.161	.175	.370***
	NZDep2018						
	Medium vs Low	.019	.040	-.047	-.096	-.034	-.070
	High vs Low	.016	.032	-.031	-.062	-.021	-.042
	R^2	.192		.198		.330	
	F	1.755*		1.820*		3.64***	
	ΔR^2	.001		.006		.003	
	ΔF	.087		.487		.305	

Note: Age, ethnicity, education and income and NZDep2018 were represented as three dummy variables with <25 years serving as the reference group (for age), Caucasian as the reference group (ethnicity), school as reference for education, <$30,000 p/a as reference for income and low NZDep2018 as the reference group.*p < .05. **p < .01, ***p < .001

Table 4.16

Significant final model of Hierarchical Regression Analysis for assessing predictive associations between food choice motivation and risk-reducing food index scores, risk-increasing food index score and overall diet quality index score

		Model 6a: Risk-reducing food score		Model 6b: Overall diet quality		Model 6c: Risk-increasing food score	
		B	β	B	β	B	β
	Constant	3.296		13.086		-.857	
	Gender	.127	.040	.012	.003	.143	.043
Age	25–34 vs others	-.061	-.018	-.408	-.083	.315	.088
	34–54 vs others	.354	.102	.555	.111	-.225	-.06
	>55 vs others	.631	.153	.684	.115	-.080	-.02
Ethnicity	Māori vs Caucasian	.132	.026	-.190	-.026	.334	.064
	Pasifika vs Caucasian	-.443	-.081	-1.253	-.160*	.798	.139
	Asian vs Caucasian	-.655	-.193	-1.177	-.24**	.496	.140
	Other vs Caucasian	.017	.003	-.476	-.061	.502	.088
Education	Other education. vs school	.108	.033	-.059	-.013	.158	.046
	Undergrad. vs school	-.345	-.100	.328	.066	-.672	-.19
	Postgrad vs school	-.422	-.072	-.484	-.058	.077	.013
Income	$30–50,000 vs <$30,000	.340	.078	-.323	-.052	.673	.148
	$50–70,000 vs <$30,000	.139	.035	-.940	-.167*	1.101	.268**
	$70–90,000 vs <$30,000	-.063	-.014	-.177	-.027	.135	.028
	>$90,000 vs <$30,000	.922	.169	.568	.072	.353	.062
FCMs	Health	.477	.187	.308	.084	.201	.075
	Weight control	-.062	-.031	-.019	-.006	-.044	-.02
	Mood	-.542	-.237*	-.954	-.29**	.396	.166
	Natural content	-.116	-.065	.347	.135	-.474	-.25*
	Convenience	.153	.068	-.149	-.046	.326	.138
	Sensory appeal	.183	.074	-.004	-.002	.144	.056
	Familiarity	.032	.017	.036	.010	.102	.052
	Ethical concern	-.146	-.083	-.068	-.026	-.205	-.11
	Family preferences	.066	.045	.066	.026	.065	.042
	Price	-.399	-.22*	-.591	-.23**	.180	.096
	R^2	.303		.539		.395	
	F	2.228**		5.986***		3.348***	
	ΔR^2	.014		.003		.026	
	ΔF	2.506		.772		5.533*	

Note: Age, ethnicity, education and income and NZDep2018 were represented as three dummy variables.*$p < .05$. **$p < .01$, ***$p < .001$

All assumptions were met prior to performing the regression for the interaction term. Absolute importance for ethically sustainable foods moderated the effect of NZiDep on overall diet quality (after adjusting for covariates, income and education). A significant negative interaction effect $B = -.148$, $p = .022$ was produced. The results of the moderation analysis are detailed in Table 4.17. Interpretation of the moderation effect can be undertaken by examining the simple slopes analysis. When importance for ethically sustainable foods was low, NZiDep did not predict overall diet quality score, $p = .761$. Conversely, when importance for ethically sustainable foods was high, there was a significant negative relationship between NZiDep and overall diet quality score, $B = -.291$, $t(134) = -3.535$, $p < .001$. The simple effects plot (Figure *4.2*) shows that as the absolute importance for ethically sustainable foods increased, the high versus low NZiDep difference in overall diet quality scores became more negative. When this food choice motivation was high in low NZiDep participants, their overall diet quality became significantly better than high NZiDep participants. No other significant interactions were seen.

Table 4.17

Regression analysis of the association between NZiDep and overall diet quality score using the ethical concern-based food choice motivation absolute importance score as the interaction term

Interaction terms	Model 7			
	B	SE	t	P-value
Constant	3.149			
NZiDep	-.170	.062	-2.74	.007
Ethical concern FCM	.122	.051	2.370	.019
Ethical concern x NZiDep	-.148	.064	-2.32	.022

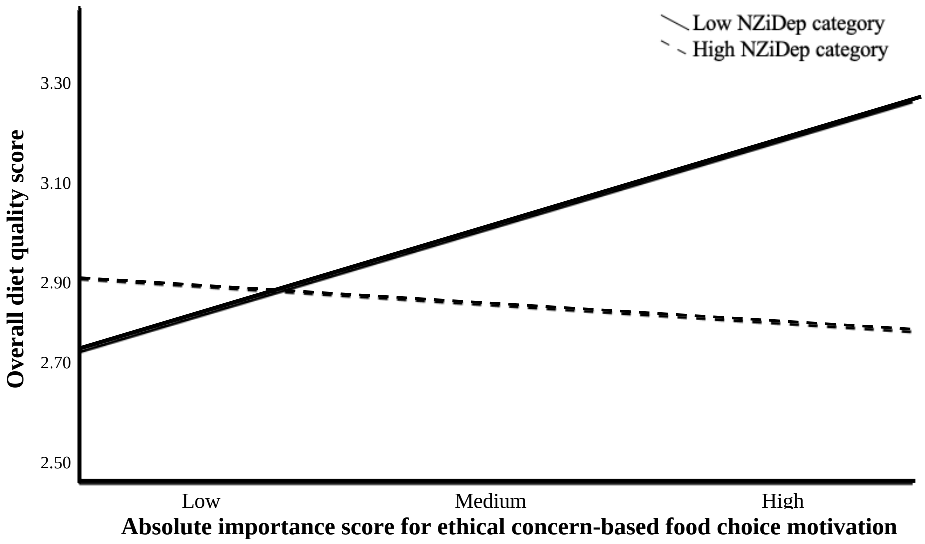

Figure 4.2 Simple Slopes plot

4.3.4 Tertiary outcome measure: Nutrition knowledge

4.3.4.1 Comparison of nutrition knowledge across demographic and SEDep groups

The following sections report the results of the Kruskal-Wallis H test and post hoc comparisons as well as independent samples Mann-Whitney U tests comparing nutrition knowledge across demographic and SEDep categories. While nutrition knowledge scores differed across education levels, tertiles of NZDep2018 and deciles of NZiDep, these differences were not significant ($p = .621$, $p = .546$ and $p = .200$, respectively) (data not shown). Alternatively nutrition knowledge significantly differed across categories of age, ethnicity, gender (Table 4.18).

Table 4.18

Nonparametric comparisons of nutrition knowledge scores across demographic categories and tertiles of community and NZiDep

Age	**Median (interquartile range)**	χ^2
<25	17 (6)	12.96**
25–34	15 (6.25)	
35-54	18 (4)	
>55	18 (4)	
Ethnicity		
Māori	17 (4)	11.05*
Pasifika	16.5 (7.25)	
Caucasian	18 (4)	
Asian	16 (4)	
Other	16 (8)	
Gender		U, Z-statistic
Females	18 (4)	2737 (-3.773***)
Males	16 (5)	

*$p < .05$. **$p < .01$, ***$p < .001$

4.3.4.2 Hierarchical regression analysis on associations between individual measures of SEDep, NZDep2018 and nutrition knowledge scores

Prior to performing the regression, all assumptions were validated and met (Section 4.2.6.2). The presence of an outlier was validated by a studentised deleted residual >±3 standard deviations. However, as this observation was not a result of data entry errors and represented a genuine observation that was extreme from the norm, the decision was made to retain this outlier in the data analysis. The final regression model including covariates, individual measures of SEDep and NZDep2018 was significant in predicting nutrition knowledge, R^2 = .268, F(18,133) = 2.705, p = .001. Nonetheless, individual measures of SEDep (income, education or NZiDep) and NZDep2018 did not significantly account for a unique amount of variance in nutrition knowledge scores.

Next, a hierarchical regression was run to determine whether nutrition knowledge was a significant predictor of risk-reducing food index scores, risk-increasing food index scores and overall diet quality index scores. All assumptions for performing the regression were met. The full model, including covariates, individual measures of SEDep (income, education and NZiDep), NZDep2018 and nutrition knowledge, was significant in predicting risk-reducing food index scores, R^2 = .260, F(19,130) = 3.839, p < .001; risk-increasing food index scores, R^2 = .129, F(19,130) = 2.158, p = .006; and overall diet quality scores, R^2 = .418, F(19,130) = 4.906, p < .001. However, nutrition knowledge did not significantly account for a unique amount of variance in these scores, p = .757, p = .388 and p = .320, indicating the variance observed was primarily predicted by the covariates and SEDep predictors.

4.4 DISCUSSION

Study 2 demonstrated how an individual’s capacity to undertake diet-related PHBCs (i.e., following a healthy diet) is impacted by SEDep status which also shapes their food choice motivations. The main findings of the study were four-fold. Firstly, participants in the high NZiDep decile were primarily female, < $30,000 p/a income earners and <25-year-olds. Those in the high NZiDep decile were predominantly Caucasian while those residing in high NZDep208 areas were mostly of Asian ethnicity. Secondly, the primary hypothesis was met in that: (1) stroke risk-reducing food intake and overall diet quality was significantly lower in high NZiDep decile participants, and (2) those residing in medium and high NZDep2018 areas had high intakes of stroke risk-increasing foods. These trends were significant above and beyond the effects of income and education, satisfying the tertiary hypothesis. Thirdly, the secondary hypothesis was only partially met whereby participants in the high NZiDep decile absolutely and relatively valued food prices. Conversely, food choice motivations did not significantly differ by NZDep2018 status. Food choice motivations driven by food prices and an individual's mood significantly predicted lower intake of risk-reducing foods and poorer diet quality. Value for foods made of natural ingredients limited intake of risk-increasing foods. Absolute importance of ethically-acceptable food production methods moderated the negative association between overall diet quality and NZiDep status. Lastly, nutrition knowledge did not significantly differ across deciles of NZiDep nor tertiles of NZDep2018. The following section compares the observed demographic trends in SEDep and dietary outcomes to the current literature evidence.

4.4.1 Demographic distribution according to deprivation and dietary habits

Gender, ethnic and age distribution of study participants in the low and high deciles of NZiDep and tertiles of NZDep2018 concur with the overall literature (Carter & Gunasekara, 2012; Centre for Social Impact, 2018; Fahy et al., 2017; Tobias & Mason, 2010). That is, a higher proportion of females and <25- year-olds in the high NZiDep decile is similar to the reported literature (Carter et al., 2008). A higher proportion of Caucasians in the low NZDep2018 and NZiDep category and Asians residing in high NZDep2018 areas has also been validated previously (Carter et al., 2008; Carter & Gunasekara, 2012; Fahy et al., 2017; Williams, 2017). A predominant proportion of high NZiDep and NZDep2018 participants were < $30,000 p/a income earners. This finding was unsurprising as the dimension of income deprivation in development of both indexes was based on an equivalised household income cut-off of $34,023. Household income below this value is considered deprived (J. Atkinson et al., 2019; Salmond et al., 2005). The study failed to match with the general literature consensus that more Māori and Pasifika reside in areas of high SEDep and have high individual SEDep (Carter et al., 2008; Centre for Social Impact, 2018; Tobias & Mason, 2010; Williams, 2017). This could potentially be explained by the small sample sizes for these ethnic groups and the restriction of recruitment to the Auckland region. Compared to Auckland, other regions such as Gisborne, Northland, Bay of Plenty and Hawke's Bay are found to host a more dense Māori population (Statistics New Zealand, 2020b) as well as some of the most deprived areas of NZ (J. Atkinson et al., 2019).

Males, 20–35-year-olds, and those of Asian ethnicity showed significantly lower intake of stroke risk-reducing foods, higher intake of stroke risk-increasing foods, and overall poorer diet quality. These findings were comparable to previous empirical conclusions in both NZ and other countries (Haslett et al., 2017; Jaeger & Bava, 2009; C. Smith et al., 2013; K. J. Smith et al., 2009; Thornton et al., 2011). As the majority of stroke risk-increasing food items were convenience/takeaway foods, gender discrepancies in their intake could be attributed to females being more likely to spend time cooking and preparing foods (Adams & White, 2015). Alternatively, females may be more invested in eating well and in health generally than males.

The trends seen for young participants in this study was potentially because these participants were primarily full-time students (Appendix 13). The vast majority of literature supports high convenience food intake in students due to time constraints and the cost effectiveness of such foods (Escoto et al., 2012; Thornton et al., 2011). Participants of Asian heritage had significantly lower risk-reducing food intake, in contrast to conclusions by Haslett et al. (2017) who illustrated a healthy diet pattern in this group. However, authors of this study grouped Asians together with Caucasians and other ethnicities, thus it is likely that the healthy diet was predominantly followed by non-Asian participants. It must be noted that diets vary significantly across different Asian sub-groups (e.g., Indian v. Chinese) (Ooraikul et al., 2008; Popkin Barry et al., 2001) and the current study participants were not asked to specify which part of Asia they hailed from. Therefore, the dietary trends observed may be more representative of a specific subgroup of Asians. Pasifika participants demonstrated poorer diet quality and higher risk-increasing food intake (compared to Caucasians) based on the regression analyses. Such conclusions concur with current literature evidence (Blakely et al., 2011; Haslett et al., 2017; Metcalf et al., 2014; Ministry of Health, 2011, 2012, 2016, 2019; Wong et al., 2017). These results re-emphasise the importance of promoting better nutrition in these highly stroke-susceptible minority groups. While Māori are typically seen to frequently consume risk-increasing dietary foods (Section 2.8.2.1), such trends were not observed in this study. This indicates the complex interplay of other socio-cultural-environmental influences on diet quality and can also be explained by the under-representation of Māori and Pasifika in this study.

The original research design had an additional objective to compare outcome measures between users of the SR and non-users to detect the impact of increased stroke risk awareness and healthy eating recommendations, regardless of SEDep status. However, as a sufficient number of SR user participants could not be recruited for this study, the impact of SR use could not be systematically assessed.

4.4.2 Deprivation and dietary Intake: Impact of income, education, NZiDep and NZDep2018.

The study reinforces the critical impact of SEDep on stroke risk-related diet quality. Compared to $70–90,00 p/a earners, <$30,000 income earners showed significantly lower prevalence of stroke risk-reducing foods, a higher prevalent intake of stroke risk-increasing foods, and overall poorer diet quality after accounting for covariates. Such trends are also corroborated in other studies (Amuzu et al., 2009; Backholer et al., 2016; Kamphuis et al., 2006; Thiele et al., 2017; Thornton et al., 2011; Venn & Strazdins, 2017). The study failed to contribute towards overall literature consensus on the positive association between one's level of education and diet quality (Backholer et al., 2016; De Mestral et al., 2019; Haslett et al., 2017; McLeod et al., 2011; Schoufour et al., 2018; Thiele et al., 2017). Differences in the cohorts studied and the design of dietary indexes used (i.e., the items included) in other studies may have contributed towards this inconsistency. Most of these studies also did not account for residual confounding due to other socioeconomic measures (e.g., income) in the adjusted models. However, the literature evidence on the association between education and diet quality has been largely inconsistent, with some evidencing an association while others do not (Miura et al., 2009; C. Smith et al., 2013).

The following sections discusses NZiDep and NZDep2018 trends in both the food index scores and consumption of individual items in the Dietary Habits Questionnaire (Section 4.3.2.1) to current literature. Very few studies have utilised a holistic measure of individual SEDep such as the NZiDep to determine diet inequalities. Instead, a greater reliance on income, education or occupation as measures of socioeconomic status was observed. Therefore, we were limited to comparing NZiDep trends in diet quality to those reported in studies utilising more singular measures of SEDep. Some aspects of the primary research hypothesis held true.

Significantly lower prevalence of risk-reducing food consumption and poorer diet quality were observed in participants in the high NZiDep decile. High NZiDep participants were more likely to have risk-increasing servings of fried meat and sugar sweetened drinks, concomitant with previous research evidence (Fahlman et al., 2010; Konttinen et al., 2013; McDonnell et al., 2013; Méjean et al., 2013; Rehm et al., 2008; Thornton et al., 2011). Additionally, more participants in the low NZiDep decile consumed risk-reducing servings of full-fat yoghurt and cheese, tea, alcohol, fruit and vegetables, similar to that seen in other studies (Amuzu et al., 2009; Dijkstra et al., 2014; Fahlman et al., 2010; Franchini et al., 2013; Jaeger & Bava, 2009; Konttinen et al., 2013; Powell et al., 2009). Such findings may be due to a higher proportion of more affluent (>50,000 p/a) and older individuals in the low individual SEDep group. These groups are typically considered to be able to better afford nutritious foods that generally tend to be costlier (Breyer & Voss-Andreae, 2013; Drewnowski, 2009). Low socioeconomic status individuals (i.e., high NZiDep study participants) are more reluctant to pay for perishable food items such as fruits that may spoil quickly and contribute to wastage (Jaeger & Bava, 2009). Instead bulkier, non-perishable items and on-the-go fast foods may be favoured if the food budget needs to be re-allocated to more urgent monetary needs such as bills (Jaeger & Bava, 2009). Additionally, as high NZiDep households tend to host two or more families/multiple persons (Carter et al., 2008), foods that can be purchased in bulk and be more filling may be favoured.

The tertiary hypothesis was supported in that NZiDep significantly predicted risk-reducing food index and overall diet index scores above and beyond income and education. Therefore, such a deprivation measure may have greater utility in explaining dietary inequalities than traditional measures of individual deprivation/socioeconomic status (income, education and occupation). Conventional measures bear several shortcomings, including insufficient population coverage and lack of cultural specificity (Salmond et al., 2005). Additionally, each indicator captures a unique area of social stratification that may be applicable to different health consequences and at unique phases in the life course (Galobardes et al., 2007). Hence, it is recommended that future studies should employ the NZiDep scale when assessing the impact of individual SEDep upon NZers health outcomes.

The study found an increase in risk-increasing food intake in those residing in areas with medium and high community SEDep (indicated by NZDep2018 scores), partially supporting the primary research hypothesis. This included significant correlations between high community SEDep and intake of fried meat, alcohol, sugar and artificially-sweetened drinks in portions that increase stroke risk. Such conclusions support emerging national and international evidence (Barton et al., 2015; Feng & Wilson, 2017; Gao et al., 2019; Haslett et al., 2017; Janssen et al., 2017; Miura et al., 2012; Thornton et al., 2010; Zarnowiecki et al., 2014). Such outcomes could be attributed to the abundance of retailers that sell such foods in the local food environment of high community SEDep areas in Auckland (Egli et al., 2020). In addition, such products tend to be strongly marketed by manufacturers and food chains (Rehm et al., 2008), are cost effective (Thornton et al., 2011) and readily available for consumption. However, evidence to the contrary also exists (Egli et al., 2020; Mulia & Karriker-Jaffe, 2012).

Hazardous alcohol intake observed among residents of high community SEDep may be due to a higher prevalence of mental distress as indicated in the literature (Carter et al., 2008; Mulder et al., 2011). Such individuals experience financial distresses such as the: (1) inability to pay for necessities (Partos et al., 2012), and (2) difficulty accessing resources and their unequal distribution. Dependence on alcohol to help cope with such stressors has been previously validated (Jahnel et al., 2019). Conversely, hazardous alcohol intake may be limited among participants residing in areas of low community SEDep as they may not be exposed to deprivation-related stressors. Additionally, greater value for one’s health and the ability to synthesise information on adverse implications of alcohol abuse (Beard et al., 2019) may be greater in such participants. In contrast, residents of areas of low community SEDep frequently consumed light to moderate servings of alcohol, characterised as stroke risk-reducing, similar to previous research (Bonevski et al., 2014; Lakshman et al., 2011). Older and high income earners, who constituted a predominant proportion of this group are known to consume light to moderate amounts of alcohol for its reward and relaxation properties (Haydon et al., 2016).

Contrary to popular belief, the study did not evidence an association between community SEDep and risk-reducing intake of fruits and vegetables (Amuzu et al., 2009; K. Ball et al., 2006, 2015; Barton et al., 2015; Haslett et al., 2017; Ministry of Health, 2019; Yen & Tan, 2012). The literature primarily attributes the association between community SEDep and diet quality to the disparities in the accessibility/affordability of specific food retailers (supermarkets, fast food outlets) (Section 2.8.2.2.1.1). Therefore, two assumptions can be made. Firstly, store availability/accessibility may have greater utility in explaining the association between community SEDep and the risk-increasing intake of fried foods, sugar-sweetened drinks and alcohol. Conversely, other factors as opposed to accessibility to grocers may be more pertinent in predicting fruit/vegetable intake. In fact, prior research suggests fruit and vegetable intake is not associated with living in neighbourhoods with poor locational access to supermarkets or convenience stores (Allcott et al., 2018; Pearce, Hiscock, et al., 2008). Firstly, residents often engage in out-shopping, travelling beyond the immediate shopping radius of their neighbourhood for food purchasing (Allcott et al., 2018; Bardenhagen et al., 2017; Breyer & Voss-Andreae, 2013; Dimitri & Rogus, 2014; Drewnowski et al., 2012, 2014). Most studies reporting an association between community SEDep and fruit/vegetable intake failed to, or had nullified outcomes after, accounting for indicators of individual SEDep (Amuzu et al., 2009; Hager et al., 2016; Haslett et al., 2017; Thornton et al., 2011) Individuals capable of affording fruits/vegetables may reside in highly deprived areas due to a number of reasons, such as better access to their workplaces or to be closer to extended family. Therefore, these observations also reiterate the importance of not ascribing community-level SEDep to the status of individual residents (ecological fallacy) (P. White et al., 2008).

4.4.3 Food Choice Motivations and demographic differences

The next stage of this study was to determine the driving forces behind the association between individual/ community SEDep and diet quality. Understanding human norms, cultural traditions, visceral and mental states, values and needs that inform food choices contributes towards a better understanding of consumers' dietary behaviours (Reisch et al., 2013). Absolute scores positively correlated with each other while relative scores had primarily negative correlations, concurring with prior studies (Clarke & Best, 2019; Konttinen et al., 2013). Significant, positive correlations between relative and absolute importance for food choices based on price, familiarity and overall convenience have been previously observed (Allès et al., 2017; Clarke & Best, 2019; Konttinen et al., 2013; Markovina et al., 2015). Familiarity referred to how important it was for the participant to eat their accustomed diet rather than exploring different food choices. Correlations between price and convenience-based food choices were unsurprising, given that convenience foods are typically cost-effective and accessible to those under budgetary or time constraints (Appelhans et al., 2012; Barosh et al., 2014; Breyer & Voss-Andreae, 2013; Kern et al., 2017; Lake, 2018). The mood scale items reflected preferences for emotionally-enhancing foods that that helped cope with adversity and related to general alertness and stress management (Steptoe et al., 1995), Therefore, correlation between familiarity and mood-based food choices may indicate a disinterest for exploring novel foods during negative affect (e.g. when stressed). Significant inter-correlations between health, natural content and ethical concern-based food choices also replicate current evidence (Clarke & Best, 2019; Markovina et al., 2015; Rankin et al., 2018). Positive correlations between food choices based on family preference and familiarity make sense as family food selections become habitual for participants. Similar correlations between family preference and convenience-based food choices could be because foods maybe prepared or purchased by others, saving time and conserving energy. As a result, family choices may make food decisions less burdensome.

The researcher also considered it important to compare absolute and relative importance of food choices. Food choice decisions typically involve conflicts between several, equally relevant, motives (Konttinen et al., 2013). During such decisions, it is rare for individuals to satisfy all their personal food choice motivations, resulting in a prioritisation process (Konttinen et al., 2013). Therefore, priorities in food choice motivations as opposed to absolute ratings may better represent the complexity of decisions made during food purchase/consumption. When food choices based on health, weight control, natural content sensory appeal and ethical concern were high, participants de-prioritised value for mood, convenience, familiarity, price and family preference. Such findings have been previously observed (Allès et al., 2017; Clarke & Best, 2019; Konttinen et al., 2013; Markovina et al., 2015). A positive correlation between relative importance for natural content and price-based food choice motivations indicated that for participants in this dataset, foods composed of natural ingredients also had to be affordable.

Demographic and individual-level SEDep trends in food choice motivations corroborated current literature evidence, as discussed in the following sections. The study failed to support the tertiary hypothesis. Specifically, income and education was more predictive of food choice motivations while NZiDep had significant associations only with food choices based on price.

4.4.3.1 The importance of convenience and food familiarity

A particular focus of this study was to distinguish between value for food convenience related to preparation time and access in relation to demographic and SEDep categories. Older study participants did not value convenience related to food preparation times. As they were predominantly retired, such individuals may have more leisure time and opportunity to prepare nutritious foods (Casini et al., 2019; Host et al., 2016). Such participants may also have a greater awareness of health and susceptibility to disease development, overshadowing the value for convenience (Section 3.4.2.2 of Study 1). The generation effect could also play a role, whereby older individuals are more accustomed to preparing meals from scratch as convenience foods were less prevalent when they were younger (Daniels et al., 2015). Alternatively, older people may also have less disposable income to spend on foods prepared outside (Janssen et al., 2017). However, other empirical studies provide evidence to the contrary. These studies found older adults valued food convenience as they tended to live alone, had to cook for themselves and had mobility issues due to physical limitations (Host et al., 2016; Kamphuis et al., 2015; Whitelock & Ensaff, 2018).

Absolute and relative importance for food preparation convenience in male participants is unsurprising given the former tend not to be primary meal preparers (Adams & White, 2015; Brunner et al., 2010; Casini et al., 2019). However, some researchers postulate females are more likely to value convenience for this same reason (Allès et al., 2017; Konttinen et al., 2013; Welch et al., 2009). Preference for convenient meal preparation in young participants (<25–34-year-olds) can be attributed to limited leisure time available for meal preparation and cleaning up due to multiple commitments (e.g., study, work, family) (Casini et al., 2019; Janssen et al., 2017). Younger people may also lack the necessary cooking skills, driving a greater preference for convenience foods (McMorrow et al., 2017; Sierra et al., 2015). Participants with only school-level education considered overall convenience more important in their food choices in relative terms, consistent to conclusions by Miura et al (2012).

This study partially failed to satisfy the secondary hypothesis and support the general literature consensus on the impact of community SEDep on food choice motivations (Barton et al., 2015). The finding that participants residing in areas of high community SEDep areas do not value convenience related to food access supports emerging ecological evidence that suggests the same (Appleton et al., 2010; Giskes et al., 2009; Gustafson et al., 2013; MacDonald et al., 2011; Minaker et al., 2013). However, evidence on the association between neighbourhood accessibility to specific food retailers and dietary behaviours is relatively inconsistent (Athens et al., 2016; Caspi et al., 2012; F. Li et al., 2009; McInerney et al., 2016; C. N. Mhurchu et al., 2013; Tallant et al., 2018). Therefore, SEDep status on the individual level, as opposed to that of the area of one's residence, may have a greater impact in driving food choices.

Males and Asian participants also indicated high relative and absolute importance for food familiarity, similar to that seen in other studies (Brunner et al., 2010; Lee et al., 2020; Mackay et al., 2018).Value for food familiarity and family preferences among Asian participants may reflect their perseverance to retaining cultural roots in a NZ setting and easing acculturation practices. The multi-ethnic food culture environment in Auckland also ensures abundant availability and easy access of Asian ingredients (Lee et al., 2020). Additionally, Asian participants in the sample were primarily young students (Appendix 13). It is likely that these participants may reside with their extended family while studying and family orientations may shape food preferences as a whole.

4.4.3.2 The value of price

Being <25 years of age was related to greater absolute and relative importance of price, in tandem with other conclusions (Brunner et al., 2010). These participants were also primarily students and unemployed. As such, greater financial difficulties and re-allocating costs for necessities such as rent may drive price-based food choices in these participants. Food prices were not of concern for older study participants who predominantly earned higher incomes (Appendix 13). These participants potentially had the financial capacity to afford good quality diets and may not have dependent children for whom they were financially responsible. This finding is in contrast to several UK-based observations which indicated that older adults prioritised food prices as they earned ‘just enough to get by’(Host et al., 2016; Kamphuis et al., 2015; Whitelock & Ensaff, 2018). Prior research indicate females are more likely to prioritise price-based food choice considerations as a result of being the primarily meal food preparers in their household (Allès et al., 2017; Konttinen et al., 2013; Welch et al., 2009). However, males in this study may shoulder the responsibility for the household grocery shopping, contributing towards price-based food choices as they seek more value for their money. As a result, budgetary limitations may be more at the forefront when choosing foods rather than spontaneous food purchase choices. Absolute price-based food preferences were observed among Asian and Pasifika participants. Such findings relate to the increase in healthy food intake following substantial price discounts among these ethnic groups (Blakely et al., 2011; N. C. Mhurchu & Ogra, 2007). However, these ethnic trends may be confounded by these participants being mainly young, low-income earners and in the high NZiDep and NZDep2018 groups (Appendix 13).

Unsurprisingly, <$30,000 p/a income earners absolutely and relatively prioritised price-based food choices, consistent to observations of others (Burns et al., 2013; Darmon & Drewnowski, 2015; Konttinen et al., 2013; Powell et al., 2009). There were no associations between price-based food choices and participants’ degree of education, in contrast to that observed in other studies (Kamphuis et al., 2015; Powell et al., 2009). However, these other studies did not account for confounding by other socioeconomic status measures (e.g., income) in the adjusted models. The secondary hypothesis was only partially met where study participants in the high NZiDep decile absolutely and relatively considered price as a significant determinant of food choice. This observation was above and beyond the effects of participant demographics, income and education. No other food choice motivations differed by NZiDep or NZDep2018 status. Those with high individual SEDep may experience budgetary constraints; a greater financial priority may be allocated to necessities such as accommodation and electricity. As a result, foods that are affordable may be preferred, regardless of nutritional value.

4.4.3.3 Natural ingredients, ethical acceptability and health concerns

Caucasians, >55 year old, $70–90,000 p/a earners and participants with higher education, in parallel, preferred foods composed of natural ingredients and met ethically acceptable criteria (e.g., environmental sustainability). These findings are consistent with earlier work (Allès et al., 2017; Host et al., 2016; Kamphuis et al., 2015; Konttinen et al., 2013). Therefore, favouring natural foods (e.g., raw vegetables) maybe concomitant with a priority for foods that do not harm the environment during production and are sourced from the natural environment. Conversely, these motivations had low importance ratings among <25 and 25–34-year-olds and <$30,000 p/a income earners. Such observations may be a result of having less disposable income, a primary constraint for organic and environmental sustainable food purchases (Baudry et al., 2017; Hoek et al., 2017). Greater value for foods with natural ingredients was observed in higher-educated participants, supporting existing evidence on the positive association between education and tendency to procure organic products (Baudry et al., 2017; Wier et al., 2008). Higher education is associated with greater knowledge regarding organic food production (e.g., use of natural raw materials) and such foods may be considered superior quality compared to conventional foods (Hjelmar, 2011).

Caucasian participants, who were primarily of low individual SEDep and high-income earners, prioritised the health value of food choices. These characteristics have been previously reported as demographic predictors of greater concerns for health-based food choices (Allès et al., 2017; Dijkstra et al., 2014). Corroborating previous work (Host et al., 2016; Kamphuis et al., 2015; Locher et al., 2009), an observed positive association between age and health importance of foods may reflect a greater concern for nutritional component of foods with age. Such values typically come with: (1) greater concern for one's health and well-being, (2) a higher consciousness of disease susceptibility, and (3) linking healthier foods with prevention of chronic disease (Cavaliere et al., 2015; Kamphuis et al., 2015). Nonetheless, other authors suggest socioeconomic status of older individuals has an impact on the value of health-based choices. Older adults of low socioeconomic status attribute less importance to health value of foods in favour of sensory appeal, price and accessibility (Cavaliere et al., 2014; Kamphuis et al., 2015). Significantly greater priority for foods that endorsed weight control was also found in 35–55-year-olds compared to <25-year-olds, similar to another cohort (Prescott et al., 2002).

4.4.3.4 Sensory appeal and mood

Based on the Kruskal Wallis data, sensory appeal (smell, taste and appearance) of foods was a relatively important consideration for participants with higher education. This was concomitant with a value for natural content of foods. Similar correlations are indicated in other studies which report natural/organic food consumers perceive a superior better taste in organic compared to conventional foods (Baudry et al., 2017; Bryła, 2016; Hjelmar, 2011). Organic foods are typically thought to be high-quality products (fresh, seasonal) which have particular appeal to more affluent and educated consumers (Hjelmar, 2011). However, value for this food choice motivation diminished once residual confounding by other demographic factors and socioeconomic markers were accounted for (regression analysis).

Older adults in this study did not report a preference for the hedonic properties of foods, in contrast to a number of other study findings (K. Ball et al., 2015; Kamphuis et al., 2015; Locher et al., 2009; Whitelock & Ensaff, 2018). In these studies, the threshold age of participants was at least 60 years or over. Therefore the absence of such a finding in the present study may be due to a minimal number of participants meeting this age criteria (participants only indicated if they were >55 years). It is also likely that for *NZ* adults meeting this demographic criteria, taste preferences may not be as significant compared to other food choice motivations. However, further investigation with a more geographically-diverse NZ sample is warranted. Mood-based food choices were relatively important for 25–34-year-old adults and absolutely important for Asian participants, consistent with a previous NZ cohort (Prescott et al., 2002). Exposure to academia-related stressors and dealing with the daily hassles of work-life management may induce a craving for foods that imbue a sense of stress relief, relaxation or comfort (Dallman, 2010; Dehghan, 2016; Mouchacca et al., 2013).

4.4.3.5 Food choice motivation associations with diet quality

Key trends arose from studying the impact of food choice motivations on diet quality.

Absolute importance for food choices based on mood and price significantly predicted a reduced intake of risk-reducing foods and overall poorer diet quality. Conversely, food choices motivated by natural content significantly predicted reduced intake of stroke risk-increasing food. Such conclusions corroborate emerging international evidence (Barosh et al., 2014; Baudry et al., 2017; Konttinen et al., 2013; Pelletier et al., 2013; Tallant et al., 2018; Thiele et al., 2017). A general consensus exists on the positive relationship between choices based on convenience and intake of convenience foods in order to address growing time scarcity issues (Djupegot et al., 2017; Janssen et al., 2017; McMorrow et al., 2017; Tallant et al., 2018; Venn & Strazdins, 2017). However, this study failed to display an association between convenience-based food choices and intake of risk-increasing foods. Only two of the nine items of the risk-increasing food index fell under the category of convenience foods (high glycaemic load foods, fried meat). Therefore, scoring on these items may not have contributed significantly towards the overall index score compared to the other seven items.

The negative impact of price upon risk-reducing food index score was unsurprising as the index was primarily composed of dietary items typically considered as being expensive (e.g., fruits and vegetables, wholegrains, low-fat milk) (Blakely et al., 2011; Dijkstra et al., 2014; Janssen et al., 2017). Literature on the food environment emphasises affordability is a recurring concern for fruit and vegetable consumption (Caspi et al., 2012). However, McMorrow and colleagues (2017) did not observe such an association in their study. This may have been due to the exclusive focus on the intake of only one component of a healthy diet. Some qualitative studies go further to suggest that among older adults, food prices endorsed a healthy diet. The authors observed that study participants could not afford the costs of eating out and price discounts were utilised for bulk buying (Host et al., 2016; Whitelock & Ensaff, 2018).

Influences of mood on dietary habits is a complex interplay between physiological and socio-environmental factors, reward mechanisms, psychological influences and previous experiences and habits (Köster & Mojet, 2015). In particular, stress-related emotions can determine not only the quantity of food consumed, but also the selection of foods to regulate emotions (emotional coping) (Burns et al., 2013). Such needs often precede health and price concerns and the tendency to compromise healthy meals in favour of calorie-dense foods for stress management is well described (Dehghan, 2016; Mouchacca et al., 2013; O'Connor et al., 2008). These trends support the negative association between mood-based food choices and risk-reducing food intake/overall diet quality observed in the present study.

As the risk-increasing food index was predominantly composed of items with additives or artificial ingredients, it was unsurprising that participants who valued natural content in foods would automatically refrain from consuming such items. Similarly, Baudry and colleagues (2017) observed that unhealthy, conventional food consumers de-prioritised food choice dimensions based on 'local and traditional production' and 'avoidance of contaminants'. In the study by Clarke and Best (2019), participants who refrained from high-calorie, energy-dense foods to lose weight valued food choices based on natural content. Conversely, while those who did not diet scored significantly higher on price-based motivations (Clarke & Best, 2019).

While socio-anthropological evidence suggests that price concerns have a direct impact in moderating the negative association between SEDep and diet quality, (Darmon & Drewnowski, 2015; Turrell & Kavanagh, 2006), a definitive investigation hasn't been conducted to date. A regression analysis with an interaction term was conducted to determine whether price-based food choice motivations moderated the impact of NZiDep scores upon the three dietary outcomes. However, the expected interaction effect was not observed. Instead, individuals in the low NZiDep decile had significantly better overall diet quality scores (compared to low NZiDep) if they highly valued ethical acceptability of foods. As better diet quality in this study meant a predominant intake of risk-reducing as opposed to risk-increasing foods, this trend is in line with other research. For example, organic food consumers are inclined to value the ethical/environmental consequences of food production during purchase decisions (Allès et al., 2017; Baudry et al., 2017; Michaelidou & Hassan, 2008; Pino et al., 2012; Wier et al., 2008). Further research is required to evidence whether a price-based association does exist, ideally with a more robustly powered study.

4.4.4 Deprivation, nutrition knowledge and impact on dietary choices and food choice motivations

Knowledge about the interrelationships between diet, nutrition and health outcomes were significantly greater in females, participants aged >35 years and Caucasians. Conversely, those of Asian and Pasifika ethnicity, and those aged 25–34-years old demonstrated poorer knowledge. These results align with existing knowledge (Hardy et al., 2017; Kullen et al., 2016; Signal et al., 2008; Yahia et al., 2016). The secondary hypothesis for this outcome was not met in that both educational level and individual and community SEDep were not significantly associated with nutrition knowledge scores. Such findings diverged from the common notion that a higher education is association with better understanding about nutrition (Drewnowski, 2009; Janssen et al., 2017; McLeod et al., 2011). These results may reflect the efficiency of nationwide education interventions to improve NZers' awareness of a healthy diets (e.g., Green Prescription, Healthy Families NZ) (Ministry of Health, 2020a). The regression analysis also failed to demonstrate a significant impact of nutrition knowledge on diet quality, adding to the growing, albeit largely inconsistent, evidence on this topic (Blakely et al., 2011; K. Brown et al., 2011; Caspi et al., 2012; Janssen et al., 2017; McLeod et al., 2011; McMahon et al., 2013; M. White, 2010). The overall findings suggest that despite similar levels of knowledge on nutrition across individual and community SEDep categories, high SEDep participants still demonstrated poorer diet quality. Therefore, the belief that consumer choices may be made healthier by providing targeted knowledge on the interrelations between food choices and health needs to be reconsidered. The aforesaid trends could potentially explain why prevention measures based on providing tailored nutritional education have high attrition rates. Instead, greater emphasis needs to be given to inter- and intra-individual food choice motivations that varied across SEDep categories and could potentially impact diet quality.

4.4.5 Study strengths

Despite these limitations, the study was the first to our knowledge to illustrate the association between holistic measures of individual and community SEDep, diet quality, food choice motivations and nutrition knowledge in a NZ context. A unique dietary index of foods specifically related to increasing or decreasing stroke risk was also established for the first time. In doing so, dietary contributors that potentially increase stroke burden in NZ's deprived populations could be discovered. Only a few studies to date have utilised an overall dietary index to determine socioeconomic disparities, compared to the vast majority that assess specific food groups (e.g., fruits). While prior research simply considers the potential contributors towards SEDep effects on diet quality, this study was the first to examine food choice drivers using a standardised scale. Other notable contributions to the literature included: (1) the moderating effects of ethical concern-based food choices upon NZiDep impact on diet quality, (2) establishing the NZiDep as a superior predictor of diet quality relevant to stroke risk and price-based food choice motivations compared to conventional measures of individual socioeconomic status and (3) value for price-based food choices and low nutrition knowledge among the stroke- susceptible Pasifika and Asian ethnicities.

4.4.6 Study limitations

4.4.6.1 Limitations of sample recruitment methods

The study held some methodological limitations that could impact the generalisability and validity of findings. A majority of the high SEDep participants recruited into the study were young, Asian and students while low SEDep participants were older, Caucasian and retired. As such, dietary patterns and food choice motivations could be confounded by these factors and not a true effect of individual and community SEDep. Some of the advertising platforms were exclusively targeted to increase the rate of young participants and those of Māori and Pasifika ethnicity. As a result there may be an overrepresentation of unemployed people in the study and differential selection biases. Future studies in this area of research will need to maximise internal validity and recruitment of difficult to obtain participants should be conducted in an identical manner to others. While this study could not establish whether SEDep limited SR impact upon study outcomes (through awareness of stroke risk and providing healthy eating recommendations), such investigations are critical in future research. Utility of such interventions lie in their ability to motivate users, particularly those of high SEDep who demonstrate higher stroke incidence rates (Section 2.8.2.1), to undertake PHBCs.

Questionnaires were provided to participants as online, self-selection surveys which came with their own sources of errors. There is often no control over the selection process in self-selection surveys (Khazaal et al., 2014). The only aspects the researcher could control was the design of the study advertisements and selection of the advertising platforms to promote response rates (Khazaal et al., 2014). The survey sample consisted of population members who chose to be surveyed for reasons that may or may not be related to the objectives and/or content of the study itself. Chain sampling bias was also possible as heavy website users or participants invested in receiving the koha may be more prone to share study information with other contacts than light users (Khazaal et al., 2014). Additionally, survey coverage was potentially limited to participants who felt they were technologically able to electronically complete the online questionnaires through a REDcap link. However, these biases were minimized by informing participants to contact the researcher if they were unable to follow the online link and preferred to complete the questionnaires by phone or face-to-face. Advertisements were also hosted on a variety of platforms (university website, job-seeking platforms, community and supermarket noticeboards) to obtain as complete a sampling frame as possible (most or all of the target population had a positive chance of being sampled).

4.4.6.2 Measurement and non-response errors

Transformation of SEDep scores from a continuous variable into categorical SEDep tertiles can also incur loss of precision in this study. However, such SEDep categorisations allow useful health outcome comparisons for disease prevention strategists and have been widely used in the food environment literature (Balcaen & Storie, 2018; Collings et al., 2014; Egli et al., 2020; Gunasekara et al., 2013; Hobbs et al., 2019; Sushil et al., 2017). Sources of survey response error included: (1) non-response errors (data not collected on individual survey questions or entire questionnaires for some participants), (2) surrogate responses where a non-specified respondent may answer on behalf of the specified respondent (e.g., an English speaker completing the survey on behalf of a non-English speaking respondent), and (3) measurement errors when the survey responses were not a true reflection of participants' actual dietary responses (Fricker, 2008; McNabb, 2014). To mitigate non-response errors on questionnaire items, participants were prompted to complete a missing item prior to submitting the questionnaire for analysis. Another method utilised to reduce non-response rates was by making a comments box available to respondents for specifying if and why they were unable to complete the survey. Consequently, it was established during the initial surveys that non-responders were typically older participants who found the survey too long or had difficulties completing it electronically. These participants were followed up by phone or email and provided the opportunity to complete the questionnaires over the phone or face-to-face. Examples of measurement error included misinterpreting survey questions, not answering sensitive questions honestly or exaggerating or misrepresenting responses (reflecting social desirability bias) (Fricker, 2008). Sensitivity of the NZiDep items and calculating servings per day for each food item in the Dietary Habits Questionnaire were potential sources of measurement errors. However, such errors were diminished by emphasising to participants that responses are confidential and will remain de-identified. Portion sizes and food intake frequencies in the Dietary Habits Questionnaire were also clearly defined in standard formats (e.g., a cup, a tablespoon). Another source of error in the surveys was the inability to verify the demographic characteristics of participants. For example, the screening questionnaire asked respondents to specify the geographic area of Auckland they resided in to determine their community SEDep eligibility. If they did not meet the criteria, the unrestricted, self-selected nature of the survey allowed the same respondents to re-do the screening form. As such respondents were potentially not truthful regarding their responses, the researcher closely monitored whether the same respondent was completing the screening form more than once. Respondents were advised to answer questions truthfully as re-entries would be discounted.

4.4.6.3 Limitations of study instruments

Some shortcomings of the outcome measures used must also be highlighted. In hindsight, developers of the Food Choice Questionnaire should consider including items that address subjective norms and peer expectations. Peer pressure has substantial influences upon dietary habits which constitute a symbol of social and cultural belonging, especially in young people (Janssen et al., 2017; Stok et al., 2015). Certain items on the nutrition knowledge index (e.g., item 15) has been largely contested in recent years. Participants’ responses may be based on their exposure to recent evidence that challenges these concepts. Furthermore, some items may not be specific enough. For example item 7 generalises fats when in reality monounsaturated and polyunsaturated fats are shown to be good for cardiovascular health (Clifton & Keogh, 2017). Given Study 2 was for purely explorative purposes, the findings should be interpreted in a way to inform a much larger-scale, robustly-powered study. Furthermore, residents of high-deprivation areas that span across NZ and not just restricted to Auckland must be incorporated. Section 6.3 further details other shortcomings that were commonplace with the other two studies in this research, including those due to the selective recruitment methods.

4.5 CHAPTER SUMMARY

There is a severe lack in research dedicated to understanding the altruistic values and influences that dictate socioeconomic inequalities in dietary habits, a critical risk factor for stroke incidence. Study 2 aimed to do the same, assessing individual *and* community level SEDep associations with *stroke risk*-related diet quality, food choice motivations and nutrition knowledge. The most prominent observations were community and individual SEDep disparities in: (1) intake of stroke risk relevant foods, and (2) importance of the structural aspects of the food environment (price, convenience in food preparation time, food familiarity) and priorities (health, natural content and ethical considerations) in food choice decisions. Such factors were more salient determinants of diet quality as opposed to nutrition knowledge which also did not vary by SEDep status in this study. Except for food choices based on ethical concern, no other food choice motivations moderated SEDep effects on diet quality. Regardless, the correlations between specific food choice drivers and SEDep warrant the inclusion of these factors during the future development of diet-based, stroke-prevention interventions. Based on study findings, Chapter 6 outlines recommendations for future primary prevention programmes and directions for research.

Chapter 5 Coping with chronic psychosocial stress (Study 3)

5.1 INTRODUCTION AND STUDY OBJECTIVE

Growing evidence suggests a positive relationship between psychosocial stress following exposure to prolonged or cumulative acute stressors and increased risk for stroke morbidity and mortality (Brainin & Dachenhausen, 2013; Egido et al., 2012; Henderson et al., 2012; Kotlęga et al., 2016; Tsutsumi et al., 2011). Psychosocial stress is defined as "at least several periods of self-reported tension, irritability, nervousness, anxiety or sleeplessness attributed to poor health, family relationships, living arrangements, occupational stress, economic/financial stress and stressful life events" (Booth et al., 2015, p. 2). When exposed to severe prolonged stressors, one's coping strategies may not work as effectively to re-establish physiological/psychological homeostasis (National Research Council (US) Committee on Recognition and Alleviation of Distress in Laboratory Animals, 2008). Although the relationship is varied and complex, the experience of psychosocial stress has a moderating role in determining how likely PHBCs are to be implemented and/or adhered to (Egido et al., 2012; Kotlęga et al., 2016; M. Liu et al., 2017). Lazarus and Folkman (1984) define coping as cognitive and behavioural attempts undertaken to master, bear or minimize one's internal and external demands and conflicts. The *objective* of Study 3 was to determine the impact of psychosocial stress upon motivation for PHBCs by exploring participants' coping behaviours and the outcomes sought from such behaviours. In order to understand their value, coping behaviours must be considered within the context that they are implemented in. Association studies between coping and stress-related illness classify coping strategies as inherently adaptive (protective) or maladaptive (detrimental) to an individual's health (Holton et al., 2016). Undertaking PHBCs in this study was defined as the ability to continue performing health behaviours (exercise, healthy diet, smoking and alcohol cessation) during stressor exposure.

This mixed-method study using both quantitative and qualitative techniques first sought to explore the sources of chronic stress using the Trier Inventory for Chronic Stress (TICS-E) questionnaire. This was then followed by an investigation on the impact of stress on PHBCs, utilising an interview approach to determine: (1) participants' reactions to stressors, (2) the adaptive/maladaptive coping strategies used, and (3) the purpose behind such strategies (e.g., emotional, avoidant, problem-focussed). In the context of Study 3, maladaptive behaviours were stroke risk behaviours that were summarised in Section 2.4.

5.2 METHODS

5.2.1 Sample selection and participant characteristics

Ethical approval was obtained from the AUT Ethics committee (Appendix 1) prior to all study procedures being conducted. Initial contact methods for participant recruitment from the RIBURST study and advertisements (when a sufficient sample number could not be recruited through the RIBURST pool) was completed utilising the same protocol as for Study 1, outlined in Section 3.2.1. While use of the SR was not integral for this study, RIBURST participants who were contacted for Study 1 and 2 were also invited to participate in this study, provided that they met the following criteria:

- Over 20 years of age and NZ-based
- Answered 'yes' to the question 'Did you experience significant emotional/mental stress in the last three months' in the SR algorithm at RIBURST baseline
    - (This information was collected to determine whether potential participants were eligible to complete the TICS-E questionnaire. As advertisement responders were not SR users, this information was attained in a screening questionnaire after participants completed the consent forms)
- Had completed the SR algorithm in the three months prior to the study start

Furthermore, eligibility was confirmed based on participants' answers in the second set of eligibility criteria questions (after consent form was signed)

- Had no history of stroke, heart attack or a chronic health condition such as diabetes
    - (This was to exclude participants who undertook adaptive behaviours primarily to manage their health conditions)

- Were contactable by residential telephone/video call
- Were able to communicate verbally in conversational English (without supported communication and/or an interpreter).

The RIBURST sample allowed a guided approach to recruitment and provided a readily available pool of participants to recruit from as the SR algorithm captured whether participants experienced mental or emotional stress prior to study initiation. The manage section of the app also provides users with recommendations on adaptively coping with psychosocial stress and the role of stress in increasing stroke risk. This allowed the researcher to address the broader rationale for performing this research, i.e., investigate whether stroke risk awareness and the contributory role of stress motivated SR users to manage stress adaptively and undertake PHBCs. The potential implications of having common participants across all three studies and its limitations are discussed in Section 6.1).

Appendix 14 and Appendix 15 display the information sheet and consent forms provided to RIBURST and advertisement participants for the study. If they met the second set of eligibility criteria, participants completed a demographics questionnaire where they selected their appropriate gender, age, ethnic and professional status, following which the TICS-E questionnaire was administered. Sample size considerations followed the same principles as outlined in Section 3.2.1.6. The researcher continued recruiting for participants until they satisfied two criteria: (1) met the TICS-E high stress categories for eligibility into the interview phase (Section 5.2.2.2), and (2) no new themes emerged from interviews and theoretical saturation was reached. Section 5.3.2 of the results section reports the final sample size based on these considerations.

5.2.2 Outcome measures

5.2.2.1 Trier Inventory for Chronic Stress (TICS-E)

The first objective of Study 3 was to differentiate between individuals who experienced chronic stress and those who underwent transient, acute stress episodes. Chronic stress, which is the focus of this study, was characterised by either: (1) repeated occurrence of various stressors over an extended time period, or (2) ongoing high demands and/or lack of life satisfaction and unfulfilled needs due to stress (Petrowski et al., 2012, 2018). As the human body struggles to habituate to chronic stressors lasting >30 days, long-term illness development is more likely to occur in response to chronic than acute stressors (Petrowski et al., 2018). Widely-used measures of stress such as the Perceived Stress Scale fail to differentiate between sources of chronic stress and stress intensities, while others only explore stress intensity within particular settings (e.g., workplace) (Petrowski et al., 2018). As the study sample hailed from a range of social and professional backgrounds, a comprehensive measure that captured a broad spectrum of chronic stressors was necessitated.

For this purpose, the standardised 57-item Trier Inventory for Chronic Stress (TICS-E) was deemed suitable for this study. Originally developed in German by Schulz, Schlotz, and Becker (2004), the TICS-E is the first instrument to distinctly capture chronic psychosocial stress into nine sub-scales: (1) Work Overload (e.g., "I have too many tasks to perform."), (2) Social Overload (e.g., "I must frequently care for the well-being of others."), (3) Pressure to Perform (e.g., "I have tasks to fulfil that pressure me to prove myself."), (4) Work Discontent (e.g., "There are times when none of my tasks seem meaningful to me."), (5) Excessive Demands at Work (e.g., "Although I try, I do not fulfil my duties as I should."), (6) Lack of Social Recognition (e.g., "Although I do my best, my work is not appreciated."), (7) Social Tensions (e.g., "I have unnecessary conflicts with others."), (8) Social Isolation (e.g., "There are times when I have too little contact with other people."), and (9) Chronic Worrying (e.g., "There are times when I worry a lot and cannot stop.") (Petrowski et al., 2018). These nine factors follow the Systemic Requirement Resource Model of Health. According to this model, the individual mobilizes external and internal resources to cope with both internal (self-imposed) and external (work-related) demands (Petrowski et al., 2018). These nine dimensions are heuristically grouped into two higher-order factors: (1) High Demands capturing work and social stressors and (2) Lack of Satisfaction due to these conditions (Figure *5.1)* (Petrowski et al., 2012). The questionnaire was translated into English in line with International Test Commission Guidelines for Translating and Adapting Tests and is found to have robust internal reliability and consistency, comparable to the German version (Petrowski et al., 2012, 2018).

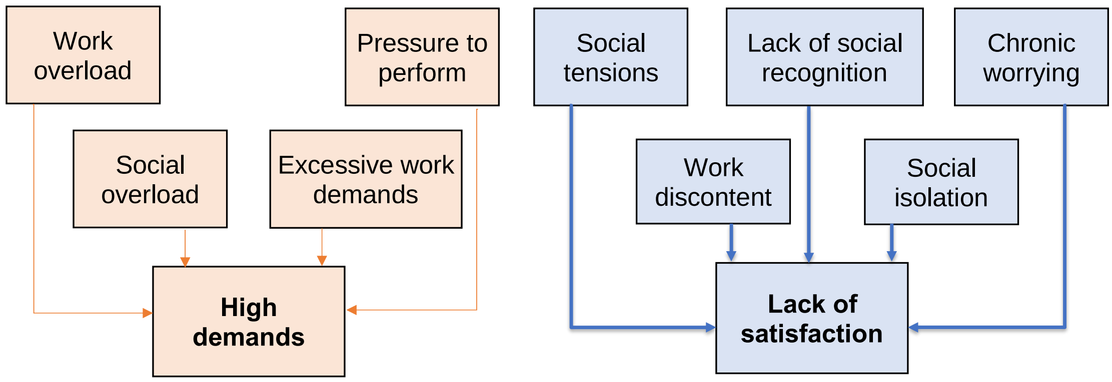

Figure 5.1 9 factors assessed by the German Trier Inventory for Chronic Stress

The inventory captured how often a given participant experienced a described stressful situation in the last three months (Appendix 16). Each item was scored on a 5-point Likert scale: 1 = never, 2 = rarely, 3 = sometimes, 4 = often, and 5 = very often. A total score on each of the nine sub-scales was calculated by summing associated item scores (Hapke et al., 2013). To mitigate the likelihood of missing values, the survey was formatted in a way such that if participants missed answering an item, they were prompted to complete this item before continuing onto the next item in the questionnaire.

5.2.2.2 *Qualitative data collection*

For the second part of data collection, open-ended, semi-structured interviews were conducted to further explore types of coping strategies participants undertook when dealing with a stressful event. Participants were considered eligible for the interview phase of the study if their overall TICS-E score met one of the two following categories. These scores were based on the distribution of scores in the overall sample: 181-201 points (50-90th percentile indicating above average chronic stress), or 206-285 points (≥90th percentile indicating high stress). Such a scoring strategy to define categories of chronic stress has been previously utilised by Hapke and colleagues (2013).

5.2.2.2.1 Theoretical rationale of study design and researcher pre-understandings

An exploratory, descriptive approach was undertaken as the theoretical basis of the qualitative design for this study, similar to Section 3.2.2.1. This design was deemed appropriate as the goal of the research was to obtain participants' experiences of psychosocial stress and how it affects their general well-being and lifestyle behaviours. Prior to this study, the researcher had pre-conceptions about the impact of psychosocial stress and how maladaptive coping methods to manage stress can be highly detrimental to health. These conceptions were shaped through their own experiences with chronic stress and failing to manage it with adaptive strategies. The following preconceptions and acknowledgements were reflected upon throughout the research process:

- There is a natural tendency to resort to addictive, maladaptive behaviours such as smoking, binge eating and alcohol intake as they provide a sense of relief. Sedentarism was highly favoured as individuals lacked the cognitive capacity and energy to exercise during times of stress
- If maladaptive behaviours are inherently preferred and automatically triggered in response to stress, individuals are less likely to give them up. This would occur regardless of them knowing the adverse health effects of such behaviours.

5.2.2.2.2 Interviews

Semi-structured interviews that lasted approximately 60 minutes were conducted to gain an in-depth understanding of the role that psychosocial stress plays in initiating and/or maintaining PHBCs. Sessions took place face-to-face from May 2019 to August 2019 over video call as all participants had access to video conferencing. The questions primarily inquired about: (1) the types of stressors participants experienced, (2) acute and long-term reactions to these stressors, (3) adaptive and maladaptive strategies participants used to cope with stress, and (4) the benefits they obtained from using such strategies (Appendix 17). Participants were also asked to report any health conditions they experienced that affected their ability to undertake PHBCs. This data was collected in order to distinguish between restrictions on performing adaptive behaviours due to stress as opposed to other causes. Further details on the explorative descriptive research approach and the interview format (including the end of session debriefing) are outlined in Section 3.2.2.3.

5.2.2.2.3 Cultural consultation for recruitment and study design

Cultural appropriateness of the outcome measurements used in this study for Māori and Pasifika participants were conducted as specified in Section 3.2.1.5.

5.2.3 Data analysis

5.2.3.1 Descriptive characteristics and comparisons of TICS-E categories

To examine the differences in TICS-E sub-scale scores between demographic categories, Kruskal-Wallis one-way ANOVA was performed. Kruskal-Wallis was preferred due to the relatively small sample size per category and the unequal sample sizes between groups. Pairwise comparisons were performed using Dunn's procedure due to the limited sample size. In order to avoid being over-conservative in the evaluation, Bonferroni correction of p-values was not performed (Kullgren et al., 2013). Alternatively, the Mann Whitney test for trend was used for gender comparisons. The output was meant for purely explorative purposes and *not* population representativeness. Both significance and 95% confidence intervals were reported with test significance accepted at $p \leq 0.05$. All tests were two-sided.

5.2.3.2 General inductive analysis, ethical considerations and data quality

For qualitative data analysis, the general inductive approach developed by Thomas (2006) was used to identify merging themes inherent within the transcribed interviews. The basis of inductive analysis includes observations generated by both the research questions and repeated reading and interpretation of the dataset. All analysis was undertaken by uploading raw interview data into a qualitative analysis software package, NVivo Version 12 (QSR International Pty Ltd, 2020). The 4-stage analytic process undertaken is described in detail in Section 3.2.3. All three forms of ethical considerations, data quality concerns and rigour as outlined in Section 3.2.4 were met for this study.

5.3 RESULTS

5.3.1 Score comparisons for each TICS-E sub-scale across demographic categories

Following completion of the recruitment period, 39 participants had consented for the study and completed the TICS-E questionnaire. Participants were primarily females (56%), >55 years of age (28%), Caucasian (46%), earned <$30,000 p/a (31%) and had school-level education (49%). Table 5.1 summarises the demographic distribution of the sample and significant differences in the nine TICS-E scale scores between demographic groups. Data is presented as medians as distributions of scores were similar for all groups.

The majority of significant differences were between age groups. Participants aged <25 and 25–34 years had significantly greater stress associated with pressure to perform, work discontent, social isolation and chronic worrying compared to other age groups. Participants aged <25 years experienced more stress associated with excessive work demands, while 25-34-year-olds had greater stress associated with social tension. Students had significantly greater stress associated with work discontent compared to those who were employed or unemployed. No other group differences were statistically significant ($p > .05$).

5.3.2 Participant characteristics recruited for the study

Seven RIBURST participants and 12 advertisement participants were recruited for the qualitative interviews that met the TICS-E chronic stress threshold criteria. A summary of participants' demographic information is listed in Table 5.2. Participants were primarily 25–34 years of age, female, other ethnicity and students. Participants also described any health conditions that they perceived were barriers or affected their ability to undertake PHBC (e.g., physical injury preventing the recommended amount of physical activity). This information is outlined in Table 5.3. This data was collected to provide valuable contextual information in which to interpret actions of participants. Difficulty exercising was primarily indicated either due to cardiovascular issues or physical incapacities. One participant noted dietary restrictions due to food allergies.

Table 5.1

Comparisons of median overall stress score for each TICS-E subscale across demographic categories

		Work overload	**Social overload**	**Pressure to perform**	**Work discontent**	**Excessive work demands**	**Lack of social recognition**	**Social tensions**	**Social isolation**	**Chronic worrying**
Gender	Males (n=17, 43.6%)	29.5	21	29.5	23.5	14.5	12	14	15	13
	Females (n=26, 86.7%)	27.5	21.5	32	21	13	11	16.5	18.5	16
	t-value	.525	.824	1.719	-.284	.327	.456	-.028	.711	.952
Age	<25$_{a}$ (n=10, 25.6%)	31	21	32$_{c, d}$	29.5$_{c, d}$	18 $_{cod}$	11.5	15.5$_{b}$	22.5$_{c, d}$	16.5$_{c, d}$
	25–34$_{b}$ (n=9, 23.1%)	29	22	33$_{c, d}$	26$_{c, d}$	13	13	20$_{c, d}$	19 $_{c}$	18$_{d}$
	35-54$_{c}$ (n=9, 23.1%)	26	20.5	27	17	12.5	8.5	14	14	13
	>55$_{d}$ (n=11, 28.2%)	22	18	26	18	12	10	12	12	11
	F	5.32	2.90	12.41**	19.82***	8.41*	6.15	14.53**	13.15**	12.54**
Ethnicity	Māori (n=3, 0.1%)	25	22	33	28	11	13	18	19	16
	Pasifika (n=3, 0.1%)	23	18	26	20	12	11	17	15	10
	Caucasian (n=15, 38.5%)	26	18	26	18	13	9	13	15	12
	Other (n=18, 46.2%)	29.5	21	32	26	15	11	17	19.5	16.5
	F	4.61	.75	3.95	6.94	3.36	6.26	6.09	4.93	5.61
Profession	Student $_{a}$ (n=12, 30.8%)	30	21	33	28$_{b, c}$	17	12	19	20	16
	Employed$_{b}$ (n=22, 56.4%)	28.5	21.5	29.5	18.5	13.5	11	14	15	13
	Unemployed$_{c}$ (retired, active job seekers) (n=6, 15.4%)	22	18	26	12	12	10	11	11	7
	F	4.00	1.18	2.93	12.61**	1.76	1.42	3.13	3.81	2.62

a-e: Denotes significant pairwise comparisons. using Dunn's procedure
*: $p < .05$, ** $p < .01$, *** $p < .001$

Table 5.2

Demographic distribution of interview participants

Age	N (%)	Ethnicity	N (%)	Profession	N (%)	Gender	N (%)
<25	6	Māori	1	Student	9	Male	7
25-34	8	Pasifika	1	Employed	10	Female	12
35-54	2	Caucasian	4				
>55	3	Other	13				

Table 5.3

Medical history of participants that they self-reported as affecting their capacity for PHBC

Health condition that is self-reported by participant as a barrier	**Number of participants affected**	**Affected PHBC**
High blood pressure	3	Insufficient exercise
Atherosclerosis	2	Insufficient exercise
Atrial fibrillation	2	Insufficient exercise
Surgical procedure	2	Insufficient exercise
Food allergy	1	Dietary restrictions
Various musculoskeletal injuries/osteosclerosis/cyst in left tibia/ prolapsed disk	3	Insufficient exercise
Limited mobility on one leg	1	Insufficient exercise

At the start of the interview, advertisement responders were asked if they had downloaded the app. They all stated they were not interested at the time to install the app and would consider this at a later stage.

5.3.3 Qualitative interview content analysis

Qualitative analysis revealed five overriding themes within the dataset, each of which reflected a pertinent stage in the experience and response to chronic stress. Each theme revolved around a central organising concept: 1) chronic stress is enabled by ongoing exposure to cognitive overload and negative experiences, 2) physiological and psychological responses are associated with both acute and chronic responses to stressors, 3) priorities, values and benefits dictate the coping strategies that are utilised, and 4) self-reflection, planning and acclimatisation is essential for management of future stressors. Table 5.4 displays the themes, sub-themes and codes arising from the data. In the following sections, the percentages of participants indicated is the predominant demographic groups that reported the given concept.

Table 5.4

Themes, sub-themes and codes generated from data analysis

THEME	SUB-THEME	CODES
Chronic stress is facilitated by ongoing exposure to cognitive overload and negative experiences	Persistently occurring stressors	Workload management
		Time pressures
		Peer or client conflict
		Workload management
		Responsibilities and expectations
		Concerns around having sufficient work.
		Performance anxiety: exams assignments
		Uncertainty around new or adverse situations: initiating a new job, wanting to prove oneself
		Unexpected outcomes from a particular situation
		Concern about meeting targets
		Responsible for family members' health and well-being
		Observing stress experienced by family members
		Deaths of family members
		Family disputes
		Combination of stressors
	Transiently occurring, intense worry	Health concerns and worry about one's appearance (e.g., weight)
		Financial obligations
		Social pressures driven by a desire to meet others' expectations
		One-off life events or activities such as a surgery or moving of house.
		Unhealthy lifestyle choices
		Minimizing of guilt associated with maladaptive behaviours
The transition from acute to chronic stress response	Knowledge of the long-term health impacts of stress	Chronic stress is more health-harmful
		Reduced longevity and increased risk for chronic disease development
		Genetic predisposition
		Family health conditions correlated to stroke
		Stress promotes hypertension, affects all bodily systems and poor mental and cardiovascular health
		Using maladaptive behaviours to cope increases risk of stroke
	Physiological and psychological responses differed between acute and chronic phases of stress	Acute physical responses within hours or a day
		Acute psychological reactions
		Chronic stress responses (over several days/weeks) due to inability to resolve stress
		Unable to eat or sleep properly
		Internalising stress
		Weight loss and weight gain

THEME	SUB-THEME	CODES
Coping strategies are dictated by the outcome that is sought and one's priorities and values	Rest, reward and relaxation	Wanting comfort, to be soothed and relax
		Well-earned reward during an emotionally draining experience
		Routines: self-care habits and performing household chores to establish normalcy, have a sense of control and accomplishment
		Relaxing activities
		Enjoyment of coping behaviours
		Increasing energy and rejuvenation
		Outlet to vent stress related anger and frustration
		High effort exchanged for low effort due to tiredness/lethargy and lack of motivation
		Sedentarism and high-calorie food intake
		'Can't be bothered' attitude
		Minimum effort and time, preference for convenience
		'I can't behave healthily, even if I want to'
		Immediate, short-term stress relief
		Self-medicating effects
		Social aspects of coping strategies
	Diversion techniques for diffusing stress intensity	Change of scenery to divert attention from contemplating on the stressor
		Promote focus and a new perspective on the stressor
		Problem resolution
		Defuse build-up of stressor intensity
		Therapeutic and meditative practices
		Headspace meditation app
		Mindfulness
		Relaxing and calming
		'Zen place'
		Self-reflection Over bingeing
		Subconscious cravings
	Sharing the burden of the stressor	Support groups
		Communication
		Problem resolution
		Sharing anxiety
		Feeling assured because someone cares
		Communication adds to the problem
		Others don't care/don't understand

THEME	SUB-THEME	CODES
Coping strategies are dictated by the outcome that is sought and one's priorities and values	Future health utility v. immediate rewards	Self-regulatory capacity
		Priority for health and well-being promotes healthy coping even if effortful
		Self-discipline
		Guilt for engaging in risk behaviour is too much
		Impact of maladaptive coping is only short-term
		Succumb to temptation
		Benefits of risk behaviours outweighed feelings of guilt
		Uncontrollable dependency
		Compensatory health beliefs
Management of future stressors incorporates self-reflection, planning and acclimatisation		Self-awareness of difficulty of resisting temptations
		Envisioning future stressors and preparing in advance
		Active strategizing to modify maladaptive coping due to negative impact of risk behaviours or wanting to role-model healthy behaviours
		Planning to implement at a more convenient time and circumstance
		Acceptance of the inevitability of stressors, controlling it as opposed to stressing
		Monitoring of stress levels
		A switch-off button from stress
		Complete removal of stress-causing situations
		Medication and counselling

5.3.3.1 Theme 1: Chronic stress is facilitated by ongoing exposure to cognitive overload and negative experiences

The interview first sought to establish the typical sources of stress participants experienced as well as the incurring physiological and psychological responses to stress. While the TICS-E summarised the most prominent categories of stress experienced, interviews provided further clarification on events and experiences that contributed towards stress and the severity and longevity of the stress experience. Two key sub-themes were identified within this theme: (1) chronic stress is a result of persistently occurring stressors, and (2) transient stressors cause intense worry but are minimized or overcome.

5.3.3.1.1 Persistently occurring stressors

Unrelenting, recurrent stressors that were at the forefront of participants' chronic stress experiences were those associated with work activities. These predominantly included challenges associated with peer or client conflict, workload management (excessive work commitments, inability to prioritise or complete tasks to a satisfactory level, pressures of meeting deadlines and targets), roles, responsibilities and expectations and concerns around having sufficient work (75% female, 62.5% 25–34-year-old, 50% Asian, 12.5% Māori). Such stressors occurred regularly for most participants, ranging from daily, to weekly, to monthly occurrences.

> "It is the shortage of staff. That can be stressful, you tend to do more jobs than you would normally do. And it goes on. But if it's going into weeks that kind of puts a toll on you." (STR_28, male, 35–54 years, Other ethnicity).

Performance anxiety was a prominent daily stressor for participants who were students (57% female and <25-years-old, 86% Asian) and those in high-intensity work. Of particular note was performance during exams and assignments as well as initiating a new job and wanting to prove oneself in the new role. Uncertainty around new or adverse situations (e.g., in a new workplace) or unexpected outcomes from a particular situation (e.g., finding out one's performance was not satisfactory) were also a constant worry.

> "The scholarship, because I'm doing a degree. Yeah, they require a certain minimum grade from me. And this is always constantly in my head if I cannot reach that minimum standard, the scholarship will stop and with my current state I'll never be able to pay myself." (STR_15, male, 25–34 years, Other ethnicity)

Family constituted a persistent source of stress for study participants (females, <25–34-year-old and Asians). Feeling responsible towards managing family members' health and well-being (e.g., dependent children), caring for sick family members or those with severe medical conditions, witnessing adversity, pain or grief experienced by family members or ongoing family disputes were described across the dataset. Grief associated with death and trauma were major stress event that persisted long-term, anywhere between 6 months to a few years.

> "My daughter has a whole pile of auto-immune diseases. And the added stress from this is still going on. Yes, it causes quite a bit of anxiousness often. Because she's up and down, and up and down. And you have to be aware of those things and make allowances and that type of thing." (STR_22, female, >55 years, Caucasian).

For two male, Caucasian participants, a combination of stressors was reported. Participants identified a highly intense stress event (e.g., death of a family member) which accumulated to a point that it became a trigger for being affected by minor stressors.

> "My father passed away several years ago, and it took a few years for that to come through. So, I used to find that was a real major, that used to probably be the main trigger. Well, the cherry on the top, I guess. So, I'll be getting stressed. And then that would come in and triggers more stress." (STR_32, male, 35–54 years, Caucasian)

5.3.3.1.2 Intermittent stressors facilitate transient stress experiences

Others identified sources of stress including health concerns, concerns about one's appearance (e.g., weight), financial obligations, social pressures driven by a desire to meet others' expectations, and one-off life events such as a surgery or moving of house (42% female and 25–34-year-olds, 68% Asians, 9% Māori and Pasifika employed and students). However, these stressors dissipated over time or were not categorised as a cause of significant worry or anxiety for participants. Unhealthy lifestyle choices, drinking and smoking in particular were often reasons for worry among participants and promoted feelings of guilt in engaging in such behaviours (70% females, 10% Māori and Pasifika, Caucasian and Asians, 60% employed). Nonetheless, these choices did not constitute a significant cause of stress as participants acknowledged that it was under their control to modify these behaviours. Guilt was minimized by attributing the inability to behave ‘healthily’ to causes outside participants’ control such as lack of time.

> “I have felt stressed about quitting smoking. I wouldn't say stressed about managing my weight. I think that's just more upsetting and frustration. I don't think I constantly think about it. If I was to feel that way, then I would just need to get off my butt and go down there to the gym. And I’m not prepared to do that right now.” (STR_6, female, 25–35 years, Māori)

Regardless of the type of stressor, a range of acute as well as long-term reactions during the stress experience that were both physiological and psychological in nature was noted within the dataset. The next theme describes these observations in detail.

5.3.3.2 Theme 2: Transitioning from acute to chronic stress responses

Participants’ responses to stress varied widely between the acute stages (i.e., immediate hours or day following exposure) and in the latter days and weeks following the event. However, participants’ knowledge around the long-term health impacts of chronic stress and the mechanisms by which stress promoted poor health were first explored. These observations constituted the first sub-theme for this theme.

5.3.3.2.1 Knowledge on long-term stress impact: chronic stress reduces longevity and promotes poor health

Some participants who were users of the SR reported that their knowledge regarding the stroke-stress relationship existed even before installing the app, while others were unaware until they used the app. Regardless, participants reported that stroke risk awareness and the role of stress in this risk, while causing some concern, did not translate into a remarkable change in their stress levels. Participants explained this was due to their stress being associated with circumstances that were often beyond their control and were likely to be ongoing. These participants acknowledged the adaptive coping methods provided in the manage section of the app. However, they reported that they tended to follow management techniques that provided them the outcomes that they sought (e.g., relaxation and rest) and fit within their capabilities. This was particularly salient for participants who followed maladaptive coping techniques such as smoking, reporting that some of the techniques provided in the app did not necessarily relieve their stress.

> "The Riskometer helped me realize how stress is a factor…It was scary. But I am helpless as stress is an everyday thing, not really in my control. And deep breathing and all..doesn't really help." (STR_33, female, 35–54 years, Other ethnicity).

Participants associated greater health harm associated with chronic stress as opposed to acute, short-term stress. In particular, participants reported a reduced life expectancy and increased risk for chronic diseases such as stroke (91% female, 55% 25–34-year-old, 9% Māori and Pasifika, 55% Asian). Such outcomes were attributed to the accumulation of stress hormones for an extended period of time. Across the dataset, there were some contrasting opinions with regards to whether intensity or the length of the stress event was more relevant for disease development.

> "I think its people who live those really stressed lifestyles who don't deal with stuff, don't look after themselves. We say in our language, 'He's going to give himself a heart attack.' And that's that long-term stress bunny. As opposed to 'My partner just died and I'm really stressed right now', I don't think that that's going to give you a stroke. No, you get over that stuff." (STR_19, female, >55 years, Caucasian)

Two young, male participants identified a genetic predisposition to stress which coupled with having a genetic history for non-communicable disease boosted the risk for illnesses. Correlating a major health event or premature death in family members to their long-term struggle with stress strengthened participants' beliefs in the association between the two factors.

> "I come from a family that are all A-type personalities, and they do tend to stress, and I see it in my oldest son now he's got already stuff laid down in his arteries. Stress is the biggest factor. I found that with all members of my family. My husband died at the age of 61. And he was in a very, very stressful job. He was an A-type personality and everything

that didn’t go completely right at the time.” (STR_22, female, >55 years, Caucasian)

The mechanisms by which stress facilitates disease development was also identified. These included its role in adversely affecting bodily systems and poorer mental and cardiovascular health (including promoting hypertension, tachycardia and atrial fibrillation) (employed/student, 73% female, 47% 25–34-year-olds, 67% Asians, 7% Pasifika). Using maladaptive behaviours such as binge eating, smoking and alcohol consumption to cope with stress were identified as contributing towards negative health outcomes.

> “More people tend to follow unhealthy habits like smoking and drinking heavily and eating bad long-term, there are also the physical changes. You are constantly thinking about the problem which makes things worse and obviously over time, build-up of that can’t be good for your body… not sleeping, sleeping very decreased hours.” (STR_13, female, <25 years, Other ethnicity).”

5.3.3.2.2 Physiological and psychological responses differed between acute and chronic phases of stress

Participants stated that the acute stages of their stress response incurred a range of physiological and psychological reactions. Physical reactions included palpitations, sweating, trembling, shallow breathing, fatigue and tiredness, chest pains and loss of focus (73% female and Asians, 45% <25-years-old). Psychological responses identified varied between anger, anxiety, uncontrollable emotions such as crying and tantrums, loneliness (i.e., feeling isolated in dealing with the stressor) and an inability to concentrate on matters other than the stressor (79% female, 43% 25–34-year-old, 64% Asian, 7% Māori and Pasifika). In particular, participants identified that an inability to resolve the stressor quickly fostered despair and chronic levels of anxiety and uncertainty.

> “When I missed the first weeks of school, I was so anxious, and on my way to school, I felt fatigued. I remember I was shaking, and I looked a bit pale. When I am stressed. I just find that there's no point in life. I can't see myself out of the situation. So, I feel like, ‘Why even bother?’ Because I am unhappy.. And I lock myself in that place..There is no motivation to do anything. Not even to wash the dishes, because it’s like, ‘Why do I want the house clean?’ Everything is pointless.” (STR_10, female, <25 years, Other ethnicity)

Such reactions were the frontline responses to stressors and resolved relatively quickly. However, participants reported that unresolved stressors often resulted in lasting hopelessness and helplessness, extreme tiredness and exhaustion. Such reactions often lasted over a period of several days or weeks as a result of not being able to control or resolve the stressor situation (females, 60% 25–34-year-old, 80% Asian, 20% Māori).

> "I was so shaken, that I just withdrew into myself.. I didn't speak a lot. But my anxiety, anxiety levels were really high. It took me a couple of days to settle down. I couldn't think.. I wasn't myself because I'm normally very, 'Yep, I know what to do. Deal with things' and I went to that completely other end of the spectrum." (STR_19, female, >55 years, Caucasian)

Other enduring responses included an inability to function normally, such as not eating or sleeping properly (62% female, 77% <25–34-year-old, 67% Asian, 8% Māori and Pasifika). Others however noted wanting to sleep excessively so that they can prolong having to confront the stressor. Some participants internalised their stress for a few weeks and a reaction was prompted when another issue such as a family argument occurred. Weight loss/gain were commonplace among participants primarily as a result of mismanaged diets.

> "When it gets incredibly intense, I just don't have the sensation of being hungry. Just don't care and just poke food in because otherwise you will be getting a headache. And I don't even care what it is.. It is difficult to swallow. And then you find out when you do eat, you can't eat very much." (STR_36, female, 35–54 years, Caucasian)

While under psychological duress in reaction to the stressor, a number of coping strategies were adopted to help re-establish pre-stress levels of functioning and equilibrium. The cohort was divided into two groups that utilised either adaptive or maladaptive methods. The next theme summarises the coping responses adopted by participants and the benefits they sought through these techniques.

5.3.3.3 Theme 3: Coping strategies are dictated by the outcome that is sought and one's priorities and values

Analysis of the dataset revealed multiple sub-themes, each centred around participants' use of either adaptive or maladaptive coping strategies to pursue specific avenues of stress relief. These included: (1) rest, reward and relaxation, (2) increasing clarity and focus, (3) escape avenues to divert attention from the stressor, and (4) feeling supported. The final sub-theme under this category specifies how participants' priority for either future health benefits or immediate rewards influences whether adaptive or maladaptive coping techniques are adopted.

5.3.3.3.1 Rest, reward and relaxation

Adaptive responses included, but were not limited to, playing sports or outdoor activities such as gardening, playing or listening to positive music, reading, watching TV, interacting with pets, being in nature and doing routine activities such as walking the dog. Participants allocated certain days of the week, commonly weekends, for activities that they enjoyed (females and <25–34-year-olds, 50% Caucasian). They engaged in activities that were relaxing, dedicated for themselves and committed to reducing the stress they accumulated during the week.

> "I just have my moments when I over-extend myself… I try to manage that by not doing too much in the weekend… I try to keep Sundays where I'm controlling it. I'm doing what I want to do when I want to do it. I And then by Sunday night, I've kind of reset. If I have that day, I have to myself…That is my day where I do want to do boring things like tidy the house and clean up a few drawers and stuff like that during the week." (STR_19, female, >55 years, Caucasian)

Three female, Caucasian participants relied on maintaining routines, including self-care habits and performing household chores for momentary stress diversion. Participants reported that conducting day-to-day routines enabled a sense of normalcy during adverse conditions. Being able to solve minor concerns and completing achievable goals allowed participants to have a sense of control over some aspects of their life. Participants identified that they felt accomplished in achieving something in the midst of a relatively uncontrollable, stressful situation.

> "If I'm stressed out about what I'm studying, I just get up and go and do something else in the house, like make my bed helps because it's just ticking off little things. It's like a small achievable goal. Again, it's like saying, 'I'm going to get out, I'm going to downstairs and

go for a walk. And then come back.’ Like you’ve done something that you’ve told yourself you’re gonna do. And for me it relieves stress when I think I’ve done something. Yeah, I try to like just to have a real routine… I kind of get a goal where I'm like, ‘Okay these are the things you've got to do this week. You've got to get from Monday to Friday.’” (STR_5, female, <25 years, Other ethnicity)

Most participants who engaged in adaptive behaviours to cope with stress spoke about genuinely enjoying such activities (83% female, 50% >35 year old, Caucasian and Asian). For example, dancing was both a stress reliever and a means for social interaction for one participant. Cooking was another activity that many older participants reported as being an enjoyable de-stressor. Frequent practice of these behaviours for restoring balance during the unsettling experience of stress eventually became part of participants’ day-to-day routines.

“I've discovered very late in life, the benefit of dance; I do hula and belly dancing. And it's the most wonderful thing. It's all age-appropriate over there, my friends are between 50–70 [years of age]. So, I love it.” (STR_23, female, >55 years, Pasifika)

Participants who enjoyed physical activity described exercise as a way to increase positive hormones and endorphins, promoting better energy levels and being rejuvenating (<25–34-year-olds, 60% males, 10% Pasifika and 90% Asian, 80% students). Additional benefits of exercise included obtaining a sense of control and being a better, positive version of themselves. For those who performed weight training, exercise also provided an outlet to vent pent-up frustration and anger related to the stressor. These participants also inferred that being physically fit increased their capacity to cope with future stressors.

“It was like a drug in itself just after you go exercising. If you do it regularly, endorphins and stuff is like higher. Half an hour, 20 minutes whatever and come back feeling more awake. Yeah, hundred percent therapeutic. When I'm out running, I don't really think about too much or if thinking about something, it’ll be a kind of productive process rather than a sort of stuck one. It just helps me to take my mind off things. Because I like to go really heavy on the weights, so I just take my anger out on that. If you see yourself sort of improving yourself, especially like at the gym, you’re more confident about yourself. You’ll be more calm as well.” (STR_14, male, <25 years, Other ethnicity)

Some participants (71% females, 79% <25–34-year-olds, 64% Asian, 7% Māori and

Pasifika) reported that they religiously practised adaptive behaviours when not stressed as they knew the associated long-term health benefits. During stress however, participants identified a significant tiredness/lethargy and lack of motivation, considering such activities too strenuous to perform. Participants who did not normally enjoy adaptive behaviours (cooking or exercising) or found it effortful described how they renounced these for more low-effort activities during stress. Most participants spoke about a 'can't be bothered' attitude and they did not want to do anything that required minute effort. Normal routines were not followed through, including house chores and basic everyday responsibilities. For those who actively exercised, sedentarism was highly preferred in such instances.

> "It is very hard to exercise when I felt that kind of depressed and [in a] stressful situation. I guess the hardest part is to get yourself out of the house. I mean, to initiate that [going for exercise] was a bit of effort." (STR_35, female, 35–54 years, Other ethnicity)

Participants also rationalised that a break from such activities were a well-earned reward during an emotionally-draining experience such as stress. Participants focussed on priorities and selectively indulged in mundane activities so as to not take on any more stress (69% female, 77% <25–34-year-olds, 8% Māori, 62% Asian). A preference for more convenient alternatives that required minimum effort and time and met participants' needs were preferred. For example, cooking and preparation of healthy meals was foregone for convenience foods or shortcut ways to preparing meals.

> "I normally have green leafy vegetables and fruit. When I'm stressed. I tend to replace the healthy foods with McDonald's. After I eat McDonald's I tend to think, 'Okay, the next meal I need to eat healthy food.'" (STR_16, male, 25–34 years, Other ethnicity)

While the aforementioned participants willingly chose to forego adaptive behaviours during stress, a number of participants reported that they were restricted by circumstances. These included limited leisure time due to work or study, physical inabilities (as identified in Table 5.3) or restrictions or over-commitment to other matters (88% female, 50% 25–34-year-old, 14% Pasifika, 57% Asian and students). Consequently, participants stated that they could not engage in their routine stress management techniques even if they had the desire to.

Alternatively, such activities were demoted in their list of priorities.

> "I wasn't running, I had a couple of niggle injuries that have caused my running to slow down and then work on top of that has negatively impacted the running. And so that that doesn't help either." (STR_25, female, 35–54 years, Māori)

In addition to foregoing normal health behaviour practice, some participants sought immediate stress relief methods in the form of smoking or alcohol intake. Such effects were acknowledged as being only short-term (<25–34-year-olds, 67% female). Participants considered such behaviours to be comforting and relaxing and alluded to its self-medicating effects, providing a temporary reprieve from the intensely negative effect of stress. Comfort food intake were also highly sought out (Asians, 55% female, <25–34-year-olds and students). Older participants viewed alcohol intake following a stressful or difficult day as rewarding oneself with a well-deserved treat.

> "I use the cigarettes more as like a crutch as well. When I'm feeling anxious and stressed and I have a cigarette it makes me feel better... there's nothing I can substitute for it or nothing I found that works. Other techniques just doesn't work as fast. I'm not really sure if it's the nicotine that helps with that when I'm stressed or if it's the deep breathing of smoking, but it helps. Smoking definitely is relaxing... it is enjoyable. I get that instant relief from the first couple of puffs of the cigarette." (STR_6, female, 2–-34 years, Māori)

5.3.3.3.2 Diversion techniques for diffusing stress intensity

Removing oneself from the stressful situation was a commonly-used technique among participants. Participants identified that a change of scenery allowed a distraction with more enjoyable activities, and in the process they gained greater clarity and another perspective on the stressor (<25–34-year-old, 75% Asians, 63% students). Exercise also identified as a diversion from the stressor. Such techniques were reported to defuse the build-up of the stressor by not dwelling on it for too long and clearing participants' minds of the emotional overload. Without negative affect clouding their judgement, this strategy allowed participants to productively work through the stressor.

> "Instead of just carrying on and trying to battle through something, I'll take myself away.

So I'll have to force myself to get up and go. And sometimes just walk out of the office and just go and chat to someone casually around something that's nothing to do with work. Go and have a drink, coffee, or glass of water or something. Not worrying about what other people think about me, you know. And defusing those situations in my mind before they become too big." (STR_32, male, 3–-54 years, Caucasian)

Some participants identified deep breathing exercises, cooking, meditation (including apps), and yoga as therapeutic and reflective practices to cope with the stress and promote focus (50% <25-year-olds, Caucasian and Asian). Use of the Headspace meditation app was popular among several participants. Such techniques improved participants' mindfulness, diverting their minds from contemplating the stressor and establishing calmness.

"Meditation and prayer helps… I would put on meditation, music, worship music and sermons... when I was extremely stressful and couldn't sleep, I would put them beside my bed and lower the tone... I tend to pray on something really positive and then wake up the next morning feeling much better." (STR_35, female, 35–54 years, Other ethnicity)

Some participants had a 'Zen place', an area where they favoured to go to de-stress, such as the beach or the local park (75% female, Caucasian and employed). Participants spoke about being in nature as highly relaxing and calming. The actual act of getting to these places (e.g., walking) and breathing in fresh air was considered meditative. Such strategies were sought out even if participants were tired and emotionally drained following the stressor, mindful of the relief that they gained from being in nature.

"Really helps my head and my stress. Makes a huge difference... even if I'm so tired I can't be bothered to walk, just go to the beach and sit on a bench. Look at the sea. Water, clouds, you know, have the wind blow through you... I feel better, much, much better. Really rewarding, I was happy with having that time in nature, and so close to the water...it [beach] just was just my Zen place really." (STR_36, female, 35–54 years, Caucasian)

For some participants however, smoking and alcohol consumptions were identified as helping them to focus and allowing time for self-reflection (<25–34-year-olds, 75% Asians). Smokers and alcohol consumers spoke about these techniques as helping them to rationally think through the stressor and achieve clarity for resolution. Smoking was also considered as a performance booster, providing energy and focus to get through their work.

> "Smoking for me is almost like meditation because I spend that time self-reflecting and figuring out what my next step is.. I'll be rationally thinking through my problem or whatever's causing me to be anxious and thinking, 'Okay, what can I do to stop feeling this way? What's my next step?' So, by the end of it, I hopefully feel better. Or at least feel like I've got a plan and I'm ready to attack it." (STR_6, female, 25–34 years, Māori)

Maladaptive methods were also utilized for the purpose of removing oneself from the stressful situation (57% males, 88% <25-34 year old, 14% Māori and Pasifika, 57% Asian). Participants reported that it was a 'time out' from the negative affect and anxiety associated with the stressor and a way to reassure themselves that the stressor does not momentarily exist.

> "Only when there's no other escape and you just want to quit reality? Alcohol does that for you. And I mean, on the next day, the problem's there again. But for one night it's gone. Smoking, I think it gives me a chance to be apart, it's like, for me, like the five minutes of having my own time. Get away from it for a bit. I do feel the nicotine on the first one. But it's the habit of smoking that gets me out of my headspace. So I end up filling my lungs with smoke." (STR_10, female, <25 years, Other ethnicity)

Often, participants pursuit for relaxation and wanting to escape reality resulted in excessively performing maladaptive behaviours such as smoking and alcohol intake, especially among social users (73% female, 55% 25-34 year old, 9% Māori and Pasifika, 64% Asian, 71% students). Frequency and intensity of such behaviours increased as participants reported that they found it difficult to limit themselves. Some participants admitted the first few drinks/smokes did not produce the necessary relief and more was consumed to facilitate escape from the stressor. Participants described that uncontrolled intake, in particular high-calorie, comfort foods, sometimes occurred subconsciously.

> "I finish off a bottle. I don't drink for pleasure, I drink for getting drunk." (STR_6, female, 25-34 years, Māori).

5.3.3.3.3 Feeling supported

Some participants adopted the view that a problem shared is problem halved, utilising support groups and communication to cope with their stress (80% females, 60% 25–34-year-old, 10% Māori and Pasifika, 60% Asian, 60% employed). These participants acknowledged that internalising the stressor made the issue larger than it actually was. Such methods provided participants with feedback or ways to resolve the stressor that they normally would not have come up with on their own. Alternatively, they reported that they simply needed someone to express their anxiety to and share the cause of their stress with. In doing do, participants spoke about feeling reassured that others cared about supporting them in their dilemma. It also, reduced the burden of having to confront the stressor on their own and assisted in self-reflection.

> "Communication is like, super key for me, especially when I'm feeling super down or really stressed. Just communicating it to my friends or my family, for me it just like helps me so much. That's my number one when things just kind of mess up and, yeah, letting it out. Letting people know what I feel and it's such a huge weight off my shoulders.. Just because it makes you reflect on what you're doing. Yeah, like, what happened during the week that could have been done better?" (STR_13, female, <25 years, Other ethnicity)

Some participants reported that the social aspects associated with drinking/smoking were therapeutic as it allowed them to engage with others and share their stress as well as distracting them from dwelling on the stressor.

> "...also there's the social aspect, I can have a smoke and talk to someone at the same time and that's probably therapeutic." (STR_6, female, 25–34 years, Māori)

In contrast, some participants identified that communicating their stress with others exacerbated their stress or the advice they provided wasn't very useful (females, 50% <25-year-olds and Caucasians). Sharing their problems did not invoke any particular benefit for these participants, as they felt that others weren't very concerned or couldn't relate to their issues. Instead, they preferred to internalise their stress and did not appreciate any advice from others.

> "Communication doesn't really help. Sometimes it just goes totally negative, because it kind of gets you back into the hole . You end up wanting to talk about the same thing every time and the other person is possibly not interested in that. It annoys you when people say they understand when they don't." (STR_438, female, 25–34 years, Other ethnicity)

5.3.3.3.4 Self-regulation and priority for future health utility v. immediate rewards

Participants who prioritised health and well-being spoke about being self-motivated to implement healthy habits even under stress. Ex-smokers and participants who religiously avoided binge eating and alcohol consumption spoke about self-discipline to circumvent risk behaviours. Other priorities such as weight management and role-modelling healthy behaviours to children were of greater value to them. Even if healthy behaviours such as cooking/exercise were effortful, they mentally compelled themselves to undertake such tasks as they were aware of the long-term health benefits of such behaviours.

> “I guess that's kind of set a little bit of a standard for myself. So for me, when I actually think to myself, like, ‘Oh, I don't want to do that,’ it's a little bit of a big thing. Because I am generally like an intrinsically motivated person. When my mind starts to say things like, ‘I don't want to go to the gym’, then that's when I kind of have like a little breaking like, ‘Okay. It's time to switch gears and maybe I should go to the gym.’” (STR_29, female, 25–34 years, Other ethnicity)

Some participants reported that they had high self-efficacy to resist maladaptive behaviours during stress as they knew it was going to be detrimental to their health (females, 60% 25–34-year-olds, Caucasian and Asians). They anticipated the feelings of guilt that would succeed after engaging in maladaptive behaviours. Participants also spoke about how such behaviours had only a rather futile and short-term impact upon actually resolving the stressor.

> “I'm not inclined to binge on processed foods during stress because I feel too guilty about it. I do comfort eat but I try to avoid really sugary stuff or processed stuff because I know it’s not very good for me.” (STR_23, female, >55 years, Pasifika)

However, some participants identified that self-regulatory capacity to resist the temptation of maladaptive behaviours depleted during times of stress (<25–34-year-olds, 67% females and students, 56% Asians). These participants spoke about their thoughts being dominated by images of performing the behaviour until they eventually succumbed. Those who utilised maladaptive techniques spoke about resorting to such methods at the height of their stress experience (usually immediately after the stressor). Participants then reverted back to healthier habits once the intensity of the stress lessened.

> "When I buy stuff that is not that great, if I'm not stressed, I can just leave it in the cupboard. But when I get stressed, I think, 'Ooh that's in the cupboard, isn't it?' And I can eat a couple of biscuits, put it away. But I just keep going back and back 'til it's all gone. It kind of keeps playing on my mind and I'm like: 'It's still there.'" (STR_24, female, >55 years, Caucasian)

Maladaptive coping behaviours took place despite participants acknowledging that they were aware about their long-term health harms. As a result, most participants described that they experienced guilt succumbing to such behaviours, referring to them as 'guilty pleasures'. For a few participants, the uptake of maladaptive behaviours worsened their physical status or intensified stress due to the associated guilt. Smokers spoke about the unpleasant aesthetics of cigarettes such as its smell and their worry about how they would be perceived by others.

> "I knew it wasn't good [eating calorie-dense foods] and I would often think before that that I don't need it. But at the time it is hard to resist because it is instant gratification. An instant release of the stress and feeling a little better, but then I often feel very quickly after that, 'Oh I may have had more than I needed to, or did I really need that?' So definitely a guilt after it." (STR_13, female, <25 years, Other ethnicity)

These participants reported how they intended to deal with future stressors more adaptively after each instance of succumbing to maladaptive behaviours (75% females, <25–34-year-olds, Asians and students). They spoke about making promises to not indulge in such behaviours again. Nonetheless, participants reported that the experience of stress often overwhelmed their intentions to resist relapse. This behavioural pattern was most salient in smokers and alcohol consumers.

> "I feel after a heavy weekend of drinking, it takes so long to get back to the week. Like Mondays are way rougher, not really feeling like back to myself until the Wednesday and then Friday night I'll be off drinking again." (STR_4, male, <25 years, Other ethnicity)

For several participants (75% females, 63% 25–34-year-olds, students and Asians), the stress relief benefits accrued from performing maladaptive behaviours outweighed the guilt and the health benefits associated with giving them up. Participants stated that they just could not manage their stress without such methods. They reported that any guilt was surpassed by taking a temporary break for health recovery and then re-initiating maladaptive behaviours when they were able to.

> "It [binge drinking] helps in managing my anxiety and release[s] it. It does kill you the next day, you feel more anxiety on Saturday though. You see your face changing. You don't look that fresh or have that glowing look. At this point of time though, the benefits I get from drinking are much bigger than those health issues." (STR_38, female, 25–34 years, Other ethnicity)

For ex-smokers, an intense period of stress, such as a major surgical procedure, instigated a relapse (students, 67% females, <25-year-olds and Asians). Participants reported that coping with intense negative affects through other means did not provide the reprieve they desired.

> "I cut cigarette smoking for maybe two months, and I started vaping. But like I went through, like surgery, and then that just made me want to smoke again. It was just dealing with the surgery, I started again. I think it gives me a chance to be apart, it's like, for me, like the five minutes of having my own time." (STR_2, female, 25–34 years, Pasifika)

In order to minimize the guilt experienced, some participants also rationalised succumbing to maladaptive coping if they ensured that they could compensate for it with another health behaviour (e.g., negate binge eating with extra time at the gym) (Asians, 75% males and students). This is referred to as a form of compensatory health beliefs as outlined in Section 3.4.2.1.

> "It's like, especially this year it became a priority for me to like, if I am eating out, or if I am eating, more carby, you know, fattening sugary food that at least this week, I will not skip the gym." (STR_29, female, >55 years, Caucasian)

The interviews also revealed techniques participants utilised to manage future stressors and to reduce their ongoing impact on their health and behavioural choices. The next theme summarises these methods in further detail.

5.3.3.4 Theme 4: Management of future stressors incorporates self-reflection, planning and acclimatisation

Participants who previously exercised maladaptive behaviours for coping with stress and experienced daily stress acknowledged the temptation to succumb to maladaptive behaviours. They identified that during stress their ability to resist temptation was significantly reduced. As a result, participants anticipated future stressful situations and set provisions in place well in advance to ensure they coped in more ‘healthful’ ways, reducing their likelihood of relapse (86% females, 50% >35-year-olds, 50% Caucasian). For example, participants who craved something to snack on during stress ensured they had access to healthier options as opposed to processed or sugar-rich foods.

> “I just tried to, like swap the candy for carrot sticks. So it's just a matter of consciously when we do the shopping... grabbing a bunch of things that are slightly better for me... it's just trying to plan ahead... like we do meal plans and stuff. Because otherwise, if we don't we’re just going to get takeout...We try to have a plan for it otherwise when we’re both stressed, and tired, then we’ll eat sh** and feel sh***. We try to avoid it from the beginning.” (STR_5, female, <25 years, Other ethnicity)

A proportion of participants who engaged in maladaptive coping reported deliberate intentions and plans to modify their maladaptive coping methods (71% females, <25–34-year-olds, Caucasian and students). They spoke about a strong willpower to change as they valued their long-term health and the adverse impacts of maladaptive behaviours were increasingly taxing. Wanting to role-model good behaviour (in front of children, work clients) also triggered a decision to cope with stressors with more adaptive techniques. Alternatively, participants who currently: (1) had time restrictions and unable to prioritise adaptive coping, or (2) experienced stress so intensely that maladaptive techniques were a ‘necessary evil’, estimated a time in the future when they would have the opportunity to implement their strategies.

> “I’m going to try my best now to just actually quit. So I already have this plan that to finish what I already bought. Coz I was stressed, I bought it. But now since I'll be moving in closer to my friends, I'll actually have someone to support me. Someone I can go and have a coffee with instead of buying a packet of smokes.” (STR_10, female, <25 years, Other ethnicity)

Participants made an attempt not to stress until it was for major concerns or issues, avoided stressful situations, or chose not to dwell on a stressor for too long (Asians, 67% males,

>35 year olds). Older participants described how they had begun to acclimatise towards the experience of stress and were not as affected due to how recurrently it occurs. These participants chose to accept that some situations cannot be changed or modified, and it is best to accept as it is rather than stressing. Participants reported that they sought to understand the stressor, controlled it and was rational enough to know that they can overcome it. Other participants closely monitored their stress levels and managed them such that they did not amplify to an extent that triggered maladaptive coping.

> “At the end of the day, it’s [stress] going to happen anyway. It is what it is basically. So, you try and control stress by understanding it is what it is, and it’s not going to change. So, you’ve got to deal with it. I’ve learnt how to control it. I accept that there’s factors outside my control, which I can’t do anything about.” (STR_27, male, >55 years, Caucasian)

Two male, Asian participants with work-associated stressors described a ‘switch-off button’ once they were home. They ensured that stressors experienced at work did not interfere with their time with family and routines at home. Such participants spoke about prioritising what was important for them and ensuring a successful work-life balance.

> “I have been nursing for years. So you tend to develop something, you learn how to switch on and off. ‘Coz once you’re home, forget about work and once you’re at work, you focus on work. You learn to have a switch that you turn on and off. When I get home, I just cycle and then forget about work.” (STR_28, male, 35–54 years, Other ethnicity)

Two female participants, >35 year old and of Caucasian ethnicity took measures to remove stressors altogether from their lives. For example, one participant chose to quit their jobs which had been a source of chronic stress for them. They reported that this was often at the cost of significant losses associated with finances and job integrity.

> “I turned my back on working full-time with children, because I wasn't coping with the stress. You have to walk away from the financial benefits of it, and the second one is, you walk away from the status of your job.” (STR_30, female, >55 years, Caucasian)

Two female participants of 25–54 years of age and of Asian ethnicity recognised that they needed additional help in the form of medication or counselling. There was an understanding that stress could not be resolved by themselves or temporary measures could not help address a more chronic issue.

> “I found that even when I changed jobs, and changed the environment, I was still carrying the same amount of stress. The stress and anxiety has not left me although I was in a different job. So I am on antidepressant medication.” (STR_33, female, 35–54 years, Other ethnicity).

5.4 DISCUSSION

This study demonstrated the critical role of stress in impacting one’s ability to undertake PHBCs. The differences in values, priorities and intentions between those who utilise maladaptive or adaptive techniques to cope with stress were also identified. Similar work has only been sparsely conducted within a NZ context (Ayers et al., 2008; E. Chang et al., 2007; Glover et al., 2010, 2013; Szabo et al., 2016). Several conclusions could be made from the qualitative and quantitative components of the study. Firstly, one of the primary contributors towards chronic stress were recurring work/academia associated stressors. These included concerns around time management and workload, discontent and performance anxiety. Additionally, tensions, isolation and pressure associated with social relationships also facilitated chronic stress. Secondly, acute stages of stress exposure incurred physiological and psychological responses which resolved relatively quickly. Conversely, responses to unresolved stressors that lasted days and sometimes weeks included hopelessness, tiredness, and abnormal eating and sleeping patterns. Thirdly, maladaptive and adaptive coping techniques were practised to obtain different outcomes, including rest and relaxation, stress diversion and feeling supported. The type of coping strategy utilised and one’s aptitude to perform PHBCs during stress was dependent on their self-regulatory capacity and priorities and values. Lastly, managing future stressors included participants reflecting on their priorities, acclimatising to stress and planning how to manage cravings in advance (e.g., implementation intentions). Increasing acclimatisation to the experience of stress and making the conscious decision to keep its impact to a minimum also improved participants’ abilities to manage stress.

The following section discusses the demographic trends in the sources of chronic stress as identified through the TICS-E questionnaire and qualitative interviews and its comparison to current literature findings.

5.4.1 Sources of stress

The TICS-E observations demonstrated that psychosocial stress in this sample of participants arose from a range of sources. These included chronic worrying (about something unpleasant happening, general worries, not being able to cope with work demands), poor workload management, social tensions and isolation, discontent with their work and performance anxiety. The interviews also identified social pressures, relationships, family and life tragedies as chronic stressors. The study adds to the growing literature evidence indicating significantly greater chronic stress experienced by females than males (Hapke et al., 2013; Sallen et al., 2018). Both <25-year-olds and 25–34-year-olds experienced significantly more pressure to perform, work discontent and chronic worrying, indicating chronic stress was more prone at this stage in life. Such observations have also been reported previously (Herrera et al., 2017; Petrowski et al., 2012; Schmitter et al., 2008). The significance of such stressors in young individuals make sense due to intellectual demands associated with study and academia (Santiago et al., 2017; Sprague et al., 2011). Work discontent is associated with a constant lack in the fulfilment of one's needs (e.g., appreciations, support) (Herrera et al., 2017). Discontent may be experienced due to not having sufficient support or appreciation (for one's performance) during study/work. It is also likely that young people may also experience discontent if they were employed in a job that did not satisfy them but were committed to supporting financial needs during study. In contrast to this study, discontent was significantly greater in unemployed participants in the study by Wade-Bohleber (2020). However, the study was primarily conducted among adolescents and the proportion of unemployed participants in the present study was low compared to students and employed individuals

Stress associated with excessive work demands were also stated by <25-year-olds. Items in this stressor category may be interchangeable with study associated demands. Stress associated with performing tasks inadequately, making mistakes and not performing as expected can also be relevant during study. Being overwhelmed by the perceived lack of time in adequately completing work have also been previously evidenced among college students (Herrera et al., 2017). Most 25–34-year-olds are also beginning to engineer a career path, encounter novel and unfamiliar work environments alongside fulfilling personal life goals (e.g., pursuing a relationship, parenthood) (Lourenço et al., 2015).

Chronic stress associated with social isolation was more pronounced for <25-year-olds while social tension was significantly greater in 25–34-year-olds. Social tension in this age group may be sourced primarily from tensions with co-workers or clients during employment. Ambiguities about one's role in the workplace and increased work demands may be a result of incompatible expectations or lack of respect for one's ideas or job role from employers (Harry, 2020). Social isolation is defined as an absence of meaningful social contacts and is typically observed during exposure to new environments (e.g., new job, new degree) (Ali & Gregg Kohun, 2007). Young people may experience social isolation during university life if they have to navigate and acclimate to its associated social and psychological demands (Ali & Gregg Kohun, 2007). Additionally, time that was otherwise spent on social engagement may have to be compromised to fulfill study demands and workload commitments. In contrast to the current study, Petrowski and colleagues (2012) observed higher scores for the social isolation scale in older participants. The authors considered this was due to the reduced number of social interactions that promote self-esteem which accompany retirement. The lack of this finding in the present study may be due to underrepresentation of older participants who were retired.

The predominant number of participants who met the 'chronic stress' criteria for interviews (determined by their TICS-E scale responses) were primarily female, 25–34 years of age and of Asian ethnicity. While it may be reflective of the literature trends observed above, these participants were the predominant responders to the study advertisements/RIBURST invitations during the recruitment phase. As such, any inferences made regarding demographic trends (on stress experiences and coping strategies) and their comparison to the literature may be biased. Hence, the discussion on the qualitative study findings will concentrate on the themes that arose and their associations with the literature. The interviews revealed greater detail on the types of stressors experienced by participants. Stress associated with multi-dimensional aspects of one’s workplace included time management pressures, excessive workload, inter-professional relationships and performance anxiety. These factors are frequently cited in the literature as top workplace stress sources (Koinis et al., 2015; J. Lim et al., 2010). Secondly, family-related concerns, in particular status of their relationships with family members and their family’s health were another source of chronic stress, concomitant with previous observations (Boss et al., 2016; Figley & McCubbin, 2016; Randall & Bodenmann, 2017). Major life events such as death of a family member, moving to a new country and the process of acculturation and assimilating to the new environment were also major stressors. These findings were similar to observations made by Karalus and colleagues (2010). Such stressors tended to be ongoing for study participants and work-associated stressors were more or less daily recurring occurrences. Alternatively one-off health concerns, social pressures and other events occurred transiently and did not persist for a prolonged period of time. Lifestyle choices such as smoking, lack of exercise and poor diet, while a cause for concern, were not chronic stressors in contrast to earlier conclusions (Twyman et al., 2014). This was achieved by often ascribing the ‘blame’ for performing these behaviours to factors outside their control, such as lack of time.

5.4.2 The stress response

Stress exposure prompts physical, psychological and behavioural responses (Koinis et al., 2015). Participants demonstrated a sound understanding regarding the adverse health implications of chronic stress (including stroke) and the SR was a delivery system for providing this information to some participants. Additionally, utilising maladaptive methods to cope with stress were recognised as aggravating stress-related risk of stroke. The nature of the stress response is associated with particular characteristics of a stressor such as its intensity, severity and level of controllability (Schneiderman et al., 2005). In the acute stages of stress exposure, participants’ physiological responses to stress included palpitations, lethargy and high blood pressure; while psychological responses varied from mood disturbances, emotional outbursts (crying, tantrums, anger), anxiety, depression, anger, loss of control and powerlessness, supporting previous observations (Holton et al., 2016; J. Lim et al., 2010). An incapacity to perform routine behaviours and responsibilities during times of stress was not atypical and is comparable to other findings (J. Lim et al., 2010). The disruptive effects of stress on normal patterning of food intake and sleep is also in agreement with the current evidence (Köster & Mojet, 2015; Louis et al., 2009; Ulrich-Lai et al., 2015), characterised as hypophagic eating responses/reduced sleep or hyperphagic food intake and/or excessive sleep (Moons et al., 2010). Such emotional and physiological responses are a product of the synchrony between two distinct neuroendocrine and immune processes (Moons et al., 2010; Russell & Lightman, 2019). Activation of the HPA axis facilitates cortisol production and proinflammatory cytokines which in turn trigger 'sickness behaviours' such as appetite suppression, poor sleep and social withdrawal (fear) (Moons et al., 2010). The sympathetic-adrenomedullary system is also activated, promoting release of hormones such as adrenalin and noradrenalin and increased heart rate and flow of blood (Russell & Lightman, 2019). These responses are commonly referred to as the 'flight or fight' response in the literature (Russell & Lightman, 2019).

Stress symptoms often extend into days and sometimes weeks (O'Connor et al., 2015; O'Connor & Conner, 2011). Therefore, the stress-related impact on health is often not only confined to the stressor period, but can extend into the phase when the individual thinks about and recovers from the episode (Chafin et al., 2008). Chronic symptoms of hopelessness and despair in not being able to resolve the stressor has been well characterised both in animal models and other cohorts (Golbidi et al., 2015; Violanti et al., 2016). Seeking and consuming energy-dense foods is more commonplace during long-term stress exposure (Torres & Nowson, 2007) and was observed among study participants. Chronic exposure to perceived uncontrollable stressors lead to anticipating dire outcomes following stressors (Landis et al., 2007; Violanti et al., 2016). Eventually, the individual discontinues their efforts to overcome stress (learnt helplessness) and engages in passive or avoidant coping (Landis et al., 2007; Violanti et al., 2016). A number of biological mechanisms that govern the stress-depression relationship have been postulated. These include reduction in neurogenesis (neural stem cell production) and aggravated brain cell death (Shishkina et al., 2010). Chronic stress also promotes neuronal remodelling and deficits in synaptic connections between prefrontal cortex pyramidal neurons, inducing depressive-like behaviours (Golbidi et al., 2015; Horchar & Wohleb, 2019).

5.4.3 Coping with stress

During stress, individuals have a subjective need for recovery and pursuing activities that help them reobtain pre-stressor level of functioning and reduce the strain promoted by stressors (Sonnentag & Zijlstra, 2006). Behaviours are governed by both a considerate, rational thought process as well as an affective system that responds to internal/external cues (Binkley, 2018). Affect regulation is a key motivational process that dictates human behaviour (Kuntsche & Bruno, 2015). People constantly seek circumstances that help them feel better, either by inducing feelings of pleasure or relieving discomfort (Kuntsche & Bruno, 2015). Indeed, SR users in the sample were not specifically motivated to utilize the coping recommendations provided in the app (unless they were already performing them). Instead, methods that they best saw fit to help them achieve the stress relief outcomes they sought were pursued. In general, maladaptive techniques were found to only temporarily alleviate stress-associated emotions among participants. Conversely, adaptive methods were more effective stress management techniques potentially due to the absence of guilt and the associated feelings of wellness. For some participants who required medications to manage their stress, it was difficult to tease out whether they were always prone to depression. If so, experience of chronic stress could have triggered and/or exacerbated it. These were individuals who, despite having permanently eliminated the source of their stress, still experienced its lingering effects. Ellegaard & Pedersen (2012) indicate the same where chronic stress among patients with lower back pain is heightened under overwhelming levels of existing depression and drain regulatory resources to cope**.** It was outside the scope of this study to discover earlier incidences of stress that could have precipitated an underlying depressive condition and intensified future stress episodes. Nonetheless, future studies should consider such influences to provide a more in-depth context as to why some individuals respond more intensely to stress than others.

The coping techniques utilised by study participants can be captured under Lazarus and Folkman's (1984) categories of avoidant/emotion-based coping (e.g., denial or distancing and passive responses) or approach/problem-centred coping (e.g., seeking support or applying strategies to solve the problem) (Martyn-Nemeth et al., 2009). The type of stressor, in particular its degrees of controllability, determined the effectiveness of coping strategies (Szabo et al., 2016). Problem-focussed coping, (i.e., actively strategising to ameliorate the cause of the stress), was not sought by all participants. This was because for some participants, the stressor was a continually occurring event with no coherent solution (e.g., work-associated responsibilities). Under stress however, study participants sought to have a level of control and feel they are capable of achieving goals within their control. For stressors that were a result of a palpable issue/concern, participants sought to eventually resolve the stressor with a tangible solution. Current evidence suggests emotional and problem-focussed coping are distinct to each other (Sulkowski et al., 2011). However, the study data suggests that for these participants, successful emotional coping promotes effective problem-solving-based coping. By allowing oneself to rest, temporarily digress from the stressor or re-establish calmness, participants gained greater clarity and novel perspectives that facilitated problem resolution.

Most participants routinely engaged in adaptive behaviours because they were: (1) mindful of their health benefits (even if they did not necessarily enjoy performing such behaviours, and (2) ‘were in a good place’ and had a positive disposition, similar to that seen in other studies (Mouchacca et al., 2013; Sonnentag & Jelden, 2009; M. Stults-Kolehmainen & Sinha, 2014). As such, the primary difference between those who utilised adaptive behaviours for coping or avoided them under stress were their individual preferences, priorities and values.

5.4.3.1 Self-regulatory strength is facilitated by habits

Stressors required participants to work harder and resolve often unforeseen and ambiguous hassles. Stress induced self-conflict, cognitive demands and negative affect: (1) weakens self-regulatory strength and promotes ego-depletion, (2) disrupts executive function (through symptoms such as sleep deprivation), overrides rational decision-making for doing ‘what ought to be done’, and (3) compels cravings and the brain’s reward circuitry based on implicit preferences (Appelhans et al., 2012; Hofmann et al., 2012; Louis et al., 2009; Sonnentag & Jelden, 2009; West, 2017) Impulsive decision-making is based on implicit preferences shaped by subconscious influences such as habitual associations, norms and upbringing (Appelhans et al., 2016; Cheung et al., 2017; De Ridder et al., 2017; West, 2017). If participants implicitly preferred risk behaviours (such as smoking), such behaviours were automatically brought to the fore during stress, similar to that seen in other studies (Cheung et al., 2016; de Ridder et al., 2017).

For some participants, exercise and healthy meal preparation were automatically part of their stress management techniques as they were inherent in their day-to-day activities. Such routines or after-work leisure activities (e.g., weekend activities) were repeat responses conducted in a stable environment. As a result, these are automatic as opposed to deliberative cognitive processes (Sonnentag & Jelden, 2009). The routine nature of behaviours is useful when self-regulatory resources are depleted due to stress or long working days (Sonnentag & Jelden, 2009). Routines attenuate the association between self-regulatory resources and effortful activities and help individuals to initiate and persist in such activities (Sonnentag & Jelden, 2009). It is a widely accepted that those habituated to exercise or who were avid exercisers had greater regulatory resources and displayed more persistence to exercise in the face of stress (Lutz et al., 2010), corroborated by present study findings. Alternatively, participants who exercised infrequently were more likely to favour sedentarism during stress, as observed in other research (Lutz et al., 2010). Participants that genuinely enjoyed or rationalised the benefits of behaviours such as cooking and exercise reported that these were critical for their stress recovery. As a result, greater engagement was observed, in agreement with previous empirical observations (Rhodes et al., 2009; Sonnentag & Jelden, 2009).

5.4.3.2 The convenience preference

For some participants however, cooking and exercise were perceived as requiring a high level of effort and self-regulation during stress and there was a natural tendency to avoid activities that required additional energy expenditure. Participants deliberately set aside health priorities (such as healthy meal preparation) to satisfy immediate needs, utilising stress as a ‘licence’ to do so. Instead, convenience food consumption and sedentarism were preferred. This was particularly salient among students for whom stress related to exams and assignments took precedence over self-care and health-promoting behaviours, in line with previous research (Oaten & Cheng, 2005; Serlachius et al., 2007). Although physical activity repelled the negative affect associated with psychosocial stress for some participants, a bi-directional relationship was also noted. This finding has been widely reported in several retrospective, prospective and cross-sectional studies (M. Stults-Kolehmainen & Sinha, 2014). Stress and its associated emotions were detrimental towards participants' efforts to initiate and/or maintain exercise-related PHBCs.

In their place, participants preferred sedentariness and engaging in activities that incorporated little or no movement, such as watching TV, complementing other findings (Owen et al., 2010; M. Stults-Kolehmainen & Sinha, 2014). Kroese and de Ridder (Kroese & De Ridder, 2016) describe such failure in self-regulation as procrastination, a phenomenon that was also observed in Study 1 (Section 3.4.3.2.2). Individuals knowingly and wilfully choose not to perform an intended behaviour (e.g., forego the gym) during stress despite expecting to be worse off (e.g., expecting guilt). While adaptive coping was consistently driven by health and wellness, the avoidant copers were more nonchalant in temporarily exchanging their priorities for more health-averse indulgences. Guilt that succeeded maladaptive behaviours (e.g., binge eating) was relieved by compensatory health beliefs (described in Section 3.4.2.1.). These beliefs helped participants justify such methods if it was compensated with other adaptive behaviours (e.g., exercising more) performed at a later stage. Such beliefs rationalised foregoing healthy meal preparation and exercise, particularly among students and parents experiencing time-related stress, in line with the study by Alm and Olsen (2017). Avoidance of health-promoting behaviours during a stressful day may have only inconsequential impact on long-term health *provided* these behaviours are eventually re-adopted. However, a detrimental impact on health may occur when stress becomes chronic and *not* engaging in health behaviours becomes the dominant behavioural pattern.

Intent and feasibility to perform adaptive coping was also reduced in participants who had other priorities, in line with the theory of planned behaviour (Louis et al., 2009; Padden et al., 2011; Sonnentag & Jelden, 2009). The depletion of self-regulatory resources during stress may be more burdensome on those who normally struggle to perform adaptive behaviours (e.g., are unable to afford healthy foods) (Louis et al., 2009). Limited leisure time availability due to time-related pressures (e.g., long working hours) was often detrimental to the pursuit of exercise and sports. These findings are in accordance with findings reported by others (K. Bauer et al., 2012; Gerber & Pühse, 2009; Sonnentag & Jelden, 2009; M. Stults-Kolehmainen & Sinha, 2014). Time stress, the perception that one doesn't have enough time to meet their goal, constitutes one of the primary contributors of chronic stress (Alm & Olsen, 2017; Beshara et al., 2010; Jabs et al., 2007). For these participants, such activities were burdens or minor stressors in themselves and considered inconvenient and 'costly' during high-stress situations. Overall, these findings are consistent with research wherein emotion-focussed coping (distancing, pursuing relaxation and rewarding oneself) is undertaken to reduce the unpleasant emotional impacts of stress (Lambert, 2004; J. Lim et al., 2010).

5.4.3.3 Escaping the problem

The inability to detach from the stressor and the continued challenge on functional systems led study participants to seek avoidance-based methods. An escape theory is also associated with undertaking maladaptive behaviours during stress, classified as motivated attempts to avoid experiencing distress and dysphoric emotions or negatively appraising oneself under stress (O'Connor et al., 2008; Sulkowski et al., 2011). Smoking was considered a necessary outlet from the gamut of stress-related emotions, provided a calming break from routines and a moment for oneself. Similar conclusions have also been reported in other research (Glenn et al., 2017; Kuntsche et al., 2017; Memon et al., 2016). Nonetheless, such techniques did not resolve the root cause of the stressor and became a vicious, negative feedback loop. Maladaptive methods were sought again and again for continued stress relief when a tangible solution was not in sight for study participants, corroborated by other findings (Kuntsche et al., 2017; J. Lim et al., 2010). While these methods alleviate stress in the short-term, long-term dependence alcohol intake and smoking can worsen rather than resolve negative affect. This can occur due to poorer physical/emotional well-being and amplified mood fluctuations, potentially as a result of increased glucocorticoid production (Gustafson et al., 2013; Hajek et al., 2010; Herman, 2012; Jahnel et al., 2019; Kuntsche & Bruno, 2015; Pampel et al., 2010; Torres-Berrio et al., 2018).

Contrary to popular belief, positive forms of avoidant coping methods were found to facilitate chronic stress resolution both in the present study and in adolescent populations (Martyn-Nemeth et al., 2009). Physical removal of oneself from the stressor situation encouraged relaxation and a diversion from the stressor and its succeeding emotional overload. A popular method for impeding the build-up of ongoing work-associated stressors was to purposefully disengage oneself both mentally and physically when participants were home. Psychological detachment has been well characterised (Sonnentag & Bayer, 2005; Sonnentag & Fritz, 2007) and key to workplace-related stress recovery, incurring not only physical removal but also not thinking about one's job-related issues (Ayers et al., 2008). In doing so, cognitive demands on functional systems that occur during work stress are significantly reduced according to the Effort-Recovery Model (Sonnentag & Bayer, 2005; Sonnentag & Fritz, 2007). Study participants also reported better mood by following this technique. Cognitive distancing or detaching oneself from the stressor allowed participants to perceive a brighter side to the situation and promote better mental health outcomes, corroborating findings in other studies (Lambert, 2004; J. Lim et al., 2010). The study findings were also consistent with research showing that mindfulness-based stress-reduction techniques such as yoga, meditation and deep breathing promote calmness and self-reflection (Holton et al., 2016). Mindfulness incorporated maintaining momentary awareness and disengaging from stress-associated negative thoughts and emotions (Ludwig & Kabat-Zinn, 2008; Y. Y. Tang et al., 2007). In doing so, emotional imbalance is restored and brain, endocrine and immune responses are regulated (lowering salivary cortisol and increasing IgA concentrations) (Ludwig & Kabat-Zinn, 2008; Y. Y. Tang et al., 2007).

5.4.3.4 Rest, reward and relaxation

The pursuit of rest and relaxation triggered a self-regulatory pathway by which hedonic balance was restored through engaging in self-perceived pleasurable activities. Techniques to reward oneself and promote rest and relaxation (e.g., enjoyable activities, self-care and routines) allowed participants: (1) time to recoup, (2) to overcome the negative affect that the stressor induced, and (3) to experience a sense of renewed control. Physical activity and sport was widely accepted for effective stress recovery and obviate displeasure both in the present study and other cohorts (Chafin et al., 2008; Holton et al., 2016; McHugh & Lawlor, 2012). This technique buffers against the deleterious effects of stress on health through multiple neuroendocrinological, immunological, and behavioural pathways (Greenwood & Fleshner, 2011). These include but are not limited to: (1) limiting activation of the sympathetic nervous system, serotonin production, immunosuppression and lowering systolic and diastolic blood pressure, (2) increasing endorphin and energy levels, and (3) fostering psychological well-being (Gerber & Pühse, 2009; Greenwood & Fleshner, 2011; McHugh & Lawlor, 2012; M. Stults-Kolehmainen & Sinha, 2014). Exercise is also a potent mood regulator, misattributing arousal through cognitive distraction or biochemical changes, minimizing the emotional nature of stress-induced thoughts and improving mood impairment within10–20 minutes (Chafin et al., 2008; Gerber & Pühse, 2009; Sonnentag & Jelden, 2009). Based on participants' accounts of feeling invigorated after exercise, even brief periods of exercise following stress can shorten the duration of one's cardiovascular reactions to psychosocial stressors (Chafin et al., 2008). Exercise performed after a stressful event interrupts the feed-forward process by which post-stress anger and autonomic activation sustain each other long after the stressor occurs (Chafin et al., 2008). If sustained over time, the collective anxiolytic and antidepressant effects of exercise helps limit sensitivity to stress and increase tolerance (McHugh & Lawlor, 2012; Sonnentag & Jelden, 2009). Furthermore, the study also evidenced how exercise improved confidence in oneself, endorsing self-esteem, mastery and self-efficacy and the ability to respond adaptively to future stressors (Gerber & Pühse, 2009; McHugh & Lawlor, 2012).

Smoking, alcohol intake and binge eating also functioned as emotion regulators and were valued for their pleasure-inducing properties, both by study participants and in other cohorts (Bryant et al., 2011; Dawson et al., 2012; Glover et al., 2010; Holton et al., 2016; Jahnel et al., 2019; Karalus et al., 2010; Memon et al., 2016; Stewart et al., 2011; Twyman et al., 2014; West, 2017). For those who were active smokers and alcohol consumers, acute periods of stress perpetuated an over-reliance on such behaviours (i.e., frequency and intensity). These methods: (1) were an indulgence or reward for confronting stressors, (2) instant 'self-medication' and stress relief that had an immediate effect, (3) enhanced performance and energy, (4) increased focus and clarity for problem-solving and (5) incurred a social aspect where the opportunity to socialise with other smokers allowed a diversion from the stress. These findings have also been replicated in other research (Glenn et al., 2017; Glover et al., 2010; Kuntsche et al., 2017; Memon et al., 2016; Stewart et al., 2011). However, scientific evidence that validates the 'self-medicating' effects of smoking or its ability to increase focus and concentration is limited (Jarvis, 2004; Memon et al., 2016), indicating it is more of a self-perceived notion. The aetiology of these associations narrows down to the fundamental, neuroendocrine responses in response to stress. Stress increases tryptophan access to the brain and facilitates repeated stimulation of the neuroendocrine HPA axis and glucocorticoid (e.g., cortisol) production (Peltier et al., 2019; Ulrich-Lai et al., 2015; Warne, 2009). Enhanced cortisol production is also linked to the regulation of the reward/stress circuitry (Herman, 2012; Sinha, 2008; Torres-Berrio et al., 2018). Activation of these pathways sensitises individuals to the reinforcing impact of substances of abuse and palatable foods on mood, cravings and physiological reactivity (Peltier et al., 2019; Ulrich-Lai et al., 2015; Warne, 2009). Addiction to such compounds occurs as a result of the strengthening plasticity of the reward pathway due to chronic stress exposure (Torres-Berrio et al., 2018). Smokers in this study strongly perceived this behaviour as an *essential* aid to face daily stressors. Life tragedies, such as coping with the loss of someone, prompted motivational tension for relapse in former smokers or drinkers, corroborating other findings (Glover et al., 2010; Karalus et al., 2010; Memon et al., 2016).

For many participants, stress instigated a preference for binge eating or palatable, high-density, calorific foods (concentrated in sugar, carbohydrates and/or fats). The association between stressor exposure and food consumption is complex and bidirectional, dictated by the severity of the stressor and whether it is acute or chronic (Ulrich-Lai et al., 2015). Study participants reported an exchange in the intake of fruits and vegetables for convenience foods and snacking during stress, similar to that seen in other studies (Dehghan, 2016; C. Liu et al., 2007; Mouchacca et al., 2013; O'Connor et al., 2008). Increased anxiety or emotional arousal limits ability to differentiate between real and stress-associated hunger and the cognitive capacity to retain food restrictions, promoting sensitivity to hedonically-appealing food stimuli (Köster & Mojet, 2015b, O'Connor et al., 2008) (Köster & Mojet, 2015; O'Connor et al., 2008).

Such food selection alterations are commonly referred to as comfort foods to represent multiple properties including: (1) reward and hedonic features, (2) reduction in perceived stress response, (3) self-medication, (4) reduce stress-induced plasma cortisol concentration, and (5) mood improvements (Ulrich-Lai et al., 2015). The intake of carbohydrate-rich foods and the consequent rise in serotonergic levels and reduced HPA activity/cortisol production reduces depressive-type symptoms and anxiety, and positively modulates mood (Dallman, 2010; Dehghan, 2016; Köster & Mojet, 2015). Pleasurable and rewarding components of sucrose reduces cardiovascular/sympathetic stress responses via the basolateral amygdala brain region, facilitating persistent stress relief (Ulrich-Lai et al., 2015).

5.4.3.5 Stress-driven addiction and cravings

Stress-triggered cravings for cigarettes, alcohol and calorific foods is underpinned by their addictive effects which is further heightened during negative affect, indicated by laboratory and naturalistic research (K. Bauer et al., 2012; Dallman, 2010; Louis et al., 2009; O'Connor & Conner, 2011; Sulkowski et al., 2011; Ulrich-Lai et al., 2015). Mood regulating, biochemical changes facilitated by substances of abuse and unhealthy snacking strengthen the dependency on these behaviours to 'feel good' during stress (Burns et al., 2013; Dallman, 2010). Subsequently, such reinforced associations become automatic if routinely followed (Burns et al., 2013; Dallman, 2010). During stress, study participants' self-efficacy to resist such behaviours was significantly diminished, as also reported by Hiscock et al. (2012). Even after quitting smoking, the lingering dependency and its powerful, stress-regulating properties promoted relapse among former smokers during high stress situations.

5.4.3.6 Social support

In tandem with previous literature (Ayers et al., 2008; O'Donnell et al., 2010), communication and social support involved active efforts to seek informational, tangible and emotional assistance for stressor resolution. Buffering of stressful experiences through reduced cortisol levels has been evidenced through availability of social support (Cohen & Sherman, 2014; Martyn-Nemeth et al., 2009; McHugh & Lawlor, 2012; Sayed et al., 2019). The general premise supports the utility of social support interventions for managing daily stress and improving outcomes such as smoking cessation (Jahnel et al., 2019). However, according to a caveat raised by Pagel and colleagues (1987), social relationships are also inherently stressful. Some participants chose to internalise their problem as communication with others often compounded their stress, also observed by McHugh and Lawlor (2012). This suggests that seeking social support to manage stress is largely dictated by individual preferences and past experiences.

5.4.3.7 Planning for Future Stressors

Preparing to deal with future stressors in adaptive, healthful ways incorporated willpower and self-efficacy to resist cravings, planning and preparation. Firstly, a desire to modify maladaptive coping methods was reported. This was primarily based on the accumulating, adverse health due to maladaptive behaviours and role-modelling adaptive behaviours in front of dependants such as children or clients. Role-modelling for children has been indicated as one of the most prominent contributors towards a desire to quit among smokers (Edvardsson et al., 2011; Glover et al., 2013; Kanis et al., 2014; Rosen et al., 2012). Nonetheless, while such causes compelled participants to seek healthier coping methods, willpower and knowledge on how to implement such intentions were critical to ensure adaptive coping. Such factors were deemed vital to not only limit palatable food intake but to replace this with healthy foods during stress, as evidenced both in this study and others (O'Connor et al., 2015). In order to restrain themselves from succumbing to maladaptive coping, participants: (1) motivated themselves to perform adaptive behaviours, (2) planned and restricted their access to unhealthy means of coping (e.g., calorie-dense snacks, cigarettes), (3) ensured better peer support, and (4) completely eliminated the stressor (e.g., resigning from a toxic work environment).

Current study participants who were conscious eaters were less likely to engage in stress-induced binge eating. This finding differs from that of Köster and Mojet (2015) who argue that those who take cognitive efforts to resist unhealthy foods are more susceptible to emotional eating. Successfully enacting healthy snacking for future stressors in study participants were contingent on the three stages outlined by O'Connor and colleagues (2015). These incorporated:

(1) motivation to eat healthy, (2) pre-purchase of only healthy foods during shopping, and (3) ensuring healthy snacks are available and accessible at time of stress. Others who frequently encountered stress-provoking events (especially in the workplace) chose not to let them overwhelm them. Instead, they stated that it was best not to dwell on it, utilising strategies such as psychological detachment. Commonly known as *secondary coping*, detachment was a form of cognitive reframing and adjusting oneself to the stressful environment using techniques such as positive reinterpretation and acceptance (Morling & Evered, 2006; Szabo et al., 2016). Such methods have shown to assist acculturation-associated stressors among international students and buffer negative affect (Szabo et al., 2016). Among study participants, these techniques were successful in reducing anxiety because participants were psychologically adjusted with the inevitability and potential lack of control over stressors.

In summary, both the quantitative and qualitative findings coalesce into a pathway of the experience of psychosocial stress and the cognitive and behavioural catalysts which substantiate its role in increasing an individual's stroke risk (Figure *5.2*).

5.4.4 Study strengths

Despite such shortcomings, this study was one of the few in the literature that attempts to explore the intentions of participants when utilising specific coping techniques for stress management. This study represented a preliminary investigation into the relationships between stress experiences and utilising adaptive vs maladaptive methods for its management. As most previous studies explored stress management in defined populations (nurses, dentists, Māori and Pasifika), a uniqueness of the current investigation was to include a broad, albeit, small, range of age, ethnic and gender categories of different income and educational status. The use of the TICS-E to determine chronic stress in a NZ population was another novelty. The scale incorporated stressors across various domains that could be experienced by a broad demographic range (Herrera et al., 2017). The study also attempted to holistically capture several dimensions of the chronicity of the stress experience (i.e., stressor frequency captured by TICS-E, coping preferences and resources, individual differences in stress reactivity, the perceived intensity of stress).

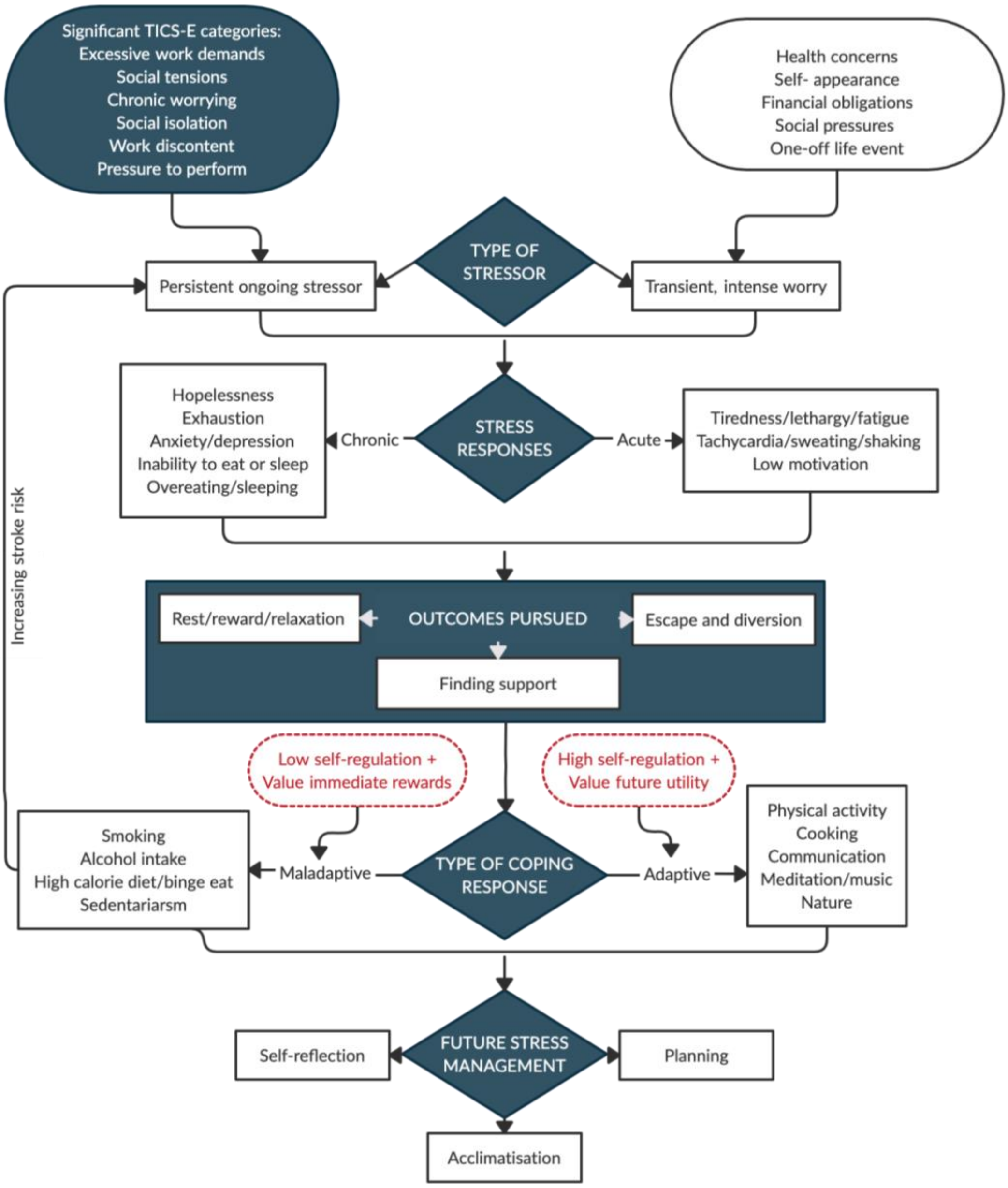

Figure 5.2 Process flow of the stress experience as evidenced by study findings

5.4.5 Study limitations

It is important to highlight several shortcomings of the study design that could impact the generalisability and applicability of study findings. In addition to the limitations in sample size and qualitative design discussed previously (Section 3.4.6), the interview sampling frame was limited. There was an overrepresentation of participants of other ethnicity and <35-year-olds who met the TICS-E cut-off threshold for chronic stress. Such limitations were due to the unavailability of willing participants who met other age and ethnic criteria. This could have resulted in potential bias in the stressors and coping strategies described in the study. Future research should aim to investigate age- and ethnicity-specific trends in the experience of chronic psychosocial stress, coping strategies and outcomes pursued. Participants' reports of the frequency and experience of stressors were largely dependent on self-report and recall. Stressors were not recorded daily and a more robust assessment of daily stress intensity and its chronicity could not be acquired. Stress experiences can influence the recall of coping behaviours with activities (such as cigarettes smoked) being over- or understated. Therefore, more detailed outcome assessment methods such a daily diary may provide more accurate accounts. Nonetheless, using such methods would have been too burdensome and impacted recruitment rates.

Early work reported by Kanner and colleagues (1981) deem daily stress events whose accumulative impact ultimately have proximal significance for health outcomes. Assessing coping in real time (e.g., during opportunistic periods of high and low stress, such as students in the midst of exams) may provide more valid measurements. Common method variance was minimized by assessing the type of stressors utilising the TRIER inventory scale and coping strategies in an open-ended interview technique. Such methodological separation of the measurement of outcome variables helps to minimize such biases (Podsakoff et al., 2003). Future larger sample enquiries must also take into account demographic characteristics (race, socioeconomic disadvantage) that could potentially protect or make one vulnerable to the effects of stress.

5.5 CHAPTER SUMMARY

The experience of stress is a key moderator in the context of initiating and maintaining PHBC for successful primary stroke risk-reduction. We are currently in an era where the presence of stress pervades multiple aspects of an individual's life. Therefore, behaviour-change interventions implemented to reduce stroke risk must take into account the individualistic, contextual and multi-dimensional aspects of stress. There is an inherent need to escape the intense negative affect, re-establish calmness and relaxation and resolve the stressor. However, the methods by which such goals are achieved (i.e., adaptive or maladaptive) is dictated by an individual's priorities, goals, personalities and self-efficacy. For those who normally utilise maladaptive methods, coping with the physiological and psychological impacts of stress deters the best of intentions to perform adaptive behaviours in even the most self-efficacious individual. Therefore, future interventions for PHBC implementation and maintenance must not only identify stress determinants but design management strategies that are both adaptive in nature and feasible for individuals.

Chapter 6 Research implications, future directions and overall limitations

6.1 SUMMARY OF RESEARCH FINDINGS

A critical point of difference that made this research significant and essential were findings that emerged from an authentic, individual-level perspective of the meaning and values ascribed to PHBCs and the motivations for/ barriers against implementing change. The findings from each study are not standalone. Instead, the outputs contributed unique knowledge towards understanding why PHBCs may or may not occur. The research led to the discovery that participants stood along a three stage continuum of behaviour change, transitioning from readiness, implementation and maintenance. Successfully progressing through each stage was dependent on an individual's personal and material standpoints, beliefs, values, priorities, goals, capabilities, socio-environment and self-regulatory capacity. Study 1 findings set the tone for the overall research by establishing the continuum and a broad understanding of the contributory influences. Results from Study 2 and 3 provided a more detailed understanding on the impact of barriers specific to SEDep and psychosocial stress upon PHBCs.

Firstly, readiness to undertake PHBCs was based on whether sufficient motivation existed for participants to modify existing risk behaviours *(*Figure *6.1)*. Study 1 reported participants' unwillingness for change correlated to: (1) the habitual/addictive nature of risk behaviours, (2) poor awareness of stroke risk/risk factors, (3) adhering to anti-PHBC social expectations and (4) compensatory health beliefs. Studies 2 and 3 delivered greater clarification on (1) the impact of SEDep restrictions in limiting intake of a stroke risk reducing diet/promoting poorer diet quality and the FCMs that drive this association (i.e., food price concerns) and (2) how pursuit of stress relief outcomes impedes readiness for PHBCs. Alternatively, Study 1 revealed that values for health and longevity, familial influences, role-modelling and exposure to pro-PHBC norms promoted PHBC preparation. Study 3 confirmed that such motivations prompted participants to utilize more health adaptive coping techniques to manage their stress. Study 1 also demonstrated how PHBC readiness could be an ambiguous experience, with some PHBC-reluctant participants reporting a push-pull moment characterized by a transitional desire to modify risk behaviours. Such experiences were often an immediate response towards the negative, after-effects of risk behaviours.

However, readiness for PHBC did not necessarily transpire into the implementation of these goals. Once participants had sufficient motivation to modify their risk behaviours, Study 1 showed that PHBC implementation were dependent on: (1) rigorous knowledge (how to) and intent to carry out PHBC intentions, and (2) self-regulatory capacity to accommodate PHBCs despite perceived barriers and resist risk behaviour cravings (Figure *6.2)*. Study 3 participants executed PHBCs and boosted self-regulatory strength through strategies such as wholly avoiding stress situations to limit cravings, generating 'if-then' plans (healthy substitutions for risk behaviour cravings) or utilizing social support.

Conversely, the unsuccessful transition of PHBCs from readiness to implementation sometimes occurred wilfully, where Study 1 participants postponed their PHBC goals by intentionally prioritizing other activities. This was primarily driven by participants dislike of PHBCs or if PHBCs were driven by the desires of others than themselves. Alternatively, some individuals were confined to their current limitations that did not allow them to execute their PHBC intentions. Typically, these included circumstances that were non-conducive (time or situational barriers) or if risk behaviours were long-term, automated responses to stress. Although not specifically examined, concerns for food prices could not only have limited readiness but also the ability to implement dietary modifications among the more individually deprived participants in Study 2. Study 3 participants elucidated how depleted self-regulatory strength due to stress limited the ability to execute PHBC goals due to depleted self-regulatory strength. Due to poor stress controllability, participants either: (1) succumbed to the addictive cravings of risk behaviours, (2) pursued the reward/relaxation imbued by risk behaviours or (3) sought to self-medicate or divert themselves using risk behaviours.

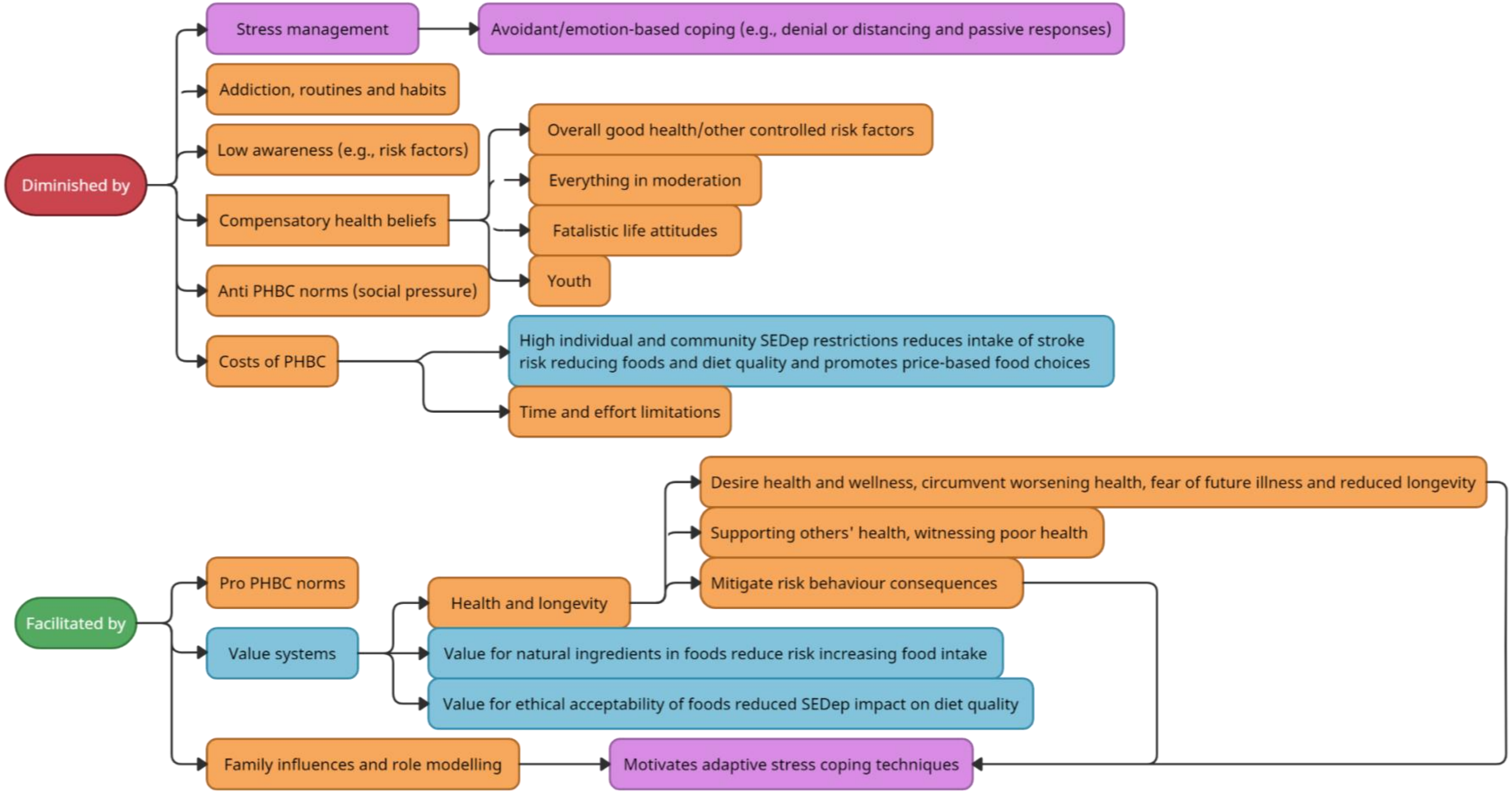

Figure 6.1 Conceptual framework of how findings from study 1 (orange), Study 2 (blue) and Study 3 (purple) interact to potentially diminish or facilitate an individual's **readiness for** PHBCs.

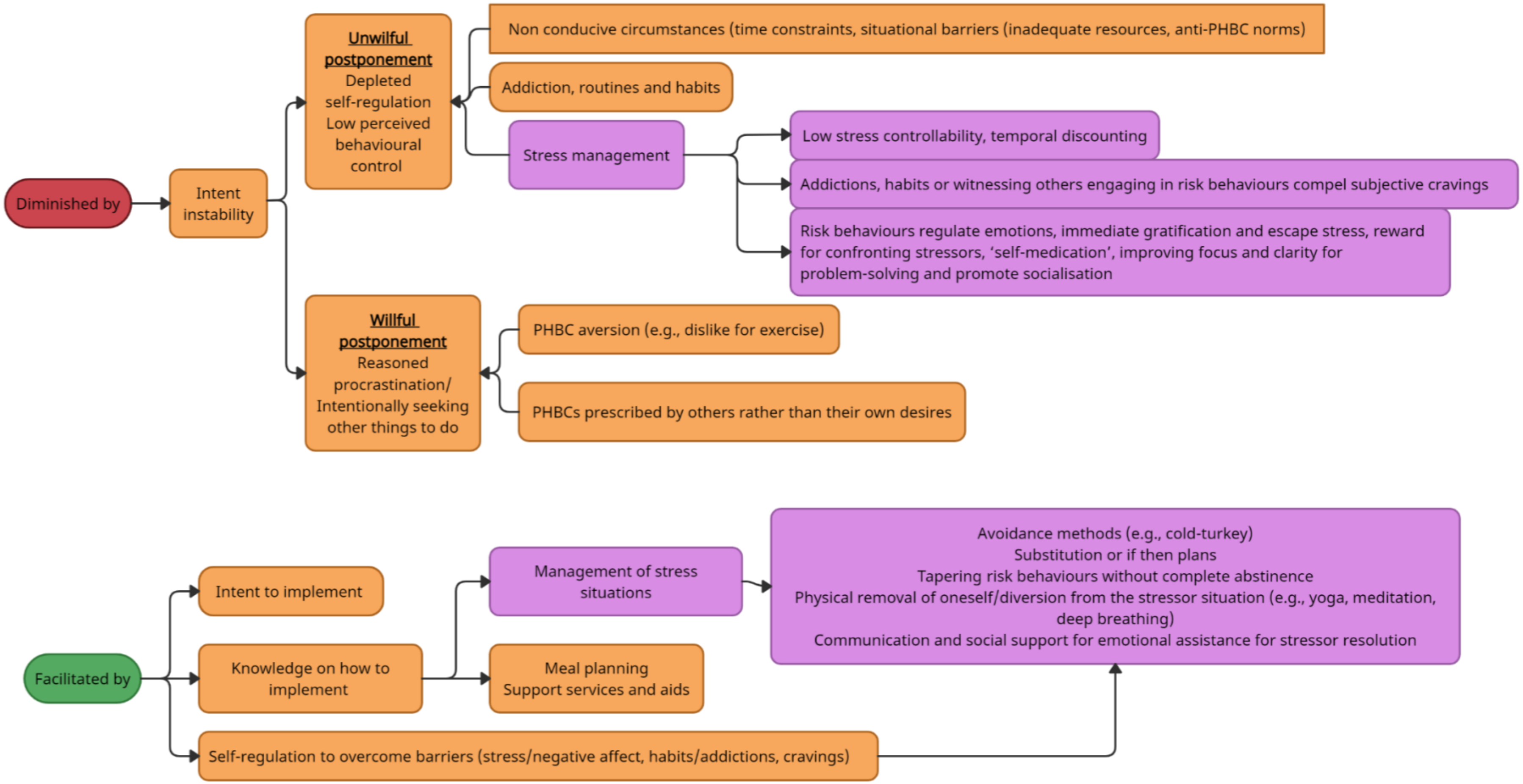

Figure 6.2 Conceptual framework of how findings from study 1 (orange) and Study 3 (purple) interact to potentially diminish or facilitate an individual's ability to **implement** PHBC goals

Lastly, Study 1 demonstrated how maintenance of PHBCs incorporated several components, including a robust self-efficacy to persistently carry out PHBCs (Figure *6.3)*. For this, participants used tools such as self-affirmation and having support systems in place. Self-efficacy among Study 3 participants was sustained using social support and communication skills as adaptive coping techniques for managing stress. PHBC continuance was also facilitated by the alignment of values/priorities with the perceived, accumulated benefits of undertaking PHBCs among Study 1 participants. For example, sustaining exercise-related PHBCs was greater when the participant's value for long-term health/wellbeing was reinforced by an improvement in their physical health. Study 3 participants who religiously followed their exercise regimen, even when stressed, strived for the mood improving, stress reducing outcomes from exercising. Eventually, PHBCs became an inherently automatic way of coping (such as cooking to dispel stress as opposed to binge eating) for some of these participants. Lastly, PHBC maintenance was achieved by a tenacious, self-regulatory capacity to continue implementing PHBCs, even when confronted by risk behaviour cravings and other barriers. Study 3 participants minimised risk behaviour relapse by: (1) adapting themselves to the inevitability of stress or alternatively, (2) wholly avoiding situations that promoted stress/cues that triggered risk behaviour or (3) developing 'if-then' plans.

On the contrary, risk behaviour relapse was facilitated by a number of factors, including the instability of intent for undertaking PHBCs, as shown in Study 1 findings. This was primarily due to: (1) PHBC goals being only short term or means to an end (e.g., improving fitness for running a marathon), (2) other priorities taking precedence (e.g., a new job) or celebratory occasions or (3) PHBCs being driven by external pressures. Sometimes, the addictive/routine nature of risk behaviours triggered short-term or more permanent relapse. Study 3 findings further clarified how stress contributed towards risk behaviour relapse. PHBCs were temporarily abandoned in pursuit of risk behaviour options that were (1) more convenient (e.g., sedentarism instead of exercising due to lethargy or low motivation), (2) regulated their emotions more effectively or (3) were previously habitual responses to stress.

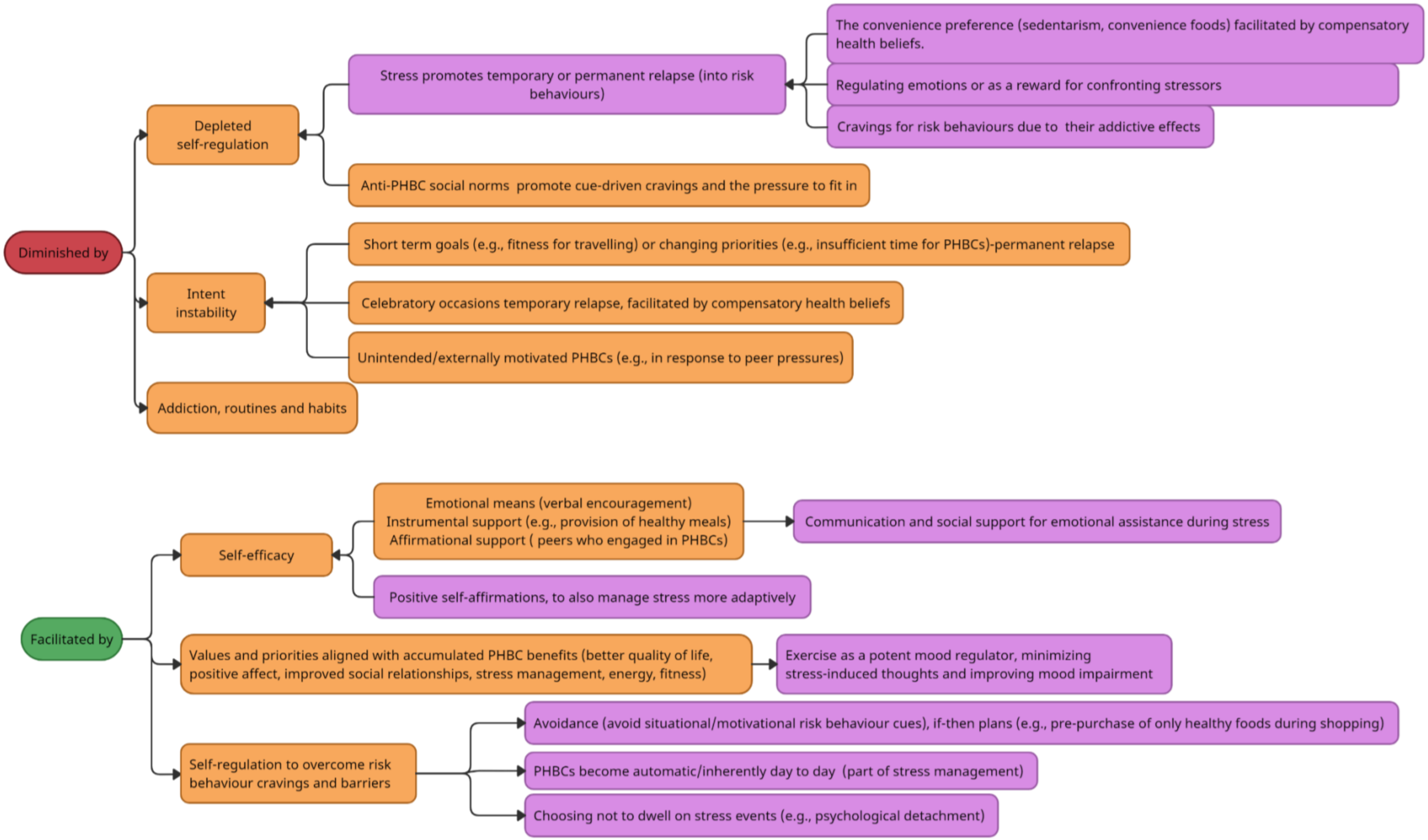

Figure 6.3 Conceptual framework of how findings from study 1 (orange) and Study 3 (purple) interact to potentially diminish or facilitate an individual's ability to maintain PHBC goals.

It must be noted that there were crossovers in participants across studies. Participants were invited to take part in all three studies if they met the eligibility criteria (Figure 6.4). Therefore, participants who identified certain PHBC-associated limitations in one study may have also responded similarly in others. For example, participants who reported time restrictions as limiting their ability to prepare a healthy meal for themselves in Study 1 identified convenience as an FCM in Study 2 (data not shown). There was value in this degree of participant involvement as the more consistent the reports of in PHBC influences across the three studies, the more reliable the participants experiences were on the impact of such factor. However, a major shortcoming of utilizing the same participants was the limited generalisability and population representativeness of the findings.

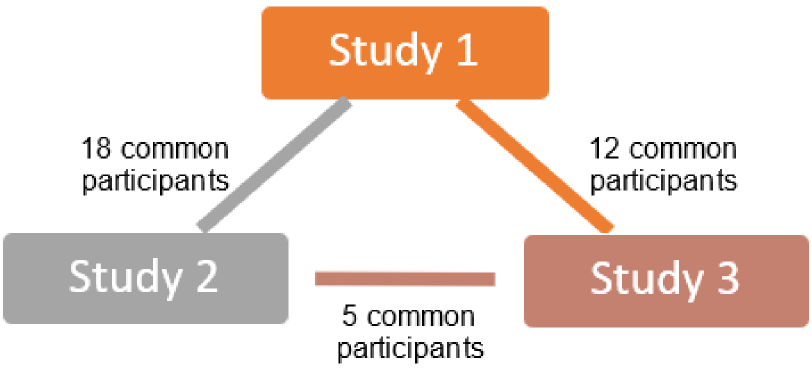

Figure 6.4. Crossover in participants between the three studies

In summary, the research findings offers unique insights into the journey that an individual traverses when implementing PHBCs and the critical influences that play a key role in this process. Developing behavioural aids unique to each individual and that account for such influences may ensure more successful, long-term PHBCs for primary stroke prevention. The following sections harness the learnings from these studies to highlight important considerations and make recommendations for future PHBC-based prevention strategies.

6.2 RESEARCH IMPLICATIONS FOR CLINICAL PRACTICE

The findings from these studies have implications on practice of prevention management and optimizing long-term health behaviours. The research, in particular Study 1 findings, challenges the traditional view of advice giving for health promotion, contributing to the growing consensus that education and awareness alone may simply not be enough to facilitate PHBCs (Section 2.7.2). This may potentially be the crux of most education-based prevention strategies, contributing towards low adherence and/or high attrition rates. For example, while stroke risk awareness may prompt PHBCs among individuals who value health and longevity, it may not be sufficient to motivate those who prioritize immediate benefits of risk behaviours. Therefore, interventions that are solely focussed on emphasising such information may be futile in a manner similar to ‘preaching to the choir’. Instead, PHBC strategists should begin viewing knowledge of disease susceptibility as interacting with other behavioural contributors in shaping an individual’s choice to acknowledge or ignore lifestyle change recommendations.

The research recommends a personalized approach to behaviour change in clinical practice, with risk awareness promotion as one of the several facets for consideration. All three study findings emphasises the need for PHBC strategists to tap into the subjectivity of individuals’ PHBC perceptions and relevant macro and micro level influences when developing PHBC goals in clinical settings. Adopting a ‘one size fits all’ approach may undervalue that impact of determinants unique to each individual’s behaviour. These include personal and material standpoints influenced by beliefs, values, priorities, goals, social and environmental contexts, psychosocial stress and self-efficacy. Behaviour change approaches should be tailored such that they cater directly to each individual’s unique needs and capabilities so as to overcome motivational barriers. In doing so, improved PHBC engagement and adherence may be attained for long-term stroke risk reduction. The research also highlights the importance of differentiating between factors that limits readiness for change to those that impede one’s ability to implement or maintain change. This can be addressed by ensuring ongoing engagement between PHBC strategists and patients/clients and modifying recommendations as and when needed. Therefore, the key to profound and long-lasting PHBCs is to move beyond resolving proximal determinants of disease and address medial and distal driving forces of behaviour (Egger et al., 2017) (Section 2.8).

Of the several findings from Study 1, it was evident how some participants were likely to minimize their perceived risk of stroke, partly due to the compensatory health beliefs that they upheld. Such observations emphasise the need for clinicians to consider patients' perceptions about the likelihood of and seriousness of having a stroke. If perceived risk is underestimated, further education may need to be provided to improve patients' awareness. For other participants, the perceived benefits associated with PHBC uptake and/or maintenance were often deemed inconsequential to its costs, deterring motivation for PHBCs. Therefore, management approaches in clinical practice should persevere to modify such perceptions, performing an in-depth exploration of clients' true values that drive their behavioural choices and addressing the limitations that restrict their motivation.

The knowledge generated from Study 2 has the potential to assist health professionals to tailor nutrition advice that also accounts for a given patient's socioeconomic restrictions. By identifying the food choice motivations that drive dietary inequalities, community-level policies and prevention strategies that address these concerns while improving nutrition may be developed. Section 6.2.1 provides strategies on how the impact of SEDep on dietary choices could be potentially reduced and increasing, such individuals' confidence in eating healthily. The conclusions drawn from Study 3 strongly advice PHBC strategists to not undervalue the role of stress and incorporate patient-appropriate coping advice when managing clinical outcomes. Patients can be educated on managing stress with more adaptive responses[23] that fit within their capabilities and motivations. Strategies should be developed such that benefits attained from maladaptive coping are attained equally through more adaptive techniques. The following sections provide specific strategies and considerations for to improve adherence rates in future PHBC interventions. Such techniques may help assist patients/clients, including those resistant to PHBCs, to successfully progress through the stages of PHBC.

6.2.1 Instigating PHBC readiness

Most evidence-based interventions including the SR app incorporate participants who are already in a pre-existing contemplative or 'readiness to change' stage (Hingle & Patrick, 2016).

[23] See glossary

As a result, there is a paucity in evidence demonstrating effectiveness of such interventions in unmotivated individuals at high risk for chronic disease (Hingle & Patrick, 2016). Behavioural strategies (such as cessation treatments) tend to only help individuals maintain PHBC when they are sufficiently motivated to do so. Future research needs to identify effective strategies for triggering a desire for PHBC readiness, based on Study 1 findings. In this prospect, motivational interviewing is a simple yet powerful interventional approach which has shown significant promise in endorsing PHBCs (Egger et al., 2017; Zuckoff, 2012). Drawing on the principles of this approach, PHBC implementers must first clarify what is considered to be PHBC for individuals. Additionally, their position on the continuum of readiness for PHBC also needs to be understood so as to tailor appropriate management approaches. Regardless of its intensity, change is difficult and the general status quo is the path of least resistance (Zuckoff, 2012). Therefore, change has to be necessary for the individual and they have to come to an acceptance that their current lifestyle will result in negative consequences (Zuckoff, 2012).

As such, PHBC implementers can deliver techniques such as: (1) identifying individuals' perceived pros and cons of their current lifestyle, their perceptions around PHBCs and envisioning two possible futures (with and without change), and (2) understanding individuals' most important ambitions and values and recognise the differences between conditions in actual life and ideal life. Such techniques can help minimize individuals' defensiveness and foster motivation by them to focus on the ideal, healthful future that they can pursue with PHBC. The way conversations around PHBCs are hosted largely dictates whether a readiness is established, especially for those utterly disinclined to change. Motivational interviewing incorporates two key conversational elements. First is the relational communication style which centres around the individual. This concept focuses on empathy and individual autonomy to establish an agreement between the individual's own aspirations with that of the PHBC implementer (Miller & Rose, 2009; Zuckoff, 2012). Secondly, there is a selective attention to promoting individual-initiated PHBC consideration. In this strategy, the conversation is structured such that individuals themselves express their desire, rationale, need and ability for change as opposed to the implementer advocating for PHBC. Subsequently there is a greater potential for the individual to commit to and ensure successful PHBCs. However, overemphasis on healthiness could deter PHBC and invoke greater risk behaviour performance (De Ridder et al., 2017). Additionally, approaches such as confidence-building, influencing decisional balance and changing beliefs around perceived efforts and values on PHBC may help promote PHBC readiness (Hardcastle et al., 2015). The ambivalence experienced during the mental push-pull state demonstrated by Study 1 participants is a potentially critical state for intervention by PHBC implementors. Provision of adequate support and mediation during such states may 'push' individuals towards a state of PHBC readiness and help them to overcome existing uncertainties.

Suggestions for countering individual resistance to PHBC without any particular reason, (i.e., an 'I don't want to' viewpoint) is for implementers to 'practise what they preach'. By role-modelling behaviours that are recommended by PHBC, implementers can potentially inspire motivation or improve PHBC adherence (as observed in Study 1). This is based on the concept of role-modelling and 'if they can do it, so can I' attitudes prevalent across Study 1 dataset. Establishing a 'can do' and 'want to' attitude and countering barriers to such attitudes is a pivotal turning point for implementing PHBC interventions. Building on the observations in Study 2 work and the social and behavioural theories that inform healthy eating determinants, health communication is critical. In addition to increasing awareness about the behavioural mechanisms active during food choices, consumers should be supported in acknowledging known biases and perceptions and provided tools for self-regulation. Strategies to promote healthier dietary intake should be augmented by: (1) environmental, social and individual influences on diet, (2) the multiplicity and complex interactions of food choice motivations and (3) the unique differences among demographic categories (i.e., SEDep) and individual goals and values. Interventions that address primary food choice drivers can increase self-efficacy to maintain healthy eating across various settings. As price is a significant promoter of poor diet quality aggravated by SEDep status, macro-level strategies that incorporate a concerted effort by the health and agricultural sectors, city planners, policy-makers, retailers, wholesalers and the broader supply chain are warranted. Interventions need to synergise opportunities for increasing consumers' self-efficacy to eat healthily and improve resources to facilitate healthier eating options. Information and market intervention measures should invest in retail strategies that are committed to endorsing health equity (Cavaliere et al., 2015). On a community and legislative level, food policy initiatives to improve affordability of nutritious foods in high SEDep communities and individuals are necessary (Balcaen & Storie, 2018; Bardenhagen et al., 2017). In doing so, nutritional outcomes can be improved and over-indulgence of convenient, processed foods maybe curbed (Balcaen & Storie, 2018; Bardenhagen et al., 2017). Increasing consumers' perceived affordability and accessibility to healthy foods may help promote greater confidence in their ability to eat healthier. Convenience regarding food preparation was of priority for several participants in Study 2. The association of this factor with consumption of energy-dense, nutrient-poor foods for those with time and budgetary constraints need to be addressed. Mitigating some of the uncertainty experienced by consumers regarding eating healthily within time constraints needs to be prioritised in dietary-based PHBCs. Nonetheless, the true success of all these approaches would be based on: (1) how politically enforceable they are, (2) the social approval of such measures and (3) their long-term impact on dietary and health outcomes such as long-term stroke risk reduction.

Stress and negative affect was another prominent barrier for PHBC readiness. Study 3 conclusions justify the need for future health policies focussed on prevention and mitigation of chronic stress and its behavioural sequela. Efforts must be taken to advance PHBC interventions by interweaving stress management methods. Simply increasing knowledge of the existence of stress isn't sufficient. Instead, individual-specific stressors, one's sense of controllability over these and its associated impact on coping styles need to objectively and subjectively assessed (Garber et al., 2011; Jackson, 2013; M. Stults-Kolehmainen & Sinha, 2014). Healthcare providers can preliminarily identify stress impact in patients for referral onto health and wellness coaches and community healthcare workers for such detailed investigations. Study 3 reinforces the need to investigate the longitudinal patterns of stress management which is more relevant to mitigate the risk of development of diseases such as stroke. While beyond the scope of this study, the association of socioeconomic disadvantage at both the community and individual level with stress management must be considered in future research. SEDep encompasses a host of significant, chronically experienced stressors (such as unequal socioeconomic resource distribution) (Businelle et al., 2010; Jahnel et al., 2019; Layte &

Whelan, 2009; Mulder et al., 2011; Pampel et al., 2010). Table 6.1 summarises recommendations that PHBC implementers can execute to counter some common barriers in PHBC readiness and implementation. Foundations for these strategies are based on identifying an individual's motivational force, stemming from their cognitive and emotional state, goals and priorities and the wider socio-physical context.

6.2.2 PHBC action planning

Once a sustainable readiness and intention for PHBC is established, developing cohesive implementation intentions should be the next priority. Unless individuals are conscientiously prepared to utilise the effective modems of known behavioural/pharmacological/motivational aids available, prospects of successfully implementing PHBCs will remain low (as observed in Study 1). Discrepancies between an individual's rational and emotional desires to determine what is the required state of mind to successfully implement PHBCs should be critically considered and teased out (Balmford & Borland, 2008). Temporal instability of intentions is a powerful moderator for PHBC implementation especially in those who experience cognitive dissonance in their desire to be healthier versus the ease of maintaining risk behaviours.

A predominant number of Study 1 participants identified not having a conducive situation, social or cognitive capacity to undertake PHBC, particularly in those with low self-regulatory capacity. Support needs to be provided to increase individuals' confidence in implementing PHBCs within existing capabilities, rather than waiting for a futuristic moment that may or may not occur. Stress-associated depletion of self-regulatory resources was arguably one of the most pervasive deterrers of PHBC implementation for participants in Study 3. Stress management interventions could be optimised if stress-coping relationships could be titrated according to each individual. Personality plays a central role in coping techniques, for example some individuals choose to exercise to cope with stress whiles others succumb to the lure of sedentarism (as observed in Study 3). Implementation of a new coping technique such as exercise, cooking or meditation that perturbates one's normal routines involves, in itself, physical and mental stressors. This can be exacerbated if one anticipates these as exhaustive efforts.

Table 6.1

Summary of recommendations to counter barriers for PHBC readiness and implementation

Barrier	Recommendations
Limited knowledge around risk susceptibility, role of lifestyle risk factors, Compensatory health beliefs	• Education on evidence-based guideline recommendations (risk-reducing servings of fruits/vegetables, how much alcohol is safe, the risk-increasing effects of risk behaviours regardless of the frequency/intensity. • 'Fear appeals' where the greater worry and concern about oneself could motivate PHBC intentions for self-protection priorities (H.-S. Kim et al., 2012). • Nutritional labels and short health messages on foods (e.g., high in fat) at the point of purchase can help prompt dietary health awareness, a process known as salient nudges in food choice (J. Bauer & Reisch, 2019).
Fatalistic life attitudes	• Education around lucrative potential of PHBCs even at an older age such as mitigating risk of illnesses including stroke and quality of life improvement. Healthy aging and preventing chronic disease among older adults is possible with preventative behaviours and continue to be applicable to individuals >75 years (Dijkstra et al., 2014; Harvey & Alexander, 2012; Rizzuto et al., 2012).
Momentary gains associated with risk behaviours	• Identifying and focusing on altruistic priorities that could rationalise PHBC. Examples include desire for longevity to see children grow, capitalise upon concerns and sense of responsibility and accountability for family well-being, impact of their behaviours on younger family members' lifestyle choices and be positive role models. Target children as PHBC-provokers by leading them to encourage parents to pursue healthy lifestyles. • Visualising and reflecting on health deterioration among people of value who did not engage in PHBCs may promote greater urgency.
'No one else is doing it'/not wanting to be the odd one out	• Peer recommendations often have greater impact than clinician advice in endorsing PHBC readiness (Amuta et al., 2017). Promote group-level PHBC implementation, incorporating individuals' family and peers in PHBC efforts and encourage social norms that stigmatise risk behaviours (Kuriakose et al., 2020). • Vicarious modelling and social collaborations.
Mood, stress and negative affect	• For those whose workplaces are a source of chronic stress (perceived time pressures (e.g., long working hours) and occupational variables (job structure, workplace location), employers need to assess whether employee absenteeism, declining performance or increasing peer conflicts are a result of workplace stress. ○ Provide social support groups, and positive workplace team functioning and activities could potentially promote better workplace performance. Such methods have been found to minimize job-related stress and improve satisfaction (Bartram et al., 2004). • Academic providers should invest in educating students on workload management techniques, such as regulating performance anxiety, planful problem-solving and social support access to cope with academic demands and improve academic performance. Adaptive coping and minimizing tension, magnitude and intensity of stressors can be achieved using such aids (Gurung, 2006; Winwood et al., 2006).
'It is my choice and I will do it when I'm ready'	• Reminders around the addictive nature of risk behaviours and 'choice' is necessarily not sufficient. Increasing health literacy around such matters and access to support systems (Jeffery, 2012; McMorrow et al., 2017; Notley et al., 2019; West, 2017).

Barrier	Recommendations
'It is my choice and I will do it when I'm ready'	• Incentivising PHBCs (e.g. financial rewards and cash payments, subsiding or providing vouchers for health foods, a 'Quit and Win' type contest using retail marketing approaches). However PHBC may only last as long as reward delivery and in the absence of an intrinsic drive for PHBC, such effects could be absent or short-lived (Jeffery, 2012; McMorrow et al., 2017).
Dislike PHBC or hedonically unappealing, Negative manifestations of PHBCs, procrastination	• Simplifying complex PHBC regimens that are within patients' capabilities. Set simple, achievable goals that enforce capacity to implement PHBCs. Identify enjoyable forms of PHBCs that individuals are willing to try. • Emphasise PHBC rewards. These include the hedonic profits such as heightened sense of smell and taste, improved performance and self-efficacy skills. • Incentivising PHBCs with a reward that is enjoyable.
Time pressures and limited leisure time	• Store provisions and marketing of healthier food alternatives such as pre-made salads, low-fat low-sodium meals (e.g., sandwiches and soups as opposed to pies and pastries). • Cooking demonstrations for creating simple healthy meal ideas in the community or near supermarkets/grocers may provide consumers with food preparation ideas that are convenient and quick. Such interventions have been previously well received and have been shown to increase fruit and vegetable consumption (Gase et al., 2016). • Insufficient time to exercise may be overcome by implementing walking meetings during work, incorporating exercise while travelling to work (e.g., parking the car at a distance and walking the remaining distance), taking the stairs instead of the lift, utilising the weekends to perform some mode of exercise (e.g., performing on-the-spot jogging while watching TV if the latter is a leisure time activity).
PHBCs are too costly (price wise)	• Enhancing skills on food budgeting and cost comparison (of alternate foods with fruits and vegetables) especially in areas of high SEDep and those with high individual SEDep (Glasson et al., 2011). • Community gardens and recognising nearby retail outlets where affordable groceries can be purchased may have great utility. • Fiscal market interventions ○ Developing legislation that permits health and well-being to be considered in zoning and planning permission and promoting initiatives to support retail food projects in underserved areas ○ Increasing the price of/taxation of unhealthy food items (e.g., sugar and artificial sweetened drinks) which show some success in experimental conditions (Duffey et al., 2010) and have become a global norm in some communities as demand for such products is price flexible ○ Subsidising healthy foods and providing tax incentives for grocers to encourage provision of coupons and price specials on groceries. The latter strategy has been found to be more effective and less burdensome on economic resources than costlier nationwide price reductions which may aggravate health inequities even more (J. Bauer & Reisch, 2019).
Cost doesn't matter (e.g., cigarettes)	• Visualisation tools: calculate income saved from not buying cigarettes and the ability to afford better quality products and services, family well-being. For example, money saved over the years from not buying cigarettes could help them buy a house.

If adaptive techniques are new and complex, flexible and user-friendly strategies must be created to assist the stressed individual or those who derail from these behaviours during stress. Alternatively, scheduling a dedicated short time for relaxation (e.g., watching TV) to replenish one's self-regulatory resources is recommended. In doing, energy to perform more effortful behaviours such as cooking and exercise at a later stage may be an alternative strategy. However, individuals with limited leisure time due to family responsibilities and other commitments may not have the necessary time to invest in such strategies.

Low self-regulatory resource can also promote addiction and cravings for smoking, alcohol, binge eating and high-calorific diet intake, as noted among Study 1 and Study 3 participants. This is particularly salient if they are a habitual response to cope with stress, reducing one's capacity to refrain from risk behaviours and implement PHBCs. Adaptive coping is then further complicated as it requires the suppression of addictive and habitual behaviours (e.g., not eating sweets) in addition to substituting it with an adaptive response (e.g., eating an apple) (Adriaanse et al., 2009). Self-regulation strategies are critical to reduce the strength of the stress-impulsivity connection (e.g., binge eat or smoking impulses) (Maes & Karoly, 2005; Sonnentag & Jelden, 2009). Intentions for implementations (Sonnentag & Jelden, 2009) is defined as the ability to anticipate future stress situations and prospectively devise specific, goal-directed behaviours (such as a sporting activity, going for coffee with a friend). Such intentions may be helpful for those who pursue any mode of stress relief they can obtain at the time and was a popular strategy among Study 3 participants who were able to successfully maintain PHBCs. If a long working/stressful day and unhealthy snacking is anticipated, PHBC engagement during the time of day when self-regulatory capacity is high should be advised. An example would be to exercise in the morning prior to heading for work. Such methods are helpful to override older, habitual responses with a new stressor response irrespective of motivation levels. Such specific 'if-then' plans have been found to previously reduce smoking re-uptake during stress (Adriaanse et al., 2009, 2011; Armitage & Arden, 2010, 2012; O'Connor et al., 2015).

Nonetheless, such methods may be deemed much harder for those who have had a life-long dependence on risk behaviours. With increasing dependence, neural pathways associated with pleasure-seeking evolve over time. In such instances, more rigorous treatment methods may be necessitated. The complex interplay between risk behaviours also needs to be considered in future PHBC-based interventions (for example, considering stress, smoking and alcohol intake as a whole entity). Strategies that address the root causes of multiple risk behaviours may prove effective to improve health in a more holistic manner. For example, if an individual successfully implements smoking cessation and experiences greater self-efficacy, confidence and energy, PHBC implementers could begin a conversation to reduce any associated binge drinking sessions. Such interventions show greater superiority over single behaviour interventions. Improvements in one behaviour can act as a gateway to changing others, as shown in studies targeting smoking and exercise or diet quality (Sorensen et al., 2007; Spring et al., 2012).

6.2.3 Promoting PHBC maintenance

If PHBCs are maintained for a reasonable amount of time in which the benefits of change are experienced (quality of life, improved health and performance), this could facilitate re-initiation of PHBC if relapse occurs (as observed in Study 1). Resisting urges to relapse into risk behaviours or re-initiating PHBC can be minimized through: (1) positive self-affirmations and reminding oneself of their own success in implementing PHBCs, (2) drawing upon the benefits accrued from PHBCs and reinforcing their positive effect (how it made them feel, improved health/well-being), (3) willpower reinforcement to control oneself when exposed to triggers and ‘if-then’ action plans to resolve urge situations, (4) ongoing support systems, (5) self-monitoring capacity, and (6) imposing minimal effort on executive functions to resist urges by refraining from situations that trigger risk behaviours. Such strategies have proven successful in other studies (Conner, 2010; De Ridder et al., 2017; O’Connor et al., 2015). Temptation management must address disruptors of an individual’s executive function in order to promote PHBC adherence (Appelhans et al., 2016; Kullgren et al., 2013). This is particularly salient in those who have low baseline levels of functioning or perform in a continuously disruptive environment (Appelhans et al., 2016; Kullgren et al., 2013). Some Study 1 participants reverted to risk behaviours after achieving short-term goals or habituated to PHBCs over time such they are no longer motivated by the original benefits. Such individuals should be provided with ongoing encouragement and peer support and concentrate on how current PHBC benefits translate into future, long-term profits such as reduced risk of disease development (Appelhans et al., 2016). PHBC implementers should counsel individuals in a person-centred and autonomy-endorsing environment. By providing feedback on PHBC performance, re-emphasising benefits and internalising value for PHBCs with individual’s values and aspirations, self-regulatory strength to maintain PHBCs may be renewed.

Delivery of personalised PHBC interventions may require collaborative efforts of healthcare providers, trained health coaches and PHBC specialists. Health providers often lack time to holistically address PHBCs during standard 15-minute consultations with patients (L. E. Ball et al., 2010; Crowley et al., 2016). Consultations are also often considered too expensive for residents in resource-poor areas (Bagshaw et al., 2017). Instead, community health workers and health coaches can be useful proxies for PHBC counselling and strengthening health and social resource connections. Such substitutions have known successes in promoting PHBC maintenance and retention in NCD primary prevention programmes and improving health outcomes (Brainin et al., 2019; Jeet et al., 2017; Scott et al., 2018). Community health workers may bridge the gap between patients and clinicians (whose advice is often disregarded by patients as seen in the present study) by sharing common life experiences or cultural/ethnic/language backgrounds as patients (Brainin et al., 2019; Hartzler et al., 2018; Jeet et al., 2017; Scott et al., 2018). The use of such professionals has shown significant utility in stress coping in older adults (Ghazavi et al., 2016). Active encouragement, advice and open discussions need to be provided and potentially as often as weekly for the first few weeks. Minority groups may require more face-to-face, culturally-friendly interventions. Mutual support and understanding may also be enabled by services such as shared appointments (Voils et al., 2014) and group consultations (including patients and their extended families). However, investment of time by clinicians and health coaches, resources and funding required for such interventions would need to be critically considered.

6.2.4 Improving effectiveness of PHBC-based apps including the Stroke Riskometer

One of the most potent strengths of the SR is its population-wide ability to: (1) function as a cost-effective, risk-estimation system utilizing ubiquitous and low-cost communication infrastructure and (2) ability to disseminate health information quickly to those with limited access to health services or cannot afford GP care (Feigin, Norrving, et al., 2016; Parmar et al., 2015). However, similar to a number of other mobile health apps, the SR is also founded upon the principles of advice giving. Therefore, its objective to facilitate self-management of risk factors may be limited to users already willing to undertake PHBCs by helping them better understand baseline risk behaviours and accelerate broader behaviour change (Hingle & Patrick, 2016). For an individual unconcerned by the potential risk of a future stroke or without a pre-emptive motivation to modify lifestyle risk factors, the SR may have low utility in prompting behaviour change. Additionally, app recommendations to manage lifestyle risk factors, although evidence-based, are population generic and may not account for the specific capabilities and limitations of each user. Such design limitations may explain why mHealth approaches such as the SR are yet to reach their full potential in motivating long-term PHBCs.

In saying so, sustained app interactivity and PHBCs among unmotivated SR users could be provoked with user-specific content and recommendations informed by behavioural determinants discovered from the current research. Strategies that resolve some of the identified PHBC barriers such as time limitations, price concerns and stress management could be attractive to users, especially if they do not obtain such ideas elsewhere. Based on the current research findings, Table 6.2 provides a (albeit, not exhaustive) list of suggestions that could potentially improve SR app engagement.

Such app tools have been successfully incorporated in other mHealth app designs (Gallagher et al., 2019; Verbiest et al., 2018). Once such features are incorporated, it would be of benefit to pre-trial the added features in a community-based focus group setting as an iterative, two-way improvement approach. Developers can obtain feedback on the features' appropriateness, acceptability and utility in addressing most PHBC barriers and a consensus reached on whether the modified content reflects community wants and needs. Such strategies have been utilized previously for refining effectiveness of other mHealth apps (Gallagher et al., 2019; Verbiest et al., 2018).

Table 6.2

Strategies to improve the SR effectiveness in providing personalised PHBC recommendations

PHBC barrier	Added features
Limited motivation to maintain PHBCs	• Goal-setting, monitoring and personalized reminders • Syncing with other trackers (such as FitBit) for reliable data • Positive self-affirmation and reinforcing feedback: Personalized, motivational/congratulatory messages daily via app notifications (e.g., you have met your physical activity goal of 1000 steps today!), reminder messages at the end of the week to track progress about how well users are doing (e.g., number of calories burnt, the days since quitting smoking). • Collect virtual reward tokens (vouchers, discounts) for goals achieved enlisting the support of financial sponsors
Limited pro-PHBC norms	• 'Find a friend' options to search and invite other users pursuing the same PHBC goals • Utilizing gaming functions to compete with other app users on similar PHBC goals. This feature to harnesses an individual's innate goal-driven and competitive nature to promote engagement. Users can compare results using a community leader board • Online forum/chat groups between users of similar goals to discuss strategies and also live support from a behavioural expert
Limited resources/capability	• To address price/convenience concerns of foods, videos for simple home gardening and recipes for on-the-go meals to reduce effort in meal preparation. • Information regarding local activities (e.g., Pasifika yoga classes, local fitness classes), contact details for local health services, nearby resources (e.g., locations of nearby supermarkets with affordable groceries) using Google Map functions.
Limited self-regulation due to stress	• If-then implementation plans (e.g., going for a run prior to starting work, doing 'walking' meetings) • Resolving the stress-a strategic plan form to develop a plan to work through the stressor (e.g., what is the source, how can it be addressed, is the solution possible, who can I reach out to?) • Meditative music, guided meditations or breathing exercises to help overcome cravings to binge or smoke during acute stress periods.

By incorporating such features, the SR can prove to be a superior primary prevention tool by distributing stroke risk awareness and personalized PHBC recommendations among both unmotivated and hard-to-reach populations. Self-management of stroke risk can be made feasible and successfully even more so by catering to each user's individuals needs and capabilities. However, such features may still be insufficient for users whose risk behaviour inclinations are rooted from resilient habits/ addictions, dislike for PHBCs or uncontrollable, non-conducive circumstances. In such instances, more personalized modes of intervention such as motivational interviewing or health and wellness coaching may be necessary to first instigate

PHBC readiness. Apps such as the SR can then function as a complementary tool to facilitate or maintain PHBC motivations.

6.3 OVERALL RESEARCH LIMITATIONS AND FUTURE CONSIDERATIONS

This research is highly relevant from the point of view of unmotivated individuals resistant to stroke risk-reducing PHBCs as it identifies perspectives on three, relatively understudied cognitive and socio-environmental influences. However, several caveats which concern the generalisability and validity of all three study findings also need to be emphasised.

6.3.1 Limitations of sample size and selective recruitment

Some of the known and novel associations observed must be interpreted with caution as these may be a result of: (1) limited study power (study samples only represents a small population of NZers) and (2) several systematic biases introduced through selective recruitment (purposive and convenience sampling techniques). As a result, errors of coverage and selection biases are highly likely which then undermine data validity and interpretation (Fricker, 2008; Khazaal et al., 2014). Although the sampling was based on pragmatic criteria of feasibility and of accessibility, selected participants included both genders and a wide variety of ages, ethnicities, income, education and professions. This was to ensure that the widest variety of discourses on the objectives of the study was obtained. However, Māori and Pasifika perspectives across all three studies were limited due to under recruitment. There were significant challenges recruiting willing participants meeting this ethnic criteria. The strategies set in place to maximise engagement fell severely short of expectations. It is likely that these limitations could have been minimized if the resources available for Māori recruitment were successfully established (i.e., support from organisations such as Ngāti Whātua Orakei Kahui Rangahau and the National Hauora Coalition). Engagement with these communities should also have begun well in advance of research initiation and participant recruitment. Future strategies would be to engage contact with experienced researchers at AUT's Māori Health Department and Department of Pacific Studies to identify challenges and develop more effective methods of participant recruitment. Assistance with Māori engagement could be acquired from the local office of Te Puni Kōkiri (Ministry of Māori Development) and Māori health research units (e.g., Tōmaiora and Whariki) to obtain advice on appropriate consultation strategies with Māori and facilitate contact with local Māori community members. Pacific recruitment could have been further augmented by meeting with Pacific church and community leaders to (1) obtain permission and guidance on how to approach congregators and (2) advertise on the researcher's behalf for securing access to more participants. As Pasifika value spiritual guidance, obtaining church leader affirmation and support has been shown to promote Pasifika access and increase researchers' knowledge around community practices (Ponton, 2018). Nonetheless, it must be emphasised that the demographic breakdown (age, gender and ethnicity) of the samples across all three studies was similar to that of the current NZ Census data (Statistics New Zealand, 2018).

Bias was influenced by patterns related to access to Internet as RIBURST participants could only be contacted initially if they had a viable email address. Additionally, the RIBURST sample pool is not representative of the entire population as they represent owners of smartphones and those who have phones with Wi-Fi, email or internet access. They also represent those within the population who are concerned enough about their stroke risk to download a relevant health app. The use of such sampling methods meant that there was a possibility of over-representation of participants who: (1) had an intrinsic interest in PHBCs, (2) were more/not successful in their PHBC efforts, (3) were aware of the risks of unhealthy behaviours or (4) were more concerned regarding their current health status. Participants who did not participate in these studies may have been systematically different to those who did and their perspectives were not represented. For example, they may have been busier in ways that maybe related to the study objectives. This may have resulted in bias as a consequence of voluntary participation. Further studies incorporating larger, more diverse groups are necessary to fully unravel the complex associations between health beliefs, SEDep and psychosocial stress and PHBCs within this population.

Participant recruitment for all three studies was difficult, resulting in having to extend sampling from the RIBURST pool into advertising platforms. While advertisement participants were encouraged to download the freely available SR app, most of them stated they were not interested in installing the app at the time of the study. As such, these participants may be more at a disadvantage as they may have comparably lesser understanding of their stroke risk and possibly less motivational drive for PHBC undertaking. Consequently, their health beliefs, stress management and diet quality will possibly be different to the RIBURST population However, in saying so, understanding of stroke risk was not a significant PHBC motivator for SR app users in Study 1. Inclusion of these participants also allowed the researcher to capture varying perspectives on these outcomes that naturally exist within the population. Relying on the RIBURST population alone which would have likely introduced bias. The sample selected (non-clinical group of participants with overall good health and no history of chronic conditions) does not allow results to be transferred to other populations. It is unknown whether the views conveyed in these studies are subject to any bias as a result of these characteristics. Consequently it is probable that the results are less applicable to those who have had a previous stroke or have existing chronic conditions. Such individuals may be privy to closer monitoring and support from overseeing clinicians in their effort to undertake PHBCs. Those with existing illnesses who are under strict dietary restrictions may not resort to unhealthy snacking or binge eating for stress management. They also may be better able to adapt their diets to SEDep restrictions. Nonetheless, the study objective was to identify PHBC motivations of those who do not meet the ‘high-risk’ stroke criteria but historically evidence a *higher* incidence of stroke and CVD (Feigin, Krishnamurthi, Bhattacharjee, et al., 2015) (Section 2.5.3). As such, the sample proved to be very useful to inform the design of future interventions to promote PHBCs in those who have limited motivation to modify existing risk factors.

6.3.2 Limitations of study design, outcome measure administration and data analysis

The data collected for all three studies were cross-sectional in nature and limits the ability to imply causal relationships or durability of observations across time. For example, does stress impact smoking directly or do smokers experience more stress? Such possibilities imply that other confounding variables may be responsible for observed associations. As temporal trends of the findings couldn't be determined, longitudinal evaluations of outcomes (e.g. how long does effectiveness of coping techniques last) will need to be further assessed as they are more relevant to negative health outcomes such as stroke. Data were retrospectively self-reported and therefore the concern of biases and data contamination associated with: (1) common method variance (measurement method variance as opposed to variance attributed to constructs represented by the measures), (2) social desirability (e.g., over reporting intake of fruits and vegetables as it is widely accepted health fact) and (3) response and recall (e.g., forgetting how much food is actually consumed) cannot be ignored (Brassington et al., 2012; Podsakoff et al., 2003; Vogel & Schwabe, 2016)..

6.4 CHAPTER SUMMARY

In conclusion, revolutionising society to address discussed barriers and the recommended strategies takes time, time during which stroke and risk factor incidence is most likely to rise. Therefore, there is a pressing need to implement preparatory measures and improve individual-clinician interactions in primary care settings. It can be done. Definitive, longitudinal conclusions about the role of health beliefs, psychosocial stress and deprivation-based disparities in food choices can only be drawn after more studies have explored this subject. Future work also needs to incorporate more extensive measurements of other social and material circumstances that may underlie PHBC uptake and long-term maintenance.

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Glossary

Term	Definition
Adaptive behaviours	Behaviours that are protective for health such as exercise
Binge drinking/bingeing (alcohol)	>three drinks/day
Cognitive dissonance	Guilt and negative after-effects
Cold turkey	The process of stopping risk behaviours abruptly such as quitting without using any quit smoking products or professional support
Comfort foods	Improve mood, mitigate stress-imbued feelings such as annoyance and worry and relieve depression by increasing serotonin production, a neurotransmitter critical for modulating depression, anxiety, and aggression. Such properties activate the reward pathways (fast sensory inputs, heightened blood glucose and adiposity levels) in the brain and result in a feedback behavioural loop for acquiring more such foods
Compensatory health beliefs	Belief that performing certain health behaviours compensates for maintaining other risk behaviours of value (e.g., rationalising having pizza after exercise)
Convenience foods	Outdoor and quickly consumed foods (snacking)
Ecological fallacy	Formal fallacy in the interpretation of statistical data that occurs when inferences about the individual level deprivation is deduced from inferences about the degree of deprivation at the community level
Fatalistic attitudes	The view that death is inevitable and trying to avoid it by implementing PHBCs is futile
Health claims	Scientifically validated short messages on the beneficial effects on health resulting from the consumption of certain foods, allowing more informed consumer choices and in line with consumer preferences (e.g., “reduces cholesterol)
Healthy diet	A diet that is low-calorie, low-salt, low-sugar, low-fat/cholesterol and is nutrient-dense (fruits, vegetables and wholegrain)
Maladaptive behaviours	Behaviours that are detrimental for health such as smoking
Negative affect	Stable tendency to experience and display negative emotions typically in response to stressors, including sadness, lethargy, fear, and distress. These emotions influence one’s actions and decision making
Nutrition labels	Nutrition claims of product’s micro- and macro-nutrients (e.g., low-fat, sugar free) and nutrient facts (scientifically validated nutrient content of products)
Palatable foods	High fat, energy-dense, snack-type foods
Preventative health behaviour change (PHBC)	Cessation of stroke risk inducing behaviours (e.g., smoking) or adoption of stroke risk-reducing behaviours (e.g., physical activity)
Psychosocial stress	at least several periods of self-reported tension, irritability, nervousness, anxiety or sleeplessness attributed to poor health, family relationships, living arrangements, occupational stress, economic/financial stress and stressful life events

Risk behaviours	Smoking, more than 1 standard drink of alcohol per day, less than 6 serves of fruits and vegetables per day or less than 2.5 of physical activity per week
Sedentarism	Relatively low levels of activity and movement
Self-efficacy	One's perceptions of one's own ability to implement and succeed in PHBC goals, with greater self-efficacy indicating greater confidence
Self-regulation	The dynamic cognitive, affective, and behavioural processes and efforts an individual undergoes to modify and modulate thoughts, emotions, and actions in order to achieve PHBC goals.
Self-determination	Extent to which a given individual's behaviour is determined by themselves (consequently experiencing a sense of freedom and choice) versus performing behaviours that are controlled (by others, by norms etc.)
Socioeconomic deprivation	observable and demonstrable disadvantage in material (goods, resources, amenities, physical environment) and social (roles, functions, rights and responsibilities) resources, relative to the norms of their local community or wider society
Subjective norm	An individual's beliefs about how significant others wanted them to behave)
Suboptimal diet quality	Insufficient intake of fruits, nuts/seeds, whole-grains and seafood and excess consumption of processed, sodium and sugar rich foods
Temporal discounting	A process by which goal-oriented rewards were deliberately put aside for risk behaviours (binge eating, smoking and alcohol intake) that provided immediate gratification and re-established equilibrium
Urban Gentrification	A movement of wealthier people into a poor, working-class urban area and subsequent improvement in housing and new business establishment. There is a displacement of current in habitants as part of the process due to the subsequent rise in living costs

Abbreviations

apps	Application
BP	Blood pressure
BMI	Body mass index
CVD	Cardiovascular disease
DALYs	Disability adjusted life years
HBM	Health belief model
ICH	Intracerebral haemorrhage
IS	Ischemic stroke
mHealth	Mobile health apps
PHBC	Preventative health behaviour changes
RIBURST	Reducing the International Burden of Stroke Using Mobile Technology
SAH	Subarachnoid haemorrhage
SEDep	Socioeconomic deprivation
SR	Stroke Riskometer app
TIA	Transient ischemic attack

Appendix 1. Ethics approval

6 March 2019
Valery Feigin
Faculty of Health and Environmental Sciences

Dear Valery
Re Ethics Application: **19/29 Investigating the modulators of health behaviour change to reduce stroke risk using the novel AUT Stroke RiskometerTM (SR) mobile application**

Thank you for providing evidence as requested, which satisfies the points raised by the Auckland University of Technology Ethics Committee (AUTEC).
Your ethics application has been approved for three years until 6 March 2022.
Non-Standard Conditions of Approval

1. In the 'How was I identified section of the Information Sheet include a reference to initial contact (for some participants) via a text from health clinics and GP's.

Non-standard conditions must be completed before commencing your study. Non-standard conditions do not need to be submitted to or reviewed by AUTEC before commencing your study.
Standard Conditions of Approval

1. A progress report is due annually on the anniversary of the approval date, using form EA2, which is available online through http://www.aut.ac.nz/research/researchethics.
2. A final report is due at the expiration of the approval period, or, upon completion of project, using form EA3, which is available online through http://www.aut.ac.nz/research/researchethics.
3. Any amendments to the project must be approved by AUTEC prior to being implemented. Amendments can be requested using the EA2 form: http://www.aut.ac.nz/research/researchethics.
4. Any serious or unexpected adverse events must be reported to AUTEC Secretariat as a matter of priority.
5. Any unforeseen events that might affect continued ethical acceptability of the project should also be reported to the AUTEC Secretariat as a matter of priority.

Please quote the application number and title on all future correspondence related to this project.
AUTEC grants ethical approval only. If you require management approval for access for your research from another institution or organisation, then you are responsible for obtaining it. You are reminded that it is your responsibility to ensure that the spelling and grammar of documents being provided to participants or external organisations is of a high standard.
For any enquiries, please contact ethics@aut.ac.nz
Yours sincerely,

Kate O'Connor
Executive Manager
Auckland University of Technology Ethics Committee
Cc: ann.george@aut.ac.nz; Rita Krishnamurthi; Priya Parmar

Appendix 2. Information sheet and consent form for Study 1

Participant Information Sheet

Date Information Sheet Produced:

28 March 2019

Project Title

Assessing the viability and usability of a mobile application for the self-management of stroke risk in a NZ population

An Invitation

My name is Shwetha Ann George. I am a PhD student at the National Institute for Stroke and Applied Neurosciences, Auckland University of Technology (AUT), Auckland *working with my faculty advisor, Professor Valery Feigin*. I would like to invite you to take part in my research study, which explores some factors which influences how well the Stroke Riskometer Pro mobile application helps NZ people manage their risk for developing a stroke. Before you decide you need to understand why the research is being done, what your participation would involve, what the benefits and risks to you might be, and what would happen after the study ends. This Participant Information Sheet will help you decide if you'd like to take part. You may also want to talk about the study with other people, such as family, whānau, friends, or healthcare providers. Please feel free to do this and I am happy to answer any questions you might have. Please make sure you have read and understood all the pages.

What is the background and purpose of this research?

Stroke is a leading cause of death and disability in NZ and affects all ages, genders and ethnicities. However, stroke is highly preventable if the risk factors (for example, being overweight or high blood pressure) are well managed. With this intent, the novel Stroke Riskometer^{TM} Pro mobile application was developed by AUT which calculates a given person's 5- and 10-year risk for having a stroke. The app also provides information on risk factors that are important for stroke and how to manage these through changes in your lifestyle to prevent a stroke event. However, a number of factors can have an impact on whether an app user begins or maintains these changes. The aim of this study is to determine how an individual's beliefs about their health, such as how likely they are to develop a stroke or the barriers they have in changing their lifestyle, affect their motivation to follow the app's recommendations.

How was I identified and why am I being invited to participate in this research?

You are invited to take part in this study because you have downloaded the Stroke Riskometer^{TM} Pro application, are a part of AUT's *Reducing the International Burden of Stroke* (RIBURST) study, meet the following eligibility criteria, and had expressed interest to be contacted for any future studies when you completed the RIBURST consent form. Your name and email ID were acquired from the RIBURST study.

You are asked to participate in this study based on your answers to the Stroke Riskometer app questions both at the time when you enrolled into the RIBURST study and at 12 months. You fall into one of the following two groups based on your answers:

Stroke Riskometer App question	Group 1 answers		Group 2 answers	
	Enrolment	12 months after	Enrolment	12 months after (should meet **at least 1** of the following criteria)
Smoking: “Do you currently smoke or have you smoked in the past year?”	Yes	Yes	Yes	No
Alcohol consumption: “Do you drink more than 1 std. alcoholic drink a day”	Yes	Yes	Yes	No
Diet: “Do you eat at least 6 servings of fruits and/or vegetables a day”	No	No	No	Yes
Exercise: “Do you do at least 2.5 hours of physical activity per week”	No	No	No	Yes

How do I agree to participate in this research?

If you agree to take part in this study, you will be asked to sign the Consent Form on the last page of this document. You will be given a copy of both the Participant Information Sheet and the Consent Form to keep.

Your participation in this research is voluntary (it is your choice) and whether or not you choose to participate will neither advantage nor disadvantage you. If you don’t want to take part, you don’t have to give a reason. You are able to withdraw from the study at any time and it will in no way affect your future health care or your relationship with the study team. If you choose to withdraw from the study, you are advised to notify a member of the research team before you withdraw. You will then be offered the choice between having any data that is identifiable as belonging to you removed or allowing it to continue to be used. However, once the findings have been produced, removal of your data may not be possible.

What will happen in this research?

If you decide to take part, I will hold an interview with you face-to-face. This will happen either by video calling (Skype, WhatsApp) or if you don’t have this facility, by a visit to a time and place suitable to you. The interview will involve questions about how likely you are to have a stroke and its consequences, as well as why you have or have not followed the app suggestions to reduce your risk factors. It should last about 60 minutes. With your permission, the interview will be recorded and if you choose not to be recorded, notes will be taken instead.

What are the discomforts and risks and how will these be resolved?

There are no known risks caused by this study. Your usual medical care will not be affected in any way by participating in the study, or by deciding not to take part in the study or withdrawing from the study at any stage. During the interview, you might be asked questions about certain topics which are sensitive or may upset you. You can refuse to answer any questions which you feel uncomfortable with, or you can stop the interview anytime. At the end of the interview, you can raise any concerns you had about the questions or the interview in general and the interviewer will do their best to clarify these questions.

Journal articles or conference presentations may include direct quotes from your interview. These may include family members, colleagues, friends that you mentioned who may identify themselves in these quotes. If they were not aware that you would be discussing them in the interview, it is a possibility that they may have negative feelings towards you for discussing them without their permission. The researcher will do their best to minimize this risk by changing the names and any other identifying information. However, it is also highly recommended that you take the opportunity to explain the goals of the study to them and seek their approval to mention them before the interview.

What are the benefits?
There is no guarantee that taking part in this research can benefit you directly. However, it will help the researchers understand why some people do not follow a healthy lifestyle even when they know it can reduce stroke risk.

Reimbursement/koha?
A $20 food/fuel voucher will be provided to you after completing the interview.

How will my privacy be protected?
The original audio will be deleted right after the transfer. Recordings will be written down word for word either by the researchers or a reputable transcriber who will sign a confidentiality agreement. All audio recordings will be transferred and saved in a password protected electronic AUT database which can only be accessed by the researcher, together with written copies of the interview. The database will also have a spreadsheet which contains your contact details and the unique ID number you have been assigned. This information will be destroyed immediately before the findings are released or if you choose to withdraw from the study. Your name and any other information that allows you to be identified directly will not be entered in the written copies of the interviews and final reports. Instead, your unique ID number will replace any mention of your name and initials will replace all other identifying information such as places or jobs in a way that doesn't change the meaning of the sentence. The data we collect will be used only for the purpose of this research; if data were to be used for future studies, further Research Ethics Committee approval will be sought. Once the study is completed, all data will be kept for 10 years in a secure place at AUT University.

What opportunity do I have to consider this invitation?
Once you have received this information sheet, we would appreciate it if you could make a decision on whether or not to take part within two weeks' time. During this time, you are welcome to get in contact with the researcher to discuss any questions you may have.

What happens after the study ends?
The results of this study will be used to complete a PhD thesis and will also be presented in both national and international conferences and published as journal articles. Please indicate in the attached consent form if you would like to or not to receive a summary of the results of the study. If you do, the summary will be sent to you by secure post. However, if you want to access the results in more detail at a later stage, please indicate on the consent form and the researchers will send you a link to access the full PhD thesis. Please note that the findings of the study will only be available by mid 2020.

Whom do I contact for further information about this research or if I have concerns about this research?
Any questions or concerns regarding the nature of this project should be notified in the first instance to researcher Shwetha Ann George, E-mail: ann.george@aut.ac.nz or Tel: 0224103809 or Project Supervisor, Dr Valery Feigin, E-mail: valery.feigin@aut.ac.nz, Tel: 09 921 9166. Concerns regarding the conduct of the research should be notified to the Executive Secretary of AUTEC, Kate O'Connor, ethics@aut.ac.nz, 921 9999 ext. 6038.

Approved by the Auckland University of Technology Ethics Committee on 1st April 2019, AUTEC Reference number 19/29.

Consent Form

Project title:	***Investigating the modulators of health behaviour change to reduce stroke risk using the novel AUT Stroke Riskometer^{TM} (SR) mobile application***
Project Supervisor:	***Dr Valery Feigin***
Researcher:	***Shwetha Ann George***

- I have read and understood the information provided about the **health beliefs study** in the Information Sheet dated (Version 1.1, dated 28 March 2019)
- I realise the study involves an interview with lifestyle questions and will last around 60 minutes. I understand that the interview will be recorded and written word for word. I can choose not to have the interview recorded and if uncomfortable, I can stop the interview at any time.
- I understand that a debriefing session will happen at the end of the study where I can discuss any concerns or issues I had during the interview.
- I understand that taking part in this study is my choice and that I may choose not to answer any questions or withdraw from the study at any time without being disadvantaged in any way.
- I understand that if I withdraw from the study then I will be offered the choice between having any data that is identifiable as belonging to me removed or allowing it to continue to be used. However, once the findings have been produced, removal of my data may not be possible.
- I understand that my participation in this study will be kept confidential and that no material that could identify me will be used in any reports on this study
- I wish to receive a summary of the research findings (please tick one)
  YesO NoO
- I have had time to consider whether to take part. I have had an opportunity to ask questions and to have them answered. I have had the opportunity to use family/whānau support or a friend to help me ask questions and understand the study
- I know whom to contact if I have any questions about the study.
- I agree to take part in this research.
- I consent to having my contact details retained in a secure file so that I can be contacted for future studies

Participant's signature: ....
Participant's name:...
Participant's Contact Details (if appropriate):...
Date: ....

Approved by the Auckland University of Technology Ethics Committee on 1/4/19, AUTEC Reference 19/29

Note: The Participant should retain a copy of this form

Appendix 3. Advertisement flier for health belief study

Appendix 4. Information sheet for advertisement recruitment for Study 1

Participant Information Sheet

This information sheet is to be used for participants in the <u>health beliefs</u> study who respond to a study ad

Date Information Sheet Produced:

12 June 2019

Project Title

Investigating the modulators of health behaviour change to reduce stroke risk using the novel AUT Stroke Riskometer^{TM} (SR) mobile application

An Invitation

My name is Shwetha Ann George. I am a PhD student at the National Institute for Stroke and Applied Neurosciences, Auckland University of Technology (AUT), Auckland *working with my faculty advisor, Professor Valery Feigin*. I would like to invite you to take part in my research study. Before you decide you need to understand why the research is being done, what your participation would involve, what the benefits and risks to you might be, and what would happen after the study ends. This Participant Information Sheet will help you decide if you'd like to take part. You may also want to talk about the study with other people, such as family, whānau, friends, or healthcare providers. Please feel free to do this and I am happy to answer any questions you might have. Please make sure you have read and understood all the pages.

What is the background and purpose of this research?

Stroke is a leading cause of death and disability in NZ and affects all ages, genders and ethnicities. However, stroke is highly preventable if important lifestyle risk factors (for example, being overweight or high blood pressure) are well managed. The aim of this study is to determine how an individual's beliefs about their health, such as how likely they are to develop a stroke or the barriers they have in changing their lifestyle, affect their motivation to undertake positive lifestyle changes long-term in order to reduce their risk of a stroke.

How was I identified and why am I being invited to participate in this research?

You are invited to take part in this study because you have responded to a study ad.

How do I agree to participate in this research?

If you agree to take part in this study, you will be asked to sign the Consent Form on the last page of this document. You will be given a copy of both the Participant Information Sheet and the Consent Form to keep. **Please note, even if you have consented, you will be required to complete some screening questions to ensure you meet the eligibility criteria of the study. If you do not meet these criteria, your participation will be excluded from the study.** Your participation in this research is voluntary (it is your choice) and whether or not you choose to participate will neither advantage nor disadvantage you. If you don't want to take part, you don't have to give a reason. You are able to withdraw from the study at any time and it will in no way affect your future health care or your relationship with the study team. If you choose to withdraw from the study, you are advised to notify a member of the research team before you withdraw. You will then be offered the choice between having any data that is identifiable as belonging to you removed or allowing it to continue to be used. However, once the findings have been produced, removal of your data may not be possible.

What will happen in this research?

If you decide to take part and meet the eligibility criteria, I will hold an interview with you face-to-face. This will happen either by audio or video calling (Skype, WhatsApp) at a time and day suitable to you. The interview will involve questions about how likely you are to have a stroke and its consequences, as well as why you have or have not undertaken behavioural changes to reduce your stroke lifestyle-related risk factors. It should last about 60 minutes. With your permission, the interview will be recorded and if you choose not to be recorded, notes will be taken instead.

What are the discomforts and risks and how will these be resolved?

There are no known risks caused by this study. Your usual medical care will not be affected in any way by participating in the study, or by deciding not to take part in the study or withdrawing from the study at any stage. During the interview, you might be asked questions about certain topics which are sensitive or may upset you. You can refuse to answer any questions which you feel uncomfortable with, or you can stop the interview anytime. At the end of the interview, you can raise any concerns you had about the questions or the interview in general and the interviewer will do their best to clarify these questions.

Journal articles or conference presentations may include direct quotes from your interview. These may include family members, colleagues, friends that you mentioned who may identify themselves in these quotes. If they were not aware that you would be discussing them in the interview, it is a possibility that they may have negative feelings towards you for discussing them without their permission. The researcher will do their best to minimize this risk by changing the names and any other identifying information. However, it is also highly recommended that you take the opportunity to explain the goals of the study to them and seek their approval to mention them before the interview.

What are the benefits?

There is no guarantee that taking part in this research can benefit you directly. However, it will help the researchers understand why some people do not follow a healthy lifestyle even when they know it can reduce stroke risk.

Reimbursement/koha?

A $20 food/fuel voucher will be provided to you after completing the interview.

How will my privacy be protected?

The original audio will be deleted right after the transfer. Recordings will be written down word for word either by the researchers or a reputable transcriber who will sign a confidentiality agreement. All audio recordings will be transferred and saved in a password protected electronic AUT database which can only be accessed by the researcher, together with written copies of the interview. The database will also have a spreadsheet which contains your contact details and the unique ID number you have been assigned. This information will be destroyed immediately before the findings are released or if you choose to withdraw from the study. Your name and any other information that allows you to be identified directly will not be entered in the written copies of the interviews and final reports. Instead, your unique ID number will replace any mention of your name and initials will replace all other identifying information such as places or jobs in a way that doesn't change the meaning of the sentence. The data we collect will be used only for the purpose of this research; if data were to be used for future studies, further Research Ethics Committee approval will be sought. Once the study is completed, all data will be kept for 10 years in a secure place at AUT University.

What opportunity do I have to consider this invitation?

Once you have received this information sheet, we would appreciate it if you could make a decision on whether or not to take part within two weeks' time. During this time, you are welcome to get in contact with the researcher to discuss any questions you may have.

What happens after the study ends?

The results of this study will be used to complete a PhD thesis and will also be presented in both national and international conferences and published as journal articles. Please indicate in the attached consent form if you would like to or not to receive a summary of the results of the study. If you do, the summary will be sent to you by secure post. However, if you want to access the results in more detail at a later stage, please indicate on the consent form and the researchers will send you a link to access the full PhD thesis. Please note that the findings of the study will only be available by mid 2020.

Whom do I contact for further information about this research or if I have concerns about this research?

Any questions or concerns regarding the nature of this project should be notified in the first instance to researcher Shwetha Ann George, E-mail: ann.george@aut.ac.nz or Tel: 0224103809 or Project Supervisor, Dr Valery Feigin, E-mail: valery.feigin@aut.ac.nz, Tel: 09 921 9166. Concerns regarding the conduct of the research should be notified to the Executive Secretary of AUTEC, Kate O'Connor, ethics@aut.ac.nz, 921 9999 ext. 6038.

Approved by the Auckland University of Technology Ethics Committee on 17th June 2019, AUTEC Reference number 19/29.

Consent Form

Project title:	***Investigating the modulators of health behaviour change to reduce stroke risk using the novel AUT Stroke Riskometer^{TM} (SR) mobile application***
Project Supervisor:	***Dr Valery Feigin***
Researcher:	***Shwetha Ann George***

- I have read and understood the information provided about the **health beliefs study** in the Information Sheet dated (Version 1, dated 12 June 2019)
- I understand I may be excluded from the study, even after consenting, if I don't meet key eligibility criteria
- I realise the study involves an interview with lifestyle questions and will last around 60 minutes. I understand that the interview will be recorded and written word for word. I can choose not to have the interview recorded and if uncomfortable, I can stop the interview at any time.
- I understand that a debriefing session will happen at the end of the study where I can discuss any concerns or issues I had during the interview.
- I understand that taking part in this study is my choice and that I may choose not to answer any questions or withdraw from the study at any time without being disadvantaged in any way.
- I understand that if I withdraw from the study then I will be offered the choice between having any data that is identifiable as belonging to me removed or allowing it to continue to be used. However, once the findings have been produced, removal of my data may not be possible.
- I understand that my participation in this study will be kept confidential and that no material that could identify me will be used in any reports on this study
- I wish to receive a summary of the research findings (please tick one)

  YesO NoO
- I have had time to consider whether to take part. I have had an opportunity to ask questions and to have them answered. I have had the opportunity to use family/whānau support or a friend to help me ask questions and understand the study
- I know whom to contact if I have any questions about the study.
- I agree to take part in this research.
- I consent to having my contact details retained in a secure file so that I can be contacted for future studies

Participant's signature:...
Participant's name:..
Participant's Contact Details (if appropriate):...
Date:

Approved by the Auckland University of Technology Ethics Committee on 17th June 2019, AUTEC Reference 19/29

Note: The Participant should retain a copy of this form

Appendix 5. Interview format for health beliefs study

Hi, thank you so much for your participation in this study. Your insights will be extremely important in helping us better understand why some strategies for preventing stroke in people are not as effective. Just to refresh your memory, we are interested in understanding what motivates individuals to begin or maintain positive lifestyle changes. In this interview we will be exploring whether you consider yourself at a high risk of stroke, what you feel the impact of stroke will be on your life if it happened and what are some of the benefits and barriers that you consider in following a healthy lifestyle. The interview will take around 1 hour and please answer each question as fully as you can as we are interested in your own experiences. If you feel uncomfortable at any time during the interview, please let me know and we can stop the interview. There will be a debriefing session at the end to identify any issues you experienced during the interview. Please be assured, your responses will be treated with utmost confidentiality and your identity kept completely anonymous during the entire study. You are welcome to withdraw from the study at any time and do not have to give any explanations. The results from the interview will be combined with other interviews for the write-up of a PhD thesis and will be also be presented at national and international conferences.
At this point, do you have any questions?

(Interviewer note: The constructs of the Health Belief Model that was explored is highlighted according to the following legend)

Susceptibility (of stroke in general and without doing the PHBC)
Severity
Short and long-term intention
Benefits
Barriers
Subjective norm
Self-efficacy
Cues to action

Stroke Riskometer download (for advertisement responders only)

Did you have the opportunity to download the Stroke Riskometer app?

1) If no, could you please specify the reasons as to why?
   a. If you had technical difficulties downloading the app, would you like to do so now?
2) If yes, what were your thoughts around the app? (i.e., its usability, information provided, being able to calculate your risk of a stroke etc.?)
   a. Did you find calculation of your stroke risk as motivating you to change your lifestyle risk factors? If not, why is that?
   b. Did you enrol into the RIBURST study through the app?

Stroke knowledge (applicable for all participants):

1) What do you think your risk of a stroke is in the next 5 to 10 years?
2) What factors make you likely at a risk of a stroke?
3) If you were to have a stroke, how do you think it would impact your quality of life?

- How would do you think it would affect your finances, family, career and social life?
- What are your thoughts about getting back to a normal quality of life after a stroke? How long do you think it would take you to recover after a serious stroke event?

Physical activity

1) How important is exercise to you? How does it make you feel? Why do you/do not exercise?
2) How likely do you think you will a health issue related to not exercising in the future?
3) What do you think are the negative impact of not exercising?
4) How do you think exercise impacts your stroke risk?
5) What do you think are the benefits of exercise?
6) Group 1: What is your normal exercise regime and how many hours per week do you spend on exercise? Has the amount of exercise you do increased in the last few months or has it always been the same? What motivated you to improve your exercise?
    a. Are there times that certain situations affect your ability to exercise? Can you describe these? Do you feel confident that most of the time you are able to keep to your exercise regime regardless of other factors?
    Is there encouragement from your GP, family or friends to exercise more?
7) Group 2: What are the barriers that you experience in exercising regularly Social, environmental, personal, professional factors?
    a. Are you likely to undertake regular exercise in the next 6months? If yes, how do you plan to do this?
    Was there encouragement from your GP, family or friends to exercise more?

Smoking use

1) How important is smoking to you? How does it make you feel? Why do you smoke
2) How likely do you think you will a health issue related to smoking in the future?
3) What do you think are the negative consequences of smoking?
4) How do you think smoking impacts your stroke risk?
5) What do you think are the benefits of not smoking?
6) Group 1: How long has it been since you quit or reduced the number of cigarettes you smoke? What motivated you?
    a. What situations gives you an urge to smoke? In these situations, how confident ae you in your ability to not smoke? On average, how many times have you elapsed since you quit?
    b. Was there encouragement from your GP, family or friends to quit or reduce the number of smokes you have?
7) Group 2: How many cigarettes do you have on average in a day? Have you increased or decreased the number of cigarettes you smoke in the last year? What are the barriers that you experience in quitting or reducing the number of cigarettes you smoke in a day?
    a. Are you likely to quit or reduce your smoking in the next 6months? If yes, how do you plan to do this? Is there encouragement from your GP, family or friends to quit?

Alcohol consumption

1) How important is drinking alcohol to you? How does it make you feel? Why do you drink?
2) How likely do you think you will a health issue related to excessive alcohol consumption in the future?

3) What do you think are the negative consequences of excessive alcohol consumption?
4) How do you think excessive alcohol consumption impacts your stroke risk?
5) What do you think are the benefits of not drinking alcohol excessively?
6) **Group 1: How long has it been since you** quit or reduced **intake of alcohol?** What motivated you?
    a. [redacted]
    b. [redacted]
    Was there encouragement from your GP, family or friends?
7) **Group 2:** How many drinks do you have on average in a day? Have you increased or decreased the number of drinks you have in the last year? What are the barriers that you experience in quitting or reducing the number of drinks you have in a day?
    a. [redacted] or reduced **intake of alcohol**[redacted]
    b. Are you likely to quit or reduce your smoking in the next 6months? If yes, how do you plan to do this? Is there encouragement from your GP, family or friends to quit?

<u>Dietary changes</u>

1) How important is eating fruits and vegetables diet to you? How does it make you feel? Why do you/do eat fruits and vegetables?
2) How likely do you think you will a health issue related to not eating fruits and vegetables in the future?
3) What do you think are the negative impact of not eating fruits and vegetables?
4) How do you think eating fruits and vegetables impacts your stroke risk?
5) What do you think are the benefits of eating fruits and vegetables?
6) **Group 1:** Has the amount of fruits and vegetables you eat increased in the last few months or has it always been the same? What motivated you to increase your intake of fruits and vegetables?
    a. [redacted]
    b. Is there encouragement from your GP, family or friends to eat well?
7) **Group 2:** What are the barriers that you experience in eating the recommended servings of fruits and vegetables?
    a. Are you likely to start eating more fruits and vegetables in the next 6months? If yes, how do you plan to do this?
    b. Was there encouragement from your GP, family or friends to eat more fruits and vegetables?

Appendix 6. Information sheet and consent form (RIBURST participants) for Study 2

Participant Information Sheet

This information sheet is to be used for participants in the socioeconomic deprivation study

Date Information Sheet Produced:

15 April 2019

Project Title

Investigating the modulators of health behaviour change to reduce stroke risk using the novel AUT Stroke Riskometer^{TM} (SR) mobile application.

An Invitation

My name is Shwetha Ann George. I am a PhD student at the National Institute for Stroke and Applied Neurosciences, Auckland University of Technology (AUT), Auckland *working with my faculty advisor, Professor Valery Feigin*. I would like to invite you to take part in my research study, which explores some factors which influences how well the Stroke Riskometer Pro mobile application helps NZ people manage their risk for developing a stroke. Before you decide you need to understand why the research is being done, what your participation would involve, what the benefits and risks to you might be, and what would happen after the study ends. This Participant Information Sheet will help you decide if you'd like to take part. You may also want to talk about the study with other people, such as family, whānau, friends, or healthcare providers. Please feel free to do this and I am happy to answer any questions you might have. Please make sure you have read and understood all the pages

What is the purpose of this research?

Stroke is a leading cause of death and disability in NZ and affects all ages, genders and ethnicities. However, stroke is highly preventable if the risk factors (for example, being overweight or high blood pressure) are well managed. With this intent, the novel Stroke Riskometer^{TM} Pro mobile application was developed by AUT which calculates a given person's 5- and 10-year risk for having a stroke. The app also provides information on risk factors that are important for stroke and how to manage these through changes in your lifestyle to prevent a stroke event. However, a number of factors can have an impact on whether an app user begins or maintains these changes. One of the main risk factors for stroke is eating a lot of takeaways and fast foods and not enough healthy foods such as fish, wholegrains, vegetables and fruits. A number of studies show that people follow an unhealthy diet because they can't afford a healthy diet or there are not enough healthy food stores (such as supermarkets and fruit and vegetable grocers) in their communities. Such issues are often found in areas where there is high rates of unemployment, low education and families with have low overall household income. The aim of this study is to determine what motivates participants food choices and whether such factors affect how participants eat.

How was I identified and why am I being invited to participate in this research?

You are invited to take part in this study because you have downloaded the Stroke Riskometer^{TM} Pro application, are a part of AUT's *Reducing the International Burden of Stroke* (RIBURST) study, had expressed interest to be contacted for any future studies when you completed the RIBURST consent form and carry out the bulk of the food shopping or make the most food choice decisions for your family. Your name and email ID were acquired from the RIBURST study.

How do I agree to participate in this research?

If you agree to take part in this study, you will be asked to sign the Consent Form. Please retain a copy of both the Participant Information Sheet and the completed Consent Form.
Your participation in this research is voluntary (it is your choice) and whether or not you choose to participate will neither advantage nor disadvantage you. If you don't want to take part, you don't have to give a reason. You are able to withdraw from the study at any time and it will in no way affect your future health care or your relationship with the study team. If you choose to withdraw from the study, you are advised to notify a member of the research team before you withdraw. You will then be offered the choice between having any data that is identifiable as belonging to you removed or allowing it to continue to be used. However, once the findings have been produced, removal of your data may not be possible.

What will happen in this research?

Firstly, your residential address will be used to determine the level of 'community socioeconomic deprivation' in your area using a national scale. A high community socioeconomic deprivation score indicates that a high number of individuals and families in your community are unemployed, do not own their own homes or cars and have too many people living in one home in addition to other factors. You will also complete a simple questionnaire to find out your level of 'individual deprivation' where a high score indicates unemployment, high dependency on a means tested benefit, low household income and education level and non-ownership of a car, phone or home.
You will also be asked to complete 3 questionnaires regarding your eating habits, what factors you consider when choosing the foods, you eat and your knowledge on food and its effects on health. These will take place by telephone at a time convenient to you and will take about 30-40 minutes. You will also have the opportunity to complete these questionnaires online at your convenience.

What are the discomforts and risks and how will these be resolved?

There are no known risks caused by this study. Your usual medical care will not be affected in any way by participating in the study, or by deciding not to take part in the study or withdrawing from the study at any stage. You might be asked questions about certain topics which are sensitive or may upset you. **This will include sensitive questions on your health, demographics (for example income range) and deprivation status.** You can refuse to answer any questions which you feel uncomfortable with (as all questions will include a do not wish to disclose option), or you can stop the questionnaire anytime. At the end of the questionnaires you can raise any concerns you had about what was asked and the researcher will do their best to clarify these questions.

What are the benefits?

There is no guarantee that taking part in this research can benefit you directly. However, it will help the researchers understand why some people do not follow a healthy lifestyle even when they know it can reduce stroke risk.

Reimbursement/koha?

A $20 food/fuel voucher will be provided to you after completing the questionnaires.

How will my privacy be protected?

All information which is collected about you during the study will be kept strictly confidential. No material that could personally identify you will be used in any reports on this study. The data we collect will be used only for the purpose of this research; if data were to be used for future studies, further Research Ethics Committee approval will be sought. All the questionnaire data we collect will be stored in a secure, AUT based database which is only accessible by the researcher and saved under your unique participant ID. The database will also have a spreadsheet which contains your contact details and the unique ID number you have been assigned. This information will be destroyed immediately before the findings are released or if you choose to withdraw from the study.

What opportunity do I have to consider this invitation?

Once you have received this information sheet, we would appreciate it if you could make a decision on whether or not to take part within two weeks' time. During this time, you are welcome to get in contact with the researcher to discuss any questions you may have.

What happens after the study ends?

The results of this study will be used to complete a PhD thesis and will also be presented in both national and international conferences and published as journal articles. Please indicate in the consent form if you would like to or not to receive a summary of the results of the study. If you do, the summary will be sent to you by secure post. However, if you want to access the results in more detail at a later stage, please indicate on the consent form and the researchers will send you a link to access the full PhD thesis. Please note that the findings of the study will only be available by mid 2020.

Whom do I contact for further information about this research or if I have concerns about this research?

Any questions or concerns regarding the nature of this project should be notified in the first instance to researcher Shwetha Ann George, E-mail: ann.george@aut.ac.nz or Tel: 0224103809 or Project Supervisor, Dr Valery Feigin, E-mail: valery.feigin@aut.ac.nz, Tel: 09 921 9166. Concerns regarding the conduct of the research should be notified to the Executive Secretary of AUTEC, Kate O'Connor, ethics@aut.ac.nz, 921 9999 ext. 6038.

Approved by the Auckland University of Technology Ethics Committee on 30th April 2019, AUTEC Reference number 19/29.

Consent Form

Project title: ***Investigating the modulators of health behaviour change to reduce stroke risk using the novel AUT Stroke Riskometer^{TM} (SR) mobile application***

Project Supervisor: ***Dr Valery Feigin***

Researcher: ***Shwetha Ann George***

- I have read and understood the information provided about the **socioeconomic deprivation study** in the Information Sheet dated (Version 1.2, dated 15 April 2019).
- I realise the study involves sensitive questions regarding **my level of socioeconomic deprivation**, **health and personal demographics**, and will include questionnaires on my food habits and motivations and will last around 30-40 minutes.
- I understand that taking part in this study is my choice and that I may choose not to answer any questions or withdraw from the study at any time without being disadvantaged in any way.
- I understand that if I withdraw from the study then I will be offered the choice between having any data that is identifiable as belonging to me removed or allowing it to continue to be used. However, once the findings have been produced, removal of my data may not be possible.
- I understand that my participation in this study will be kept confidential and that no material that could identify me will be used in any reports on this study
- I wish to receive a summary of the research findings (please check one)
  Yes☐ No☐
- I have had time to consider whether to take part. I have had an opportunity to ask questions and to have them answered. I have had the opportunity to use family/whānau support or a friend to help me ask questions and understand the study
- I know whom to contact if I have any questions about the study.
- I agree to take part in this research.
- I consent to having my contact details retained in a secure file so that I can be contacted for future studies

Participant's signature: ....………………………………………………………
Participant's name:..............................………………………………………………………
Date:

Approved by the Auckland University of Technology Ethics Committee on 30th April 2019, AUTEC Reference 19/29

Note: The Participant should retain a copy of this form.

Appendix 7. Information sheet and consent form (advertisement participants) for Study 2

Participant Information Sheet

This information sheet is to be used for participants in the socioeconomic deprivation study recruited through advertisements.

Date Information Sheet Produced:

6 June 2019

Project Title

Investigating the modulators of health behaviour change to reduce stroke risk using the novel AUT Stroke Riskometer^{TM} (SR) mobile application.

An Invitation

My name is Shwetha Ann George. I am a PhD student at the National Institute for Stroke and Applied Neurosciences, Auckland University of Technology (AUT), Auckland *working with my faculty advisor, Professor Valery Feigin*. I would like to invite you to take part in my research study, which explores some factors which influences how well the Stroke Riskometer Pro mobile application helps NZ people manage their risk for developing a stroke. Before you decide you need to understand why the research is being done, what your participation would involve, what the benefits and risks to you might be, and what would happen after the study ends. This Participant Information Sheet will help you decide if you'd like to take part. You may also want to talk about the study with other people, such as family, whānau, friends, or healthcare providers. Please feel free to do this and I am happy to answer any questions you might have. Please make sure you have read and understood all the pages.

What is the purpose of this research?

Stroke is a leading cause of death and disability in NZ and affects all ages, genders and ethnicities. However, stroke is highly preventable if the risk factors (for example, being overweight or high blood pressure) are well managed. With this intent, the novel Stroke Riskometer^{TM} Pro mobile application was developed by AUT which calculates a given person's 5- and 10-year risk for having a stroke. The app also provides information on risk factors that are important for stroke and how to manage these through changes in your lifestyle to prevent a stroke event. However, a number of factors can have an impact on whether an app user begins or maintains these changes. One of the main risk factors for stroke is eating a lot of takeaways and fast foods and not enough healthy foods such as fish, wholegrains, vegetables and fruits. A number of studies show that people follow an unhealthy diet because they can't afford a healthy diet or there are not enough healthy food stores (such as supermarkets and fruit and vegetable grocers) in their communities. Such issues are often found in areas where there is high rates of unemployment, low education and families with have low overall household income. The aim of this study is to determine what motivates participants food choices and whether such factors affect how participants eat.

How was I identified and why am I being invited to participate in this research?

You are invited to take part in this study because you have responded to a study ad. We expect there will be about 266 people in the study.

How do I agree to participate in this research?

If you agree to take part in this study, you will be asked to sign the Consent Form on the last page of this document. You will be given a copy of both the Participant Information Sheet and

the Consent Form to keep. **Please note, even if you have consented, you will be required to complete some screening questions to ensure you meet the eligibility criteria of the study. If you do not meet this criteria, your participation will be excluded from the study and you won't be required to complete the questionnaires for the study.**
Your participation in this research is voluntary (it is your choice) and whether or not you choose to participate will neither advantage nor disadvantage you. If you don't want to take part, you don't have to give a reason. You are able to withdraw from the study at any time and it will in no way affect your future health care or your relationship with the study team. If you choose to withdraw from the study, you are advised to notify a member of the research team before you withdraw. You will then be offered the choice between having any data that is identifiable as belonging to you removed or allowing it to continue to be used. However, once the findings have been produced, removal of your data may not be possible.

What will happen in this research?

Firstly, your residential address will be used to determine the level of 'community socioeconomic deprivation' in your area using a national scale. A high community socioeconomic deprivation score indicates that a high number of individuals and families in your community are unemployed, do not own their own homes or cars and have too many people living in one home in addition to other factors. You will also complete a simple questionnaire to find out your level of 'individual deprivation' where a high score indicates unemployment, high dependency on a means tested benefit, low household income and education level and non-ownership of a car, phone or home.
You will also be asked to complete 3 questionnaires regarding your eating habits, what factors you consider when choosing the foods, you eat and your knowledge on food and its effects on health. These will take place by telephone at a time convenient to you and will take about 30-40 minutes. You will also have the opportunity to complete these questionnaires online at your convenience.

What are the discomforts and risks and how will these be revolved?

There are no known risks caused by this study. Your usual medical care will not be affected in any way by participating in the study, or by deciding not to take part in the study or withdrawing from the study at any stage. You might be asked questions about certain topics which are sensitive or may upset you. **This will include sensitive questions on your health, demographics (for example income range) and deprivation status.** You can refuse to answer any questions which you feel uncomfortable with (as all questions will include a do not wish to disclose option), or you can stop the questionnaire anytime. At the end of the questionnaires you can raise any concerns you had about what was asked and the researcher will do their best to clarify these questions.

What are the benefits?

There is no guarantee that taking part in this research can benefit you directly. However, it will help the researchers understand why some people do not follow a healthy lifestyle even when they know it can reduce stroke risk.

Reimbursement/koha?

A $20 food/fuel voucher will be provided to you after completing the questionnaires.

How will my privacy be protected?

All information which is collected about you during the study will be kept strictly confidential. No material that could personally identify you will be used in any reports on this study. The data we collect will be used only for the purpose of this research; if data were to be used for future studies, further Research Ethics Committee approval will be sought. All the questionnaire data we collect will be stored in a secure, AUT based database which is only accessible by the researcher and saved under your unique participant ID. The database will also have a spreadsheet which contains your contact details and the unique ID number you have been assigned. This information will be destroyed immediately before the findings are released or if you choose to withdraw from the study.

What opportunity do I have to consider this invitation?

Once you have received this information sheet, we would appreciate it if you could make a decision on whether or not to take part within two weeks' time. During this time, you are welcome to get in contact with the researcher to discuss any questions you may have.

What happens after the study ends?

The results of this study will be used to complete a PhD thesis and will also be presented in both national and international conferences and published as journal articles. Please indicate in the consent form if you would like to or not to receive a summary of the results of the study. If you do, the summary will be sent to you by secure post. However, if you want to access the results in more detail at a later stage, please indicate on the consent form and the researchers will send you a link to access the full PhD thesis. Please note that the findings of the study will only be available by mid 2020.

Whom do I contact for further information about this research or if I have concerns about this research?

Any questions or concerns regarding the nature of this project should be notified in the first instance to researcher Shwetha Ann George, E-mail: ann.george@aut.ac.nz or Tel: 0224103809 or Project Supervisor, Dr Valery Feigin, E-mail: valery.feigin@aut.ac.nz, Tel: 09 921 9166. Concerns regarding the conduct of the research should be notified to the Executive Secretary of AUTEC, Kate O'Connor, ethics@aut.ac.nz, 921 9999 ext. 6038.

Approved by the Auckland University of Technology Ethics Committee on 11th June 2019, AUTEC Reference number 19/29.

Consent Form

Project title:	***Investigating the modulators of health behaviour change to reduce stroke risk using the novel AUT Stroke Riskometer^{TM} (SR) mobile application***
Project Supervisor:	***Dr Valery Feigin***
Researcher:	***Shwetha Ann George***

- I have read and understood the information provided about the **socioeconomic deprivation study** in the Information Sheet dated (Version 1.3, dated 6 June 2019).
- I understand I may be excluded from the study, even after consenting, if I don't meet key eligibility criteria
- I realise the study involves sensitive questions regarding **my level of socioeconomic deprivation**, **health and personal demographics**, and will include questionnaires on my food habits and motivations and will last around 30-40 minutes.
- I understand that taking part in this study is my choice and that I may choose not to answer any questions or withdraw from the study at any time without being disadvantaged in any way.
- I understand that if I withdraw from the study then I will be offered the choice between having any data that is identifiable as belonging to me removed or allowing it to continue to be used. However, once the findings have been produced, removal of my data may not be possible.
- I understand that my participation in this study will be kept confidential and that no material that could identify me will be used in any reports on this study
- I wish to receive a summary of the research findings (please check one)
  Yes☐ No☐
- I have had time to consider whether to take part. I have had an opportunity to ask questions and to have them answered. I have had the opportunity to use family/whānau support or a friend to help me ask questions and understand the study
- I know whom to contact if I have any questions about the study.
- I agree to take part in this research.
- I consent to having my contact details retained in a secure file so that I can be contacted for future studies

Participant's signature: ....
Participant's name: ....
Participant's email:
Date:

Approved by the Auckland University of Technology Ethics Committee on 11th June 2019, AUTEC Reference 19/29

Note: The Participant should retain a copy of this form.

Appendix 8. Advertisement flier

Appendix 9. The NZiDep questionnaire

The eight questions for the five-point individual-level index of socioeconomic deprivation are shown below. The order of the eight questions is not important, although they are listed here in the estimated decreasing order of occurrence. The simple scoring system is described after the questions. A suggested lead-in to these questions is: “The following few questions are designed to identify people who have had special financial needs in the last 12 months. Although these questions may not apply directly to you, for completeness we need to ask them of everyone." The nine questions are:

1. In the last 12 months have you personally been forced to buy cheaper food so that you could pay for other things you needed? (Yes/no)
2. In the last 12 months, have you been out of paid work at any time for more than one month? (Yes/no)
3. NOTE: This unemployment question is defined as no for those 60 and over, and for full -time care- givers/homemakers.
4. Did you yourself get income in the 12 months ending today from any of these sources: Unemployment Benefit, Domestic Purposes Benefit, Independent Youth Benefit, Sickness Benefit, and Invalids Benefit? (Yes/no)
5. In the last 12 months have you personally put up with feeling cold to save heating costs? (Yes/no)
6. In the last 12 months have you personally made use of special food grants or food banks because you did not have enough money for food? (Yes/no)
7. In the last 12 months have you personally continued wearing shoes with holes because you could not afford replacement? (Yes/no)
8. In the last 12 months have you personally gone without fresh fruit and vegetables, often, so that you could pay for other things you needed? (Yes/no)
9. In the last 12 months have you personally received help in the form of clothes or money from a community organization (like the Salvation Army)? (Yes/no)

Creating the NZiDep index:
Add the ‘yes’ responses (count any missing data as ‘no’).
Re-code the count of deprivation characteristics into the following five ordinal categories (relatively few people will have the largest number of deprivation characteristics):
1: no deprivation characteristics
2: one deprivation characteristic
3: two deprivation characteristics
4: three or four deprivation characteristics

Appendix 10. Dietary Habits Questionnaire

This section will look at your consumption of specific foods. When answering these questions please think back over the past month and week and state on average whether you consume that item never; less than 1 time per MONTH; 1-3 times per MONTH; 1-3 times per WEEK; 4-6 times per WEEK; once per DAY; 2 or more times per DAY. Remember to think about all meals (that is breakfast, lunch and dinner) as well as snacks, and times when you eat both at home and away from home. Interviewer note: Items in red are stroke risk-increasing food items and items in green are stroke risk-reducing

1. Do you eat whole grain breakfast cereals? Please say YES ONLY if you eat the following: Muesli (all varieties), Weetabix (all varieties), Bran cereals (e.g. All Bran, Bran flakes), Bran based cereals (e.g. Sultana Bran, Sultana Bran Extra), Light and fruity cereals (e.g. Special K, Light and Tasty), cooked oatmeal?
   On average, how many servings each time? A 'serving' = 1 cup/250 ml

2. Do you eat wholegrain, brown, wholemeal, multigrain bread/bread rolls?
   On average, how many servings each time? A 'serving'= 1 slice

3. Do you drink low fat/skim/trim milk?
   On average, how many servings each time? A 'serving'= 1 cup/250 ml

4. Do you eat or drink soy products? Please say YES ONLY if you eat the following (Soymilk, tofu, soybean curd)
   On average, how many servings each time? A 'serving'= 250 mL1 cup

5. Do you eat low-fat yoghurt? Please say YES ONLY if you eat the following: Regular, flavoured, Greek, frozen
   On average, how many servings each time? A 'serving'= 1 cup/250 ml

6. Do you have full-fat or normal fat yoghurt? Please say YES ONLY if you have the following: soy and fromage frais, Greek, regular, flavoured, frozen
   On average, how many servings each time? A 'serving'= 1 cup/250 ml

7. Do you drink tea? Please say YES ONLY if you drink the following: black, herbal, green, fruit, iced, lemon teas, tea made from Bovril
   On average, how many servings each time? A 'serving'= 1 cup/250 ml

8. Do you eat the following: Please say YES ONLY if you have: bagels, English muffins (savoury, low fat and bran); cornbread; doughnuts, pastries, crumpets, scone, pancakes, waffles, cake, regular and low-fat cookies, sweet and savoury pie
   On average, how many servings each time? A serving =1 piece/half a scone/half a pasty or meat pie/half a cake slice

9. Do you eat biscuits (plain and filled?)
   On average, how many servings each time? A serving =1 piece

10. Do you eat crackers?
    On average, how many servings each time? A serving = 1 PIECE

11. Do you eat potato chips? Please say YES ONLY if you eat the following: Potato chips, French fries, wedges, crisps, fried potatoes, tortillas, corn chips
    On average, how many servings each time? A serving =10 chips/fries/1 cup wedges

12. Do you eat the following: Please say YES ONLY if you have: Fried chicken, Fried/battered fish, croquettes, hash browns?
    On average, how many servings each time? A serving = 1 piece

13. Do you have added sweeteners? Please say YES ONLY if you have the following: Jelly, jam, marmalade, syrup; sugar in coffee or tea
    On average, how many servings each time? A serving =1 tablespoon

14. Do you eat cocoa-based products? Please say YES ONLY if you have the following: chocolate bars, chocolate drinks, and chocolate snacks (including confectionery, biscuits, desserts, nutritional supplements, and candy bars)
    On average, how many servings each time? A serving =1 piece

15. Do you drink full fat/full fat milk, rice or goat's milk?
    On average, how many servings each time? A 'serving'= 1 cup/250 ml

16. Do you have any of the following: Please say YES ONLY if you have: buttermilk, mayonnaise, sour cream
    On average, how many servings each time? A serving =1 tablespoon of mayo/sour cream, A 'serving' = 1 cup/250 ml of milk

17. Do you drink coffee? Please say YES ONLY if you have: All varieties including caffeinated/decaffeinated, specialty coffees, iced coffees
    On average, how many servings each time? A 'serving'= 1 cup/250 ml

18. Do you drink fruit juices and drinks? Do not include diet or diabetic varieties. Please say YES ONLY if you have: Freshly squeezed varieties, and brands such as Just Juice, Fresh-up, Keri, Golden Circle, Ribena, Thextons, McCoy and Charlie's. Excludes - 'diet varieties', soft drinks and energy drinks, flavoured waters (e.g. H2Go), and sports waters (e.g. Charlie's Sports water, Mizone and Aqua-shot).]
    On average, how many servings each time? A 'serving'= 1 cup/250 ml

19. Do you drink soft drinks or energy drinks? Do not include diet varieties. Please say YES ONLY if you have: Coca-cola, Pepsi, Lemonade, Ginger beer, Energy drinks (e.g. 'V', Red Bull, Lift plus), Powerade, E2 and G-force. Excludes - 'diet varieties', fruit juices and drinks, flavoured waters (e.g. H2Go), and sports waters (e.g. Charlies Sports water, Mizone and Aqua-shot).]
    On average, how many servings each time? A 'serving' =1 cup/250 ml

20. Do you drink artificially sweetened soft drinks? Please say YES ONLY if you have: sugar-free carbonated beverages, such as diet cola, diet coke or diet fruit drinks
    On average, how many servings each time? A 'serving' =1 cup/250 ml

21. Do you eat the following: Please say YES ONLY if you have: veal, beef, pork, mutton or hamburger? Varieties include mixed dishes (casseroles, stews, stir-fries, boil up, curries)
    On average, how many servings each time? A serving =1/2 cup stewed or canned or curry;1/2 cup diced and cooked; half a steak;1 patty

22. Do you eat full fat/normal fat cheese? Please say YES ONLY if you have the following: Cheddar, edam, specialty (blue, brie, feta, etc), ricotta, cream cheese, cottage cheese. Do not include curd
    On average, how many servings each time? A serving = 2 heaped tbsp/1 slice cheese (8.5 x 2.5 x 2mm)/ 1 cube cheese, match box size

23. Do you eat processed meat? Please say YES ONLY if you have the following: smoked, cured, or salted meats, bacon, salami, sausages, hot dogs or other processed deli or luncheon meats. Please think of sandwiches, curries or other meals you have.
    On average, how many servings each time? A serving =1 sausage/frankfurter;3 bacon rashers (middle or shoulder bacon), 3 medium slice ham, 3 slice luncheon meat/salami/chorizo; 1/2 cup canned/smoked/salted meats

24. Do you drink beer?
    On average, how many mls each time?

25. Do you drink wine (All varieties including red, white, mulled, rose, flavoured wine (elderflower, fruit, ginger)?
    On average, how many servings each time? 1 small glass=100 mls; 1 average glass=150 mls

26. Do you eat fresh, frozen, canned or stewed fruits? Do not include fruit juice or dried fruit. Please say YES ONLY if you eat the following: Bananas, cantaloupe, honeydew, apricots, grapefruit, kiwifruit, mango, papaya, pineapple, watermelon, citrus fruits. Note: some are seasonal, please state if you eat these when in season
    On average, how many servings each time? A 'serving' = a medium piece of fruit such as an apple or two small pieces of fruit such as two apricots, or 1 cup (250mL) of stewed or 1 cup halves (250mL) canned fruit

27. Do you eat fresh, cooked, frozen or canned vegetables? Please don't include vegetable juice. Please say YES ONLY if you eat the following: lettuce, spinach, silver beet, puha, rocket, taro leaves, broccoli, horseradish, kale, cabbage, Brussels sprouts, Cauliflower, Bok choy, Chinese cabbage, Turnip root; greens, Watercress, Radish, mushrooms, peas, cucumbers, zucchini, eggplants, pumpkin, squash, butternut, corn, swede, green beans, green and red peppers, tomatoes
    On average, how many servings each time? = A serving = 1 medium potato/kumara or 1 cup cooked/frozen vegetables or 1 cup of salad vegetables)

28. If there were any food items that you never eat, please state if is it due to any health, dietary or cultural restrictions:

Scoring:

Intake of items 1 and 2 was combined to give a score for wholegrain intake, intake of items 8-11, 13 combined to give a score for GI intake, items 24 and 25 combined to give a score for alcohol intake and items 18 and 29 combined to give overall fruit intake per day.
The g/day or ml/day consumption of each food item was calculated by multiplying the daily frequency value with the serving size. For each food item where they met the threshold, they were given a score of 1, otherwise a 0. The risk-increasing index score, which could range from 0 to a maximum of 9, was then obtained by summing individual food item scores. The higher the score, the greater the intake of stroke risk-increasing food items. The stroke risk-reducing food intake index score was calculated in a similar manner except that scores included were food items that reduced the risk of stroke, Scores ranged from 0 to a maximum of 12. For calculating overall diet quality score, the stroke risk-increasing food item scores were reverse coded (i.e., a score of 0 if they met the threshold serving and a score of 1 if they did not). Scores for all items were then summed to generate the overall dietary score (possible range 0 to 21) where a higher score indicated a healthier diet quality.

➢

7-point scale	never	less than 1 time per MONTH (0.5/30)	1-3 times per MONTH (2/30)	1-3 times per WEEK (2/7)	4-6 times per WEEK (5/7)	once per DAY (1/1)	2 or more times per DAY (2.5/1)
Daily Frequency (i.e., once a day)	0	0.016	0.066	0.285	0.712	1	2.5

Food item	Serving size in questionnaire	Gram/ml equivalent
Whole-grain breakfast cereal (breakfast cereals with 25% or more whole-grain or bran content by weight), cooked oatmeal	1 cup	250ml
Wholegrain bread	1 slice	slice
Low fat milk	1 cup	250ml/day
soy products	1 cup/glass (soymilk) 1 piece (tofu)	250 ml/day
low fat yoghurt	1 cup/250 ml	260.775
full fat Yoghurt	1 cup/250 ml	252.85
Tea	1 cup/250 ml	250ml
Fried potatoes	10 chips/fries/1 cup wedges/1-piece croquette or hash brown	36.6
Fried chicken; Fried/battered fish	1 piece	piece
added sweeteners	1 tablespoon	15.7
Cocoa-containing foods	1 piece	35.7
full-fat milk, rice or goat's milk	1 cup/250 ml	264.8076923
Sour cream, mayo, buttermilk	1 tablespoon (15 ml) of mayo/sour cream;1 cup/250 ml of milk	15
Coffee	1 cup/250 ml	250ml
Sugar-sweetened beverages-soft drinks or energy drinks	1 cup/250 ml	250ml
Artificially sweetened soft drinks	1 cup/250 ml	250ml
Unprocessed red meat	1 cup/1 cup diced/1 steak/1 piece/1 patty	107 g

Full fat cheese	1 tbsp/1 slice/cube/wedge/ 1 cup grated (250mL)	22.2 g
Low fat cheese	1 tbsp/1 slice/cube/wedge/ 1 cup grated (250mL)	22.2 g
processed meat	1 sausage/frankfurter;3 bacon rashers (middle or shoulder bacon), 3 medium slice ham, 3 slice luncheon meat/salami/chorizo; 1/2 cup canned/smoked/salted meats	76.5
Beer	Participant asked how much they drink each time (e.g., 330 ml can)	330
Wine	Medium glass, Small glass	150 ml; 100 ml
Fruits	A medium piece (e.g., apple) Two small pieces (e.g. apricots) 1 cup stewed/halved/fruit juice	piece/day or 250ml (juice)
Vegetables	1 medium potato/kumara 1 cup cooked/frozen/salad	piece/day or 250ml

Gram or ml equivalent to a serving as defined by the NZ Concise food conversion table (Sivakumaran et al., 2016)

➢ Glycaemic index score and available carbohydrate for food items in the food frequency questionnaire. Values obtained from (F. S. Atkinson et al., 2008; Sivakumaran et al., 2016)

Food item	**Glycaemic index score**	**Available carbohydrate**
cake	43.71	33.57
Cupcake	73.00	26.00
Doughnut	50.00	20.00
Muffin	51.19	28.63
Pancakes, pastry, scones	71.60	27.89
Lamingtons	87.00	29.00
English Muffin	77.00	14.00
Cookies/biscuits	52.25	18.60
Crackers	65.14	17.69
chips	62.55	27.82
Pie	41.57	33.29
Crumpet	69.00	19.00
Cornbread	72.00	43.00
Bagel	69.00	35.00
Marmalade	45.00	18.25
jelly	53.00	19.00
Jam	50.17	16.00
Syrup	61.67	20.33

➢ **Calculation of average GI for each participant:**

➢ ((Sum of GI) *(Av. Daily amount) *(%carb content))/ total daily carbohydrate intake=Av GI.

High GI intake was classified as having an average GI intake >70 based on common GI definitions

Appendix 11. Food choice questionnaire

Several different factors influence our choice of food. For every person, there will be a different set of factors that is important. In the next set of questions, we are interested in finding out what factors influence your choice of food. Listed below are a series of factors that may be relevant to your choice of foods. Read each item carefully and state if you strongly disagree, disagree, neither agree nor disagree, agree or strongly agree
Put a tick in the box that best reflects your feelings. Remember, there are no right or wrong answers - we are interested in what is important to you.

It is important to me that the food I eat on a typical day…

1. Is easy to prepare
2. Contains no additives
3. Is low in calories
4. Tastes good
5. Contains natural ingredients
6. Is not expensive
7. Is low in fat
8. Is familiar to me
9. Is high in fibre and roughage
10. Is nutritious
11. Is easily available in shops and supermarkets
12. Is good value for money
13. Cheers me up
14. Smells nice
15. Can be cooked very simply
16. Helps me cope with stress
17. Helps me control my weight
18. Has a pleasant texture
19. Is packaged in an environmentally friendly way
20. Comes from countries I approve of politically
21. Is like the food I ate when I was a child
22. Contains lots of vitamins and minerals
23. Contains no artificial ingredients
24. Keeps me awake and alert
25. Looks nice
26. Helps me relax
27. Is high in protein
28. Takes no time to prepare
29. Keeps me healthy
30. Is good for my skin/teeth/hair/nails etc.
31. Makes me feel good
32. Has the county of origin clearly marked?
33. Is what I usually eat
34. Helps me to cope with life
35. Can be bought in shops close to where I live or work

36. Is cheap
37. Is what my family typically eats

Food choice factors:

Health	Mood	Convenience		Sensory appeal
Natural content	Price	Weight control	Familiarity	Ethical concern

Participants were asked to rate 37 statements each preceded by “It is important to me that the food I purchase.” Responses were then scored on a 5-point scale (1 = disagree strongly, 2 = disagree, 3 = neither agree nor disagree, 4 = agree and 6 = agree strongly. For each participant, each item was scored according to the rating participant gives them (e.g., a score of 1 for item 1 if participant chooses to disagree strongly). Participant responses were then categorized into the subgroups of the FCQ. The absolute importance of each motive factor was calculated with the un-weighted average score of the items belonging to each respective factor. The relative importance of each motive was computed by dividing each participant’s absolute rating of it by his/her mean score on all thirty-six motive items

Appendix 12. Food nutrition knowledge questionnaire

1. It is better for health to choose lean meat (with little visible fat)
2. It is better for health to limit those foods which contain high levels of sugar such as soft drinks, cordial and biscuits
3. Adequate calcium intake may reduce the risk of osteoporosis
4. It is recommended that adults have some milk, cheese or yoghurt every day
5. Fruit is a poor source of vitamin C
6. Whole-grain breads are good sources of fibre
7. It is recommended that we eat fat and oil in limited amount
8. Bread, cereal, fruit and vegetables should make up the smallest part of our diet
9. Dietary fibre from whole meal foods combined with an adequate intake of drinking water prevents constipation
10. Low sugar intake may decrease the risk of dental cavities
11. Saturated fats are found in large quantities in butter, lard and dripping
12. A high intake of saturated fat can protect against heart disease
13. Choosing whole meal bread provides no health benefits
14. Choosing salt-reduced food provides no health benefits
15. Adults should choose full-cream milk instead of Skim or Trim milk
16. Meat, fish, chicken and eggs should make up the largest part of our diet
17. A high intake of plant food combined with a low salt intake may protect against high blood pressure
18. Milk and milk products such as cheese and yoghurt are the best sources of iron
19. Meat, poultry and fish are the best sources of calcium
20. Dark green and orange vegetables like spinach, broccoli, carrots and pumpkin are low in vitamin A

Appendix 13. **Study 2 sample breakdown according to demographic** categories

	Income					Education				Ethnicity					Gender	
	>90K	70-90K	50-70K	30-50K	<30,000	Postgrad	Undergrad	Other education	School	Other	Asian	NZ European	Pasifika	Māori	Males	Females
Age																
<25	0	0	3	5	29	1	4	16	18	3	22	7	4	3	23	16
25-34	3	4	12	7	23	3	9	14	3	4	18	4	2	2	30	22
35-54	7	14	9	5	10	3	21	16	7	6	8	23	7	3	16	31
>55	4	4	8	7	5	8	8	10	12	0	5	27	2	5	17	22
Gender																
Females	8	14	25	13	24	8	29	32	22	6	20	46	9	12		
Males	6	8	7	11	44	7	24	32	23	9	40	26	7	5		
Ethnicity																
NZ European	13	9	21	7	12	11	20	24	17							
Māori	1	1	4	4	7	1	4	6	6							
Pasifika	0	2	1	5	8	1	2	2	9							
Asian	0	8	4	6	32	2	18	26	13							
Other	0	2	2	2	9	0	9	6	0							
Education																
School	2	3	7	4	24											
Other education	6	7	10	8	26											
Undergrad	4	9	12	9	13											
Postgrad	2	2	3	3	3											

Appendix 14 Information sheet and consent form (RIBURST participants) for Study 3

Participant Information Sheet

This information sheet is to be used for participants in the stress study

Date Information Sheet Produced:

28 March 2019

Project Title

Assessing the viability and usability of a mobile application for the self-management of stroke risk in a NZ population.

An Invitation

My name is Shwetha Ann George. I am a PhD student at the National Institute for Stroke and Applied Neurosciences, Auckland University of Technology (AUT), Auckland *working with my faculty advisor, Professor Valery Feigin*. I would like to invite you to take part in my research study, which explores some factors which influences how well the Stroke Riskometer Pro mobile application helps NZ people manage their risk for developing a stroke. Before you decide you need to understand why the research is being done, what your participation would involve, what the benefits and risks to you might be, and what would happen after the study ends. This Participant Information Sheet will help you decide if you'd like to take part. You may also want to talk about the study with other people, such as family, whānau, friends, or healthcare providers. Please feel free to do this and I am happy to answer any questions you might have. Please make sure you have read and understood all the pages.

What is the purpose of this research?

Stroke is a leading cause of death and disability in NZ and affects all ages, genders and ethnicities. However, stroke is highly preventable if the risk factors (for example, being overweight or high blood pressure) are well managed. With this intent, the novel Stroke Riskometer^{TM} Pro mobile application was developed by AUT which calculates a given person's 5- and 10-year risk for having a stroke. The app also provides information on risk factors that are important for stroke and how to manage these through changes in your lifestyle to prevent a stroke event. However, a number of factors can have an impact on whether an app user begins or maintains these changes. There have been a number of studies to show that high stress tends to increase the risk of a stroke. The aim of this study is to explore the common reasons for stress and whether people who are highly stressed use unhealthy, stroke risk-increasing behaviours (such as smoking) to cope.

How was I identified and why am I being invited to participate in this research?

You are invited to take part in this study because you have downloaded the Stroke Riskometer^{TM} Pro application, have been a part of AUT's *Reducing the International Burden of Stroke* (RIBURST) study for at least 6 months, meet the following eligibility criteria, and had expressed interest to be contacted for any future studies when you completed the RIBURST consent form. Your name and email ID were acquired from the RIBURST study.

You are asked to participate in this study because you said 'yes' to having experienced significant or emotional stress in the past year when you completed the app.

How do I agree to participate in this research?

If you agree to take part in this study, you will be asked to sign the Consent Form on the last page of this document. You will be given a copy of both the Participant Information Sheet and the Consent Form to keep. Your participation in this research is voluntary (it is your choice) and if you don't want to take part, you don't have to give a reason and it will not affect you in any way. You are able to withdraw from the study at any time and it will in no way affect your future health care or your relationship with the study team. If you choose to withdraw from the study, you are advised to notify a member of the research team before you withdraw. You will then be offered the choice between having any data that is identifiable as belonging to you removed or allowing it to continue to be used. However, once the findings have been produced, removal of your data may not be possible.

What will happen in this research?

If you decide to take part, I will hold an interview with you face-to-face. This will happen either by video calling (Skype, WhatsApp) or if you don't have this facility, by a visit to a time and place suitable to you. The interview questions will explore the situations that have caused you intense feelings of stress and how you cope. It should last about 60 minutes. With your permission, the interview will be recorded and if you choose not to be recorded, notes will be taken instead.

What are the discomforts and risks and how will these be resolved?

There are no known risks caused by this study. Your usual medical care will not be affected in any way by participating in the study, or by deciding not to take part in the study or withdrawing from the study at any stage. During the interview, you might be asked questions about certain topics which are sensitive or may upset you. You can refuse to answer any questions which you feel uncomfortable with, or you can stop the interview anytime. At the end of the interview you can raise any concerns you had about the questions or the interview in general and the interviewer will do their best to clarify these questions. If you any concerns after the interview is over, you are welcome to contact any of the researchers mentioned at the end of this form
Journal articles or conference presentations may include direct quotes from your interview. These may include family members, colleagues, friends that you mentioned who may identify themselves in these quotes. If they were not aware that you would be discussing them in the interview, it is a possibility that they may have negative feelings towards you for discussing them without their permission. The researcher will do their best to minimize this risk by changing the names and any other identifying information. However, it is also highly recommended that you take the opportunity to explain the goals of the study to them and seek their approval to mention them before the interview.

What are the benefits?

There is no guarantee that taking part in this research can benefit you directly. However, it will help the researchers understand why some people do not follow a healthy lifestyle even when they know it can reduce stroke risk.

Reimbursement/koha?

A $20 food/fuel voucher will be provided to you after completing the interview.

How will my privacy be protected?

The original audio will be deleted right after the transfer. Recordings will be written down word for word either by the researchers or a reputable transcriber who will sign a confidentiality agreement. All audio recordings will be transferred and saved in a password protected electronic AUT database which can only be accessed by the researcher, together with written copies of the interview. The database will also have a spreadsheet which contains your contact details and the unique ID number you have been assigned. This information will be destroyed immediately before the findings are released or if you choose to withdraw from the study. Your name and any other information that allows you to be identified directly will not be entered in the written copies of the interviews and final reports. Instead your unique ID number will replace any mention of your name and initials will replace all other identifying information such as places or jobs in a way that doesn't change the meaning of the sentence. The data we collect will be used only for the purpose of this research; if data were to be used for future studies, further Research Ethics Committee approval will be sought. Once the study is completed, all data will be kept for 10 years in a secure place at AUT University.

What opportunity do I have to consider this invitation?

Once you have received this information sheet, we would appreciate it if you could make a decision on whether or not to take part within two weeks' time. During this time, you are welcome to get in contact with the researcher to discuss any questions you may have.

What happens after the study ends?

The results of this study will be used to complete a PhD thesis and will also be presented in both national and international conferences and published as journal articles. Please indicate in the attached consent form if you would like to or not to receive a summary of the results of the study. If you do, the summary will be sent to you by secure post. However, if you want to access the results in more detail at a later stage, please indicate on the consent form and the researchers will send you a link to access the full PhD thesis. Please note that the findings of the study will only be available by mid 2020.

Whom do I contact for further information about this research or if I have concerns about this research?

Any questions or concerns regarding the nature of this project should be notified in the first instance to researcher Shwetha Ann George, E-mail: ann.george@aut.ac.nz or Tel: 0224103809 or Project Supervisor, Dr Valery Feigin, E-mail: valery.feigin@aut.ac.nz, Tel: 09 921 9166. Concerns regarding the conduct of the research should be notified to the Executive Secretary of AUTEC, Kate O'Connor, ethics@aut.ac.nz, 921 9999 ext. 6038.

Approved by the Auckland University of Technology Ethics Committee on 1st April 2019, AUTEC Reference number 19/29.

Consent Form

Project title:	***Investigating the modulators of health behaviour change to reduce stroke risk using the novel AUT Stroke Riskometer^{TM} (SR) mobile application***
Project Supervisor:	***Dr Valery Feigin***
Researcher:	***Shwetha Ann George***

- I have read and understood the information provided about the **stress study** in the Information Sheet dated (Version 1.1, dated 28 March 2019).
- I realise the study involves an interview with lifestyle questions and will last around 60 minutes. I understand that the interview will be recorded and written word for word. I can choose not to have the interview recorded and if uncomfortable, I can stop the interview at any time.
- I understand that a debriefing session will happen at the end of the study where I can discuss any concerns or issues I had during the interview.
- I understand that taking part in this study is my choice and that I may choose not to answer any questions or withdraw from the study at any time without being disadvantaged in any way.
- I understand that if I withdraw from the study then I will be offered the choice between having any data that is identifiable as belonging to me removed or allowing it to continue to be used. However, once the findings have been produced, removal of my data may not be possible.
- I understand that my participation in this study will be kept confidential and that no material that could identify me will be used in any reports on this study
- I wish to receive a summary of the research findings (please tick one)

  YesO NoO
- I have had time to consider whether to take part. I have had an opportunity to ask questions and to have them answered. I have had the opportunity to use family/whānau support or a friend to help me ask questions and understand the study
- I know whom to contact if I have any questions about the study.
- I agree to take part in this research.
- I consent to having my contact details retained in a secure file so that I can be contacted for future studies

Participant's signature: ....

Participant's name: ....

Participant's Contact Details (if appropriate):………………………………………………………………………………..

Date:

Approved by the Auckland University of Technology Ethics Committee on 1/4/19, AUTEC Reference 19/29

Note: The Participant should retain a copy of this form.

Appendix 15. Information sheet and consent form (advertisement participants) for Study 3

Participant Information Sheet

This information sheet is to be used for participants in the stress study who respond to a study ad

Date Information Sheet Produced:

12 June 2019

Project Title

Investigating the modulators of health behaviour change to reduce stroke risk using the novel AUT Stroke Riskometer^{TM} (SR) mobile application

An Invitation

My name is Shwetha Ann George. I am a PhD student at the National Institute for Stroke and Applied Neurosciences, Auckland University of Technology (AUT), Auckland *working with my faculty advisor, Professor Valery Feigin*. I would like to invite you to take part in my research study. Before you decide you need to understand why the research is being done, what your participation would involve, what the benefits and risks to you might be, and what would happen after the study ends. This Participant Information Sheet will help you decide if you'd like to take part. You may also want to talk about the study with other people, such as family, whānau, friends, or healthcare providers. Please feel free to do this and I am happy to answer any questions you might have. Please make sure you have read and understood all the pages.

What is the purpose of this research?

Stroke is a leading cause of death and disability in NZ and affects all ages, genders and ethnicities. However, stroke is highly preventable if the risk factors (for example, being overweight or high blood pressure) are well managed. There have been a number of studies to show that high stress tends to increase the risk of a stroke. The aim of this study is to explore the common reasons for stress and whether people who are highly stressed use unhealthy, stroke risk-increasing behaviours (such as smoking) to cope.

How was I identified and why am I being invited to participate in this research?

You are invited to take part in this study because you have responded to a study ad.

How I agree to participate in this research?

If you agree to take part in this study, you will be asked to sign the Consent Form on the last page of this document. You will be given a copy of both the Participant Information Sheet and the Consent Form to keep. **Please note, even if you have consented, you will be required to complete some screening questions to ensure you meet the eligibility criteria of the study. If you do not meet these criteria, your participation will be excluded from the study.** Your participation in this research is voluntary (it is your choice) and if you don't want to take part, you don't have to give a reason and it will not affect you in any way. You are able to withdraw from the study at any time and it will in no way affect your future health care or your relationship with the study team. If you choose to withdraw from the study, you are advised to notify a member of the research team before you withdraw. You will then be offered the choice between having any data that is identifiable as belonging to you removed or allowing it to continue to be used. However, once the findings have been produced, removal of your data may not be possible.

What will happen in this research?

If you decide to take part and meet the eligibility criteria, I will hold an interview with you face-to-face. This will happen either by audio or video calling (Skype, WhatsApp) at a time and day suitable to you. The interview questions will explore the situations that have caused you intense feelings of stress and how you cope. It should last about 60 minutes. With your permission, the interview will be recorded and if you choose not to be recorded, notes will be taken instead.

What are the discomforts and risks and how will these be resolved?

There are no known risks caused by this study. Your usual medical care will not be affected in any way by participating in the study, or by deciding not to take part in the study or withdrawing from the study at any stage. During the interview, you might be asked questions about certain topics which are sensitive or may upset you. You can refuse to answer any questions which you feel uncomfortable with, or you can stop the interview anytime. At the end of the interview you can raise any concerns you had about the questions or the interview in general and the interviewer will do their best to clarify these questions. If you any concerns after the interview is over, you are welcome to contact any of the researchers mentioned at the end of this form.

Journal articles or conference presentations may include direct quotes from your interview. These may include family members, colleagues, friends that you mentioned who may identify themselves in these quotes. If they were not aware that you would be discussing them in the interview, it is a possibility that they may have negative feelings towards you for discussing them without their permission. The researcher will do their best to minimize this risk by changing the names and any other identifying information. However, it is also highly recommended that you take the opportunity to explain the goals of the study to them and seek their approval to mention them before the interview.

What are the benefits?

There is no guarantee that taking part in this research can benefit you directly. However, it will help the researchers understand why some people do not follow a healthy lifestyle even when they know it can reduce stroke risk.

Reimbursement/koha?

A $20 food/fuel voucher will be provided to you after completing the interview.

How will my privacy be protected?

The original audio will be deleted right after the transfer. Recordings will be written down word for word either by the researchers or a reputable transcriber who will sign a confidentiality agreement. All audio recordings will be transferred and saved in a password protected electronic AUT database which can only be accessed by the researcher, together with written copies of the interview. The database will also have a spreadsheet which contains your contact details and the unique ID number you have been assigned. This information will be destroyed immediately before the findings are released or if you choose to withdraw from the study. Your name and any other information that allows you to be identified directly will not be entered in the written copies of the interviews and final reports. Instead your unique ID number will replace any mention of your name and initials will replace all other identifying information such as places or jobs in a way that doesn't change the meaning of the sentence. The data we collect will be used only for the purpose of this research; if data were to be used for future studies, further Research Ethics Committee approval will be sought. Once the study is completed, all data will be kept for 10 years in a secure place at AUT University.

What opportunity do I have to consider this invitation?

Once you have received this information sheet, we would appreciate it if you could make a decision on whether or not to take part within two weeks' time. During this time, you are welcome to get in contact with the researcher to discuss any questions you may have.

What happens after the study ends?

The results of this study will be used to complete a PhD thesis and will also be presented in both national and international conferences and published as journal articles. Please indicate in the attached consent form if you would like to or not to receive a summary of the results of the study. If you do, the summary will be sent to you by secure post. However, if you want to access the results in more detail at a later stage, please indicate on the consent form and the researchers will send you a link to access the full PhD thesis. Please note that the findings of the study will only be available by mid 2020.

Whom do I contact for further information about this research or if I have concerns about this research?

Any questions or concerns regarding the nature of this project should be notified in the first instance to researcher Shwetha Ann George, E-mail: ann.george@aut.ac.nz or Tel: 0224103809 or Project Supervisor, Dr Valery Feigin, E-mail: valery.feigin@aut.ac.nz, Tel: 09 921 9166. Concerns regarding the conduct of the research should be notified to the Executive Secretary of AUTEC, Kate O'Connor, ethics@aut.ac.nz, 921 9999 ext. 6038

Approved by the Auckland University of Technology Ethics Committee on 17th June 2019, AUTEC Reference number 19/29

Consent Form

Project title: ***Investigating the modulators of health behaviour change to reduce stroke risk using the novel AUT Stroke Riskometer^{TM} (SR) mobile application***

Project Supervisor: ***Dr Valery Feigin***

Researcher: ***Shwetha Ann George***

- I have read and understood the information provided about the **stress study** in the Information Sheet dated (Version 1, dated 12 June 2019)
- I understand I may be excluded from the study, even after consenting, if I don't meet key eligibility criteria
- I realise the study involves an interview with lifestyle questions and will last around 60 minutes. I understand that the interview will be recorded and written word for word. I can choose not to have the interview recorded and if uncomfortable, I can stop the interview at any time.
- I understand that a debriefing session will happen at the end of the study where I can discuss any concerns or issues I had during the interview.
- I understand that taking part in this study is my choice and that I may choose not to answer any questions or withdraw from the study at any time without being disadvantaged in any way.
- I understand that if I withdraw from the study then I will be offered the choice between having any data that is identifiable as belonging to me removed or allowing it to continue to be used. However, once the findings have been produced, removal of my data may not be possible.
- I understand that my participation in this study will be kept confidential and that no material that could identify me will be used in any reports on this study
- I wish to receive a summary of the research findings (please tick one)

  YesO NoO
- I have had time to consider whether to take part. I have had an opportunity to ask questions and to have them answered. I have had the opportunity to use family/whānau support or a friend to help me ask questions and understand the study
- I know whom to contact if I have any questions about the study.
- I agree to take part in this research.
- I consent to having my contact details retained in a secure file so that I can be contacted for future studies

Participant's signature: ....

Participant's name: ....

Participant's Contact Details (if appropriate):..

Date:

Approved by the Auckland University of Technology Ethics Committee on 17th June 2019, AUTEC Reference 19/29

Note: The Participant should retain a copy of this form.

Appendix 16. English version of the Trier Inventory for Chronic Stress (TICS-E)

I will narrate some descriptions of situations and experiences. Please answer how often each event has happened to you in the past 3 months, using a rating of never, rarely, sometimes, often or very often.

(Interviewer note: The items that fall under each of the 9 TICS-E subscales are highlighted according to the following legend)
Work overload
Social overload
Pressure to perform
Work discontent
Excessive demands at work
Lack of social recognition

Chronic Worrying

1. I have to postpone much needed rest
2. I receive too little appreciation for my accomplishments
3. I make too many mistakes because what I have to do demands too much of me
4. I do not have enough time to perform my daily tasks
5. I must perform tasks that seem nonsensical to me
6. I have differences of opinion with other that lead to tension
7. I have work to do that involves carrying a lot of responsibility for other people
8. Situations in which I must make an effort to win others' trust
9. I worry that something unpleasant will happen
10. My daily tasks are not interesting
11. Times when I am lonely
12. Situations when I must make pains to have a good relationship with others
13. I have to perform tasks that I do not enjoy
14. I have tasks to perform during which I am being critically observed
15. I have conflicts with others because they have different goals
16. Times when I cannot suppress worrisome thoughts
17. Times when so many business appointments accumulate that I can barely get caught up
18. I try in vain to gain recognition for my good work
19. I spend a lot of time dealing with other peoples' problems
20. I perform my tasks inadequately, despite trying my best
21. Times when none of my tasks seem meaningful to me
22. I have work to do that must not disappoint others
23. I have to try to make a good impression with people
24. Times when I can no longer cope with the demands of my work
25. Times when my worries overwhelm me
26. I have conflicts with others because I do not act the way they expect me to
27. Times when I must work under strict deadlines

28. I have to deal with other people's problems too much
29. Times when I do not have the opportunity to share my thoughts and feelings with others
30. Situations in which it depends entirely on me if a relationship with another person develops satisfactorily
31. Although I do my best, my work is not appreciated
32. I have tasks to fulfil that pressure me to prove myself
33. I have conflicts with others because they meddle too much in my affairs
34. Times when I am so isolated from other people
35. Times when I am not able to perform as well as expected
36. Times when I worry a lot and cannot stop
37. I object to duties that I must fulfil
38. Times when I have too many duties to fulfil
39. I must frequently care for the well-being of others
40. Situations in which I must make an effort to please other
41. Times when I have nothing meaningful to do
42. Times when I have too little contact with other people
43. People have high expectations for tasks that I must fulfil
44. Times that my work overwhelms me
45. I have arguments with people that lead to long-lasting conflicts
46. I am not adequately rewarded for my efforts
47. I worry that I will not be able to fulfil my tasks
48. I must do work that does not take advantage of my abilities
49. Situations in which the well-being others depend on how well I work
50. I have too many tasks to perform
51. Times when I miss having contact with others
52. I have unnecessary conflicts with others
53. Times when I have no tasks that make me happy
54. I experience having too much to do
55. Although I try, I do not fulfil my duties as I should
56. Times when I have no friends to do things with
57. Times when my responsibility for others becomes a burden for me

Appendix 17. Stress study Interview template

Stroke Riskometer download (for advertisement responders only)

Did you have the opportunity to download the Stroke Riskometer app?

1. If no, could you please specify the reasons as to why?
    a. If you had technical difficulties downloading the app, would you like to do so now?
2. If yes, what were your thoughts around the app? (i.e., its usability, information provided, being able to calculate your risk of a stroke etc.?)
    a. Did you find calculation of your stroke risk as motivating you to change your lifestyle risk factors? If not, why is that?
    b. Did you enrol into the RIBURST study through the app?

Stress interview

1. What are your thoughts about stress and its impact on heart attacks and strokes? Do you think there is a relationship- if yes in what way; if not why not?
2. For SR users-did the app increase your understanding about the relationship between stress and stroke?
    a. Did you find knowing your stroke risk motivating you to manage your stress better or decrease your stress levels?
    b. what were your thoughts on the recommendations provided to manage your stress (prompts-were they useful, help you manage stress more adaptively)
3. Think back to a day that was particularly stressful for you., either at work or home. Ideally it should be a common cause of stress for you. Could you describe it for me?
    a. Who was that with (for peer/interpersonal pressure)?
    b. When did it happen?
    c. What happened and what about it was stressful?
    d. How long has this been going on?
    e. Does this happen often?
    f. Was there anything out of the ordinary in this?
    g. How stressful was this for you?
    h. How were you feeling before this happened? How did you feel while it was happening? What mood were you in after this happened?
    i. Did you respond to the stress the way you wanted to?

4. Think about the relationship between stress and your ability to make a lifestyle change. How easy is it to make a change when you are stressed?
5. Prompt- Some people who are stressed, are not able to think about making any changes to their lifestyle- what do you think about this? Can you give me some examples from your experience?
    a. Increased in smoking frequency. If yes, how many cigarettes on average would you have on a day that is not stressful compared to a stressful day? How does it make you feel? Does that carry on?

b. Increased in alcohol consumption. If yes, how many standard alcoholic drinks would you have in a day/week during a time that is stressful compared to when you are not stressed? How does it make you feel? Does that carry on?
c. Dietary changes. If yes, what sort of foods would you have more of when you are stressed compared to when you are not? Think about high calorie food intake such as processed foods, fast food/takeaways, and sweet/dessert items. Does your intake of healthy foods reduce under stress (i.e., fruits/vegetables)?
d. Reduced exercise. If yes, how is your level of exercise affected when you are under stress?
e. Weight increase. If yes, do you find yourself tending to increase weight when you are under stress? What contributes towards your weight increase?
    i. Prompt- Others become stressed when they try to make a change. Have you had this experience? What do you think about this?
    ii. Prompt- some people feel better in themselves if they make a lifestyle change (e.g. stop smoking). Have you had this experience? Tell me about it.

6. Do you undertake any of the following behaviours when dealing with the stressful situation?
    a. Exercise or physical activity. What sort of exercise techniques do you typically undertake in, how often compared to normal?
    b. Relaxation techniques such as yoga, a massage, deep breathing, progressive muscle relaxation, meditation, spiritual/religious activities: What sort of techniques do you typically undertake in, how often compared to normal?
    c. Communicate with a friend or family member (phone, e-mail or in person) or with a counsellor, psychologist or health professional (phone, e-mail or in person).
    d. Any other positive behaviours that you undertake while stressed?

7. Do you have any health conditions that affected your ability to undertake positive health behaviour changes (e.g., a physical injury sustained that prevents recommended amount of physical activity)?