A Qualitative Study Examining the Opinions and Experiences of New Zealand Participants Regarding Beliefs of Sugar as an Addictive Substance.

Alexandra Rosser

Auckland University of Technology

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Faculty of Health and Environmental Sciences
School of Public Health and Psychosocial Studies

Primary Supervisor: Associate Professor Jason Landon

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, nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institute of higher learning.

Signed by: Date: 24th October 2023

Alexandra Rosser

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Abstract

The present study aims to examine New Zealand participants' perceptions of sugar as an addictive substance. The concept of sugar addiction is not new and there has already been some research around this, however due to ethical implications in human research, most studies have used animal experiments. Despite the myriad of health concerns caused by sugar overindulgence, including diabetes, obesity, cardiovascular disease, stroke, cancer, tooth decay and other issues, we do not yet have a conclusive answer as to the validity of sugar addiction. This study asked participants to draw from their understanding and experiences of sugar to explain whether they believed it should be classified as addictive. Qualitative content analysis was used to draw meaning and context from the rationale described by participants. Both inductive and deductive methods were used to determine whether perceptions and experiences by individuals in this study aligned with established scientific criteria surrounding substance dependence. For a considerable majority, signs and symptoms relating to excessive sugar intake conformed to current understandings of addiction. Conversely, those who did not believe sugar was addictive referenced how various biopsychosocial influences may contribute to sugar overindulgence, highlighting the complex nature of sugar consumption. While relying exclusively on subjective measures has inherent limitations, understanding individual experiences with sugar is essential in comprehending how a range of factors may shape indulgence. Given the consistency between participant experiences of sugar addiction and scientific literature concerning substance dependence, further measures should be implemented in evaluating the credibility of sugar as an addictive substance.

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Chapter 1: Introduction

The scope of the problem

Since the mid-1970s, the global burden of obesity has more than tripled (Congdon & Amugsi, 2022). While originating in industrialised nations, obesity is now also spreading quickly throughout economically developing and underdeveloped countries (Ford et al., 2017). Obesity, defined as a Body Mass Index (BMI) ≥ 30, is the leading cause for type 2 diabetes mellitus (Malik & Hu, 2022). It is a significant risk factor for range of chronic health conditions such as stroke, many cancers, and diabetes (Abdelaal et al., 2017). Due to its implication in the development of deadly and chronic diseases, obesity reduces life expectancy and increases overall mortality (Abdelaal et al., 2017). With such a significant impact worldwide, a large amount of research literature has focused on the causes and origins of global obesity, alongside potential ways to combat the epidemic (Safaei et al., 2021). We know that obesity results from excessive calorie intake in relation to calorie expenditure, leading to a positive energy balance which is stored as body fat (Hruby & Hu, 2015). On the surface, this appears to be a behavioural problem that can be reversed by behavioural change. However, an individual's behaviour is influenced by complex genetic, socioeconomic, and environmental factors (Anekwe et al., 2020). Genetically, twin and adoption studies have demonstrated that the heritability of obesity is between 40 and 70% (Herrera & Lindgren, 2010). Socioeconomic status (SES) has reliably been a determining factor of obesity, with higher weight associated with lower SES (Anekwe et al., 2020). Arguably though, the most substantial root cause of the rise of the obesity pandemic relates to environmental shifts through time, which have seen lifestyle changes affecting how we eat and what we eat (Temple, 2022).

Literature which investigates the progression of worldwide obesity often emphasises the substantial impact of free sugar (Meldrum et al., 2017; Sahned et al., 2019). Free sugar refers to the monosaccharides and disaccharides added to food and drinks by the manufacturer, i.e., in packaged food in the supermarkets or the sugar found in home baking. It also refers to sugar found naturally in syrups, honey, and fruit juices (World Health Organisation, 2015). Free sugar is distinct from naturally-occurring sugar, the latter referring to sugars which are already present in the diet, such as in

fructose (e.g. dried and fresh fruit) and lactose (e.g. milk products) (Mela & Woolner, 2018). This distinction is important to make, as naturally-occurring sugars are often found in foods that are necessary for our body and that lower the risk of CVD, such as in fruit, vegetables and whole-grains (Li et al., 2015). Studies have found that high naturally-occurring sugar intake is associated with higher fibre, fruit and vegetable intake, and lower wheat consumption (Kaartinen et al., 2017; Mela & Woolner, 2018). Foods that are high in natural sugars yet low in calories, such as various types of grains, legumes, and fruits, are commonly associated with lower risk of obesity and type 2 diabetes (Livingstone & McNaughton, 2016; Schwingshackl et al., 2017). Conversely, added sugars such as those in sugar-sweetened beverages (SSBs) have been directly linked to weight gain and subsequent chronic diseases that are caused by excess body fat (Malik & Hu, 2022; Schwingshackl et al., 2017). References to "sugar" throughout the rest of this paper will refer to free and added sugar, such as those in processed foods and sweetened beverages, rather than healthier alternatives.

The past 50 years have seen dramatic changes in food systems which have increased the availability of cheap, calorific foods, in an effort to focus on food efficiency rather than nutrition (Branca et al., 2019). The 1970s saw movement towards the consumption of energy-dense, diverse, and processed foods (Guldan, 2019). Normalisation of eating away from home increased reliance upon ready-made meals and convenience foods such as chips, chocolate, and sweetened beverages (Golper et al., 2021). Mechanical aids and vehicular transport resulted in the decline of physical activity and the rise of more sedentary lifestyle (Goryakin et al., 2015). Technological changes and globalisation saw the rise of the phenomenon known as the "nutritional transition" (Popkin, 2015). "Nutritional transition" is the process through which food systems change to accommodate urban populations. Diets shift from relying on animal-sourced foods and starchy staples to consumption of globalised, palatable foods excessive in sugar, sodium and saturated fats (Batal et al., 2018; Guldan, 2019). Thus, urbanisation saw increased calories at lower cost with lessened opportunity for calorie expenditure, increasing the likelihood of people becoming overweight or obese (Goryakin et al., 2015). A systematic review looking at four populations that had undergone "nutrition transition" found sugar to be the nutrient category most significantly linked to negative health outcomes, especially diabetes and obesity (Pressler et al., 2022). The findings from this study mimics data from

world trends which have examined the influence of diet on our health. Through such studies, a positive correlation between free sugar consumption and obesity prevalence has been established (Faruque et al., 2019).

The role of sugar in obesity is relevant when looking closer to home. As of 2021, approximately one in three adults in New Zealand is classified as obese (Ministry of Health, 2021). New Zealand has the third highest obesity rates among adults within the Organisation for Economic Cooperation and Development (OECD), and New Zealand ranks second in childhood obesity within the OECD (Mackay et al., 2022). In examining New Zealand's leading causes of death, which are currently cancer, ischaemic heart disease, and cerebrovascular disease (Te Whatu Ora, 2023), lifestyle factors such as obesity and smoking appear to play a significant role. For example, suboptimal diet and weight are the second leading causes of preventable cancer in NZ after tobacco smoking (Cancer Society New Zealand, 2022). Ischaemic heart disease, the most prevalent type of cardiovascular illness, has well-established risk factors including diets rich in calorific processed foods and sedentary lifestyle (Khan et al., 2020). Cerebrovascular disease, otherwise known as a cerebrovascular accident or stroke, is largely caused by hypertension, obesity, smoking, and diabetes (Caprio & Sorond, 2019). This brief overview of Aotearoa's deadliest diseases demonstrates the strong link between weight-related issues and mortality rates, especially regarding modifiable lifestyle choices (Walsh & Grey, 2019). A primary goal of the New Zealand health system has long been to ensure and improve equitable health outcomes, and avoidable mortality is at the forefront of this goal (Walsh & Grey, 2019). However, despite the evidence and increased education about the dangers of sugar overconsumption (NZ Nutrition Foundation, 2014) more than half New Zealanders continue to adversely consume free sugar (Kibblewhite et al., 2017). This has seen our already problematic obesity rates continue to rise (Ministry of Health, 2023).

Concerningly, the role of sugar on negative health outcomes continues to be controversial in spite of increasing evidence linking the two (Kearns et al., 2016; Vos et al., 2017). This is comparable to the way in which the tobacco industry tried to keep the negative health consequences from their products from being brought to public attention (Action on Sugar, 2014). It was discovered within the

last decade that the sugar industry funded research in the 1960s downplaying the hazards of sugar and emphasising the role of fats (Kearns et al., 2016). Similarly, the tobacco industry paid prominent scientists from the early days of research to conduct studies that countered any potentially damaging scientific evidence emerging about the harmful effects of smoking (Brownell & Warner, 2009). Other resembling factors between the tobacco and sugar industries include persistent and unrelenting advertisements of their respective products (Malhotra et al., 2018; Throsby, 2020) their convenience, accessibility, and affordability (Capewell & Lloyd-Williams, 2018). Significantly for global populations, unhealthy diet and tobacco use are among the leading risk factors for the world's most preventable diseases (Zawertailo et al., 2020). We have seen tobacco move from a widely socially acceptable product to one fraught with legal regulations due to its addictive and unhealthy properties. Arguably, models for sugar regulation should be heading the same way (Pasha & Silbert, 2022; Throsby, 2020).

Tobacco was officially recognised as an addictive substance in the late 1970s with its inclusion in the third edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-III) and in the ninth revision of the International Classification of Diseases (ICD-9) (American Psychiatric Association, 1980; Wiley et al., 2013). Early models of addiction focused on substances that induced tolerance and withdrawal effects, such as heroin and alcohol, which also had detrimental social, familial, and professional consequences (Crocq, 2007). The lack of observable intoxication effect in smokers, combined with its social acceptance and the understanding smoking could be acknowledged as a lifestyle choice, meant that the inclusion of tobacco dependence in the DSM-III and ICD-9 was highly controversial (Batra, 2009; Gearhardt et al., 2011; Mars & Ling, 2008). There was also debate around whether classifying tobacco dependence as a mental disorder would stigmatise those who chose to smoke because they enjoyed it, or that more people would hide their smoking habits out of fear of prejudice (Castaldelli-Maia et al., 2015). Many of these arguments mimic those surrounding inclusion of sugar as an addictive substance. For example, food excessively high in sugar does not produce observable changes in mental state and behaviour (Ahmed et al., 2013). Withdrawal from sugar, and sugar-induced tolerance is still highly debated in human studies (Adams et al., 2019; Ziauddeen et al., 2012). There is also concern as to whether labelling people as "addicted" to sugar

could do more harm than good, due to social stigma and public perception (Adams et al., 2019). These similarities bring to question whether the inclusion of tobacco in the DSM-III and ICD-9 as an addictive substance should serve as a basis for the inclusion of sugar as well.

Defining addiction

To understand the factors which comprise substance addiction, it is useful to examine the current two internationally recognised systems of disease identification and classification; the ICD-11 and the DSM-5 (American Psychiatric Association, 2013; World Health Organisation, 2019). The ICD is a classification of global diseases, injuries, and causes of death, whereas the DSM specifically covers behavioural, mental, and substance use disorders. The primary disorder relating to substance abuse in the ICD-11 is Substance Dependence, classified as a disorder of regulation of substance use which arises from continued or repeated use of that substance. This is manifested by two or more out of three diagnostic guidelines. The central diagnosis relating to substance abuse in the DSM-5 is Substance Use Disorder (SUD), understood as clinically significant distress or impairment resulting from a problematic pattern of substance use. It is necessary for two out of eleven criteria to be present for this diagnosis to be made. Criteria for diagnosis in both the DSM-5 and ICD-11 are demonstrated in Table 1:

Table 1

Comparisons Between the DSM-5 and ICD-11 Diagnostic Criteria (American Psychiatric Association,

2013; World Health Organisation, 2019)

Criteria	DSM-5	ICD-11
Craving	Craving or a strong desire or urge to use the substance	Impaired control over substance use, in terms of the onset, level, circumstances, or termination of use, sometimes accompanied by a subjective sensation of urge or craving.
Desire to quit / control	Persistent desire or unsuccessful efforts to cut down / control use	
Substance use greater / longer than intended	Substance taken in larger amounts or over a longer period than intended	
Activities given up	Recurrent substance use resulting in a failure to fulfil major role obligations	Substance use an increasing priority in life, takes precedence over other interests or enjoyments, daily activities, responsibilities, or personal care. Takes a central role in a person's life, relegating other areas to the periphery. Substance use often continues despite consequences and harms.
Time spent using / recovering	A lot of time is spent obtaining, using, and recovering from the substance's effects	
Continued use	Substance use is continued despite knowledge of physical / psychological problems exacerbated by substance	
Tolerance	Need for increasing amounts of substance for same effect or diminished effect with continued use	Physiological features as manifested by a) tolerance, b) withdrawal symptoms following cessation in use of the substance, or c) repeated use of the substance (or similar) to alleviate withdrawal symptoms.
Withdrawal	Withdrawal syndrome present for substance, or substance is taken to avoid withdrawal symptoms	

The ICD-11 specifies that a diagnosis may be made if the substance use has gone on for longer than a year, or if the substance has been used continuously during at least a one-month period. The DSM-5 emphasises the need for two criteria to be met during a 12-month period. Sugar, or food in general, is not yet included in either the ICD-11 or the DSM-5 as an addictive substance. This is despite additions of arguably less harmful substances such as caffeine and cannabis (Nugent et al., 2017; Wikoff et al., 2017). However, it is important to note the inclusion of eating disorders (EDs), such as anorexia nervosa

(AN) and binge eating disorder (BED), in both the ICD-11 and DSM-5 under "disorders due to addictive behaviours" and "behavioural addictions" (American Psychiatric Association, 2013; World Health Organisation, 2019).

Models of food addiction (FA) have seen overlap into the territory of EDs due to the association with obesity and disordered eating (Hauck et al., 2019). The most used model of FA is the Yale Food Addiction Scale (YFAS), which was developed specifically to measure addictive-like eating behaviour (Gearhardt et al., 2009). This model was based of the DSM-IV, translating the diagnostic criteria for substance use disorder into food addiction (Gearhardt et al., 2009). The YFAS, presented as a 25-point self-questionnaire, identified eating patterns similar to those seen in behaviours surrounding substance abuse, validating the idea that food can be addictive (Gearhardt et al., 2009). Similarities between this model and those surrounding EDs include features such as reduced control over food consumption, elevated impulsivity concerning food, and continuation of the eating behaviour despite negative consequences (Gearhardt et al, 2011; Zou et al., 2017). There are critical differences to be aware of when considering whether someone has a potential FA or ED. For example, EDs are characterised by elevated concerns with body image and weight, whereas this core pathology is not considered in models surrounding FA (Gearhardt et al., 2011; Pursey et al., 2014). On the other hand, FAs include psychological symptoms such as tolerance and withdrawal, which are not included in diagnosing EDs (Zou et al., 2017). As would be expected, studies using the YFAS have consistently demonstrated that highly processed foods, especially those high in fat and glycaemic load, are most associated with addictive-like eating patterns (Pursey et al., 2015; Schulte et al., 2016). Currently, the consensus of the YFAS is that while it does not categorically provide evidence that FA exists, it can be useful as a tool to identify whether certain individuals may experience an addictive-like response to food (Meule & Gearhardt, 2014).

It is helpful to examine the report published by the Surgeon General in 1988 to understand the important components of substance addiction. This case examined the potential for tobacco to be classified as a substance of abuse, with nicotine as the primary active agent responsible for addiction (United States Department of Health and Human Services (USDHHS), 1988). The three primary

scientific criteria used in this report to identify whether a substance could be considered addictive were: the ability of the substance to (1) cause compulsive use, (2) have psychoactive effects, and (3) reinforce behaviour. Compulsive use may be understood as behaviour around obtaining and using drugs, where individuals are often driven by strong urges, despite a desire or repeated attempts to quit (Gearhardt & DiFeliceantonio, 2023; USDHHS, 1988). Psychoactive effects relate to alterations in mood resulting from the ability of the drug to affect the brain (Gearhardt & DiFeliceantonio, 2023; USDHHS, 1988). The final criterion is that the substance must have pharmacological properties that are sufficiently rewarding to reinforce and maintain use (Gearhardt & DiFeliceantonio, 2023; USDHHS, 1988). Additional criteria included those found commonly associated with addictive behaviour, such as ongoing use despite negative consequences and cravings, and the physiological symptoms of tolerance and withdrawal. This report considered the three primary criteria as sufficient to define substance dependence, and thus concluded that tobacco can be considered addictive (USDHHS, 1988). Gearhardt & DiFeliceantonio (2023) used these criteria, with an added a fourth criterion of urges and cravings, to argue that highly processed foods may be considered addictive. They explained the necessity of this fourth criterion due to our current understanding of urges and cravings as being central to the addictive nature of substances of abuse (American Psychiatric Association, 2013; Gearhardt & DiFeliceantonio, 2023; World Health Organisation, 2019).

Prior considerations of sugar as an addictive substance

Use of the Surgeon General's report (USDHHS, 1988) assists our understanding of sugar addiction. This understanding may be split into 3 separate components: the behaviour, the substance, and the activating agent. In tobacco dependence, smoking is the predominant behaviour associated with tobacco use, whilst nicotine is understood to be the active agent responsible for the addictive nature of cigarettes (USDHHS, 1988). Extrapolating this to sugar addiction, sugar may be regarded as the activating agent within the substance (i.e. food) that drives eating behaviour (Westwater et al., 2016; Zawertailo et al., 2020). Continuing with this comparison, it has been discovered that nicotine is not the only addictive part of smoking. Many smokers enjoy the habit and rituals associated with the act of smoking, as well as sensations of pleasure and stress relief associated with inhaling tobacco (Fidler & West, 2009; Loud et al., 2021). This is similar to the way in which the act of eating itself can

be enjoyable and alleviate negative affect (Bédard et al., 2020; Wu et al., 2020). It is understood that excessive consumption of palatable foods can affect eating behaviour through activation of the reward system, which in turn can disrupt appetite regulation and induce pleasure (de Macedo et al., 2016; Erlanson-Albertsson, 2005). This is because, as with most drugs of abuse, high-fat, high-sugar foods can activate the dopamine reward system, resulting in increased extracellular dopamine release in the nucleus accumbens (de Macedo et al., 2016). The sugar addiction model proposes that sugar is key in perpetuating addictive eating patterns, just as nicotine is key in smoking dependence (Westwater et al., 2016).

Animal studies have been used from as early as the 1970s to examine whether consumption of sugar may create physiological dependence (DiNicolantonio et al., 2017). Rats will self-administer most drugs of abuse and have been known to develop signs of physiological addiction after prolonged exposure to such drugs (Ahmed, 2013). Early brain imaging studies demonstrated that increases in dopamine levels in rats from eating sugary foods was similar to the increase in dopamine levels shown when cocaine was provided (Hernandez & Hoebel, 1988). Sweetness itself, whether from sugar or saccharin, was often preferred by lab rats over other drugs of abuse (Cantin et al., 2010; Lenoir et al., 2007). Ahmed et al. (2013) collated data from 75 studies using rats that compared the effects of differing interventions on cocaine reward and motivation versus sucrose reward and motivation in rats. Overall, 88 out of 91 interventions altered the cocaine-motivated and cocaine-rewarded behaviours, while 17 out of 91 impacted the sucrose-motivated and sucrose-rewarded behaviours. This strongly suggests that the underlying mechanisms of sucrose reward and motivation are more powerful than those relating to cocaine (Ahmed et al., 2013). Experiments using the binge-eating model, in which animals have intermittent and repeated access to sugar, have demonstrated neuronal alterations like those seen with some addictive substances (Avena et al., 2008). Some of these include increases of dopamine, opioid receptor stimulation, elevated serotonin levels, and functional changes in GABA-A and glutamate receptors (Corwin et al., 2011). It has been discovered that sugar and opiate withdrawal in rats shows similarities, and the opioid antagonist naloxone can precipitate signs of withdrawal in sugar-bingeing rats (Avena et al., 2008; Colantuoni et al., 2002;

Corwin et al., 2011). Overall, research supports the hypothesis that some animals, particularly rats, can become physiologically dependent on sugar (Avena, 2010).

Numerous studies involving food and/or sugar addiction in humans have been conducted in the past 20 years. Despite this, review articles remain divided on the concept (Fletcher & Kenny, 2018; Greenberg & St Peter, 2021; Ho & Verdejo-Garcia, 2021). Some human studies have used functional magnetic resonance imaging (fMRI) or positron emission tomography (PET) scans as non-invasive approaches to observe the effect of highly calorific foods on the brain (Bragulat et al., 2010; Gearhardt et al., 2011; Pelchat et al., 2004; Rothemund et al., 2007). These studies have demonstrated the ability of palatable foods to trigger brain responses similar to those seen with drug cues in individuals with SUD (Volkow et al., 2009). For example, it was discovered that subjective palatability positively correlated to greater activation in the brain regions implicated in reward processing (Bragulat et al., 2010). Furthermore, higher BMI or FA scores positively correlated to greater activation in the brain regions implicated in habit learning, anticipation, and encoding the motivational value of stimuli (Gearhardt et al., 2011; Rothemund et al., 2007). This is comparable to the way in which individuals with SUD show greater activation in the brain regions that encode the reward value of stimuli in response to drug cues than those without SUD (Franklin et al., 2007; Volkow et al., 2006). It has also been found that cues of palatable foods activate the same neural pathways that are involved in drug reward and motivation (Volkow et al., 2009). These similarities may indicate an addiction potential for hyper-palatable foods, which are commonly known to be high in fat, sodium, and carbohydrates (Fazzino et al., 2019). However, little objective research has been able to specifically examine the impact of sugar on the human brain (Freeman et al., 2018).

While the evidence for physiological sugar addiction in rats is robust (Avena, 2010; Hoebel et al., 2009), this research is not easily transferrable to humans. One reason is that our naturally varied diet makes it a lot harder to identify craving and withdrawal symptoms particular to sugar (DiNicolantonio et al., 2017; Westwater et al., 2016). Further, there are ethical limitations to subjecting humans to extreme dietary imbalances (Wiss et al., 2018). We do know that foods high in sugar are able to stimulate the brain regions associated with craving and reward more than their

healthier counterparts (Lennerz et al., 2013). This may be a reason why sugar bingeing can trigger problematic behaviours comparable with those seen in drug addiction (Freeman et al., 2018). However, it should be noted that the ability of sugar to activate the same reward circuitry in the brain does not necessarily transfer to the full range of problematic behaviours elicited by drug use (Greenberg & St Peter, 2021). The significant rates of obesity worldwide and subsequent health problems have demonstrated that some overeating tendencies can be maladaptive and compulsive (Kornacka et al., 2021). Whether addiction is indicated through such tendencies is a question yet to be answered, and several studies have aimed to do so regarding subjective perceptions of food addiction (Ruddock et al., 2015; Ruddock & Hardman, 2017; Schulte et al., 2019). One study researching the subjective experiences of overweight and obese adolescents found that cessation of sugar-sweetened beverage consumption led to craving and withdrawal symptoms (Falbe et al., 2019). However, there is a gap in scientific literature focusing on perceptions and symptoms of sugar addiction from a generalised population, and none which are specific to New Zealand (Kibblewhite et al., 2017).

The current study therefore aims to provide insight into subjective experiences surrounding sugar, with an emphasis on attitudes about the concept of sugar addiction. Despite the abundance of literature on sugar's negative impacts on health, there is limited research addressing subjective experiences of its potentially addictive nature (Schulte et al., 2015). The percentage of individuals who perceive sugar as being addictive will be investigated to understand whether there is a prevailing consensus amongst participants in this group. The use of relevant diagnostic criteria will be necessary to compare whether the perceptions and experiences concerning sugar addiction by participants in this study align with current scientific understandings of addiction (Volkow & Boyle, 2018). Identification of any correlations between acute or chronic sugar overconsumption and substance use disorder will be significant in understanding shared behaviours, and may be further used in shaping treatment approaches (Volkow & Boyle, 2018). Additionally, clarifications as to why some participants believe people overconsume sugar in the absence of addiction will help to identify prominent drivers of excessive sugar intake. Recognition of such factors may have significant implications for prevention strategies, as understanding non-addictive causes of overconsumption could aid in reducing the risk of sugar-related health issues (Rippe & Angelopoulos, 2016).

Chapter 2: Methodology

Research approach and aim

A qualitative approach to this research was chosen to give a broad understanding of participants' experiences and to uncover meaning within the context it was provided (Merriam, 2009). Qualitative research is a way of investigating a phenomenon in a systematic manner that allows for the behaviours, thoughts, and interpretations of participants to be paramount (Merriam, 2009). It is used to collect, organise, and interpret textual material through exploring the meanings that individuals give to social phenomena (Jansen, 2010). Data may be expressed through conversations, written texts, or visual forms, and it is commonly collected through surveys, individual interviews, or focus groups (Grossoehme, 2014). A short survey using structured questions was deemed most appropriate for this research, as it enables participants to explain their views on a focused topic (Hammarberg et al., 2016). Questions asked by researchers using qualitative methods are often open-ended to elicit conversation, and analysis may be either inductive or deductive (Jansen, 2010). Inductive analysis uses raw data to identify relevant topics and dimensions, whereas deductive analysis is used to categorise raw data into pre-defined categories (Jansen, 2010).

Primary criticisms of qualitative analysis purport it to be less trustworthy than quantitative analysis, due to the inherent bias of subjective measures (Hammaberg et al., 2016; Noble & Smith, 2015). A method's trustworthiness may be improved through a robust description of the procedure, so that reviewers can follow and understand the progression of decisions and events leading to data generation and management (Kitto et al., 2007). Credibility can be increased through incorporating methodological strategies aimed at establishing reliability and validity of research findings (Noble & Smith, 2015). Reliability refers to the consistency of a measure; i.e. whether the same results will be obtained if the study is repeated, whereas validity refers to whether the conclusion truly supports what it claims (Grossoehme, 2014). Researchers should address any potential influences on research findings and conclusions by explaining steps taken to minimise the impact of bias and subjectivity on the study (Noble & Smith, 2015). To improve reliability, the accuracy of the data should be taken into consideration by constant comparison of the original source, and data analysis should refer to

quantitative aspects where possible (Leung, 2015). Validity may be increased by ensuring the procedure and methods are appropriate for the research paradigm, while also distinguishing between inductive and deductive approaches (Leung, 2015). Transparency regarding strategies implemented to enhance the validity and reliability of the project will in turn increase its overall trustworthiness (Grossoehme, 2014).

It should be noted that a purely descriptive analysis of qualitative data is not possible due to the innately subjective nature of the process (Cruz, 2015). To explore and interpret the essence of meaning given to a particular topic, researchers must immerse themselves in the raw data (Merriam, 2009). Such immersion cannot be neutral; as the subject matter is being decoded by the researcher, they will also implicitly be encoding their own perspectives, beliefs, and assumptions into their research (Cruz, 2015). This framework will therefore influence how the researcher interprets, assembles, and presents the data (Cruz, 2015). The importance of subjectivity is demonstrated by the researcher's ability to capture features and nuances of individuals' lived experiences that may be considered too complex for an entirely quantitative investigation (Mohajan, 2018). Qualitative research aims to develop explanations for a phenomenon by interpreting individual experiences (Austin & Sutton, 2014), which is why it was chosen as the research approach to understand participants' opinions on sugar addiction.

Participants and recruitment

Participants were eligible to partake in the study if they were 18 years or older, provided consent, were living in New Zealand, and were willing to complete both the initial and the follow-up questionnaires. Advertising for the baseline survey ran from 14 to 31 August 2021, and was conducted online due to the COVID-19 lockdown restrictions. The survey was promoted through the University recruitment website and email distribution, and both paid and unpaid promotion was conducted on social media. In total, NZ$1207.53 was spent on advertising, reaching 106, 298 New Zealanders. 608 individuals consented to participate in the trial. Of these, 381 participants completed the two-month follow-up survey on sugar addiction, which was conducted from 20 November 2021 to 5 January

2022. While money was not provided for survey completion, participants who completed the follow-up surveys could participate in a prize draw to win a NZ$50 voucher or other prizes. Demographic information for participants who answered the two-month follow-up survey on sugar addiction is outlined in Table 2:

Table 2

Demographics of Participants who Completed the Survey on Sugar Addiction (N=381)

Category	*n*	%
Gender		
Female	335	87.9
Male	42	11.0
Gender diverse	4	1.0
Age		
18-29	85	22.3
30-44	57	15.0
45-59	118	31.0
60+	121	31.8
Ethnicity		
Pakeha	275	72.2
Māori	35	9.2
Pasifika	4	1.0
Indian	16	4.2
Asian	20	5.2
Other	31	8.1
Education		
Secondary/diploma	130	34.1
Undergraduate	133	34.9
Postgraduate	115	30.2
Other	3	0.8
Income		
<20,000	21	5.5
20,000-39,999	52	13.6
40,000-69,999	71	18.6
70,000-99,999	89	23.4
>100,000	148	38.8
BMI category		
Underweight	3	0.8
Normal	147	38.6
Overweight	118	31.0
Obese	110	28.9

Procedure

This research was conducted as a follow-up to a larger study focusing on objectively measurable and subjectively assumed sugar consumption among people living in New Zealand. Participants answered questions to the initial survey online, through a website built with Qualtrics XM web software. The survey on sugar addiction was sent to randomly allocated participants via email two months after the initial study. This specific project aims to examine the idea of sugar as an

addictive substance by analysing participants' answers to five questions about their perception of sugar addiction. Using their lived experience, participants were asked whether they believed sugar to be an addictive substance, and to give reasons for their answers.

Survey on sugar addiction

The survey was composed of one multi-choice question and four short-answer questions, split into two groups depending on the participant's answer to the first question. The first question asked: "Based on your experience, do you think sugar is addictive?" Answers were 1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree. Participants who answered 1 or 2 were placed in the "No" group. They were asked the following two questions: "What are the reasons you think sugar is NOT addictive?" and "What is your view on why some people overconsume sugar?" Participants who answered 3 or 4 were placed in the "Yes" group. They were asked the following two questions: "What are the reasons you think sugar is addictive?" and "What signs or symptoms have you experienced that indicate sugar is addictive?" Demographic information and answers to the multi-choice question were collated using a Microsoft Excel spreadsheet. This data was further analysed through Jamovi to detect any correlations between demographic information and answers to the multi-choice question. The short answers were formatted using Microsoft Word, and spelling and grammar was corrected where necessary.

Established scientific criteria

Combined use of scientific literature and current diagnostic manuals identified five criteria to be used in data analysis. *Compulsive Use, Psychoactive Effects* and *Reinforcing Behaviour* were chosen due to their significance in the Surgeon General's report in establishing the potential for nicotine dependence (USDHHS, 1988). Commonalities between tobacco and sugar have been explained throughout this paper, and therefore using similar criteria to establish addiction potential is deemed appropriate. Gearhardt and DiFeliceantonio (2023) used these three criteria, with the addition of *Urges and Cravings*, to argue that highly processed foods could be considered addictive. They included *Urges and Cravings* due to their significance in predicting use and relapse of addictive

substances (Gearhardt & DiFeliceantonio, 2023). Further predictors of substance abuse and relapse are *Tolerance and Withdrawal*, which are used in both the DSM-5 and ICD-11 to diagnose substance addictions (American Psychiatric Association, 2013; World Health Organisation, 2019). These criteria are outlined in Table 3:

Table 3

Established Scientific Criteria Identified for Data Analysis (American Psychiatric Association, 2013;

Gearhardt & DiFeliceantonio, 2023; USDHHS, 1988; World Health Organisation, 2019)

Category	Description	Example
Compulsive Use	Actions surrounding using and obtaining substances despite desire to stop and/or presence of negative consequences	Bingeing on sugar, cannot stop eating sugar despite desire to do so, consequences include: weight gain, rotting teeth, eating until sick, feeling of guilt and shame
Psychoactive Effects	Use of a substance results in altered mood states, commonly increased pleasure and decreased negative affect	Eating sugar to increase comfort and decrease stress, sugar gives a feel-good mood
Reinforcing Behaviour	Pharmacological properties of the substance are sufficiently rewarding so self-administration is maintained	Consumption of sugar for reasons other than hunger, enjoying effects of sugar, enjoying the taste of sugar
Urges and Cravings	Desire to use a substance is driven by thoughts and/or bodily sensations	Obsessing about sugar, wanting more, spending time thinking about sugar, finding the idea of sugar hard to resist
Tolerance and Withdrawal	Physiological effects of repeated substance use. Tolerance: needing more to have same effect. Withdrawal: bodily symptoms when substance is removed.	Becoming accustomed to sweet taste, feelings of low mood without sugar, experiencing negative bodily sensations without sugar e.g. headaches

Data analysis

Qualitative content analysis was the method chosen to examine the answers to the four short-answer questions (Elo & Kyngäs, 2008; Hseih & Shannon, 2005). This research method focuses on the importance of language, with specific attention drawn to contextual meanings found in the text (Hseih & Shannon, 2005). Qualitative content analysis is used to describe a phenomenon through condensing text into content-related categories, with the purpose of providing new insight through practical representation of a dataset (Elo & Kyngäs, 2008). Two common approaches to qualitative content analysis are inductive and deductive content analysis (Bengtsson, 2016; Elo & Kyngäs, 2008).

An inductive approach is recommended when a phenomenon has limited former understanding and prior research literature (Mayring, 2000). Discovering themes within a dataset is an important basis for social science research, as it allows investigators to describe, compare, and explain their findings (Ryan & Bernard, 2003). It aims to provide understanding and knowledge of people's experiences through systematically coding themes and identifying patterns (Downe-Wamboldt, 1992; Hseih & Shannon, 2005). A deductive approach is useful when a theory to explain the phenomenon exists. Therefore the structure of the analysis is based on prior knowledge (Elo & Kyngäs, 2008). This approach is guided by predetermined categories, through which participant experiences are identified and categorised (Hseih & Shannon, 2005).

Answers in the "No" category were analysed through inductive content analysis, to draw meaning out of the text to understand why some participants believed sugar was not addictive. Answers in the "Yes" category were analysed through deductive content analysis, to discover whether participants' experiences with sugar aligned with relevant diagnostic criteria. In structuring and examining data through qualitative inductive and deductive content analysis, Bengtsson (2016) suggests the following four stages:

- *Stage 1*. The decontextualization: the researcher familiarises themselves with the data to gain a sense of a whole, before breaking it down into smaller units. Meaning units are labelled with a code, and each code facilitates the identification of a concept into which the data is assembled. Depending on the study design, codes are created inductively (through the course of the process) or deductively (created before starting the process).

- *Stage 2*. The recontextualization: the researcher checks whether all aspects of the text have been covered in the meaning units. Coloured pencils are used to distinguish each meaning unit, and the researcher considers whether any unmarked text should be included in the analysis.

- *Stage 3*. The categorisation: meaning units are condensed by dividing the coded material into broad groups, otherwise known as categories. Each category is made up of meaning units, otherwise known as subcategories.

- *Stage 4*. The compilation: the writing up and analysis begins once the categories are established. Using tables to show a summary of categories and subcategories alongside quantification of each category can be a useful way to present information.

Ethical considerations

This study was approved by the University of Auckland Human Participants Ethics Committee on 21/07/21 for three years, with the reference number 22241. Participants were referred to the website where the study results were made available for their own interest. Additionally, at follow-up participants were asked if they wanted to be emailed a summary of the study results once they were published. After the study completion (i.e., two-month follow-up) participants in the control group were able to request intervention in the form of the three resources provided to the intervention group.

Chapter 3: Results

Table 4 displays the percentage of people in each demographic who indicated whether they did or did not believe sugar was addictive, as outlined below:

Table 4

Percentage of Participants Placed in 'Yes' and 'No' Groups

Category	% of participants in 'yes' group	% of participants in 'no' group
Gender		
Female	91.3	8.6
Male	90.5	9.5
Gender diverse	100.0	0.0
Age		
18-29	96.5	3.5
30-44	91.2	8.8
45-59	99.0	8.3
60+	88.4	11.6
Ethnicity		
Pakeha	90.5	9.5
Māori	97.1	2.9
Pasifika	75.0	25.0
Indian	87.5	12.5
Asian	95.0	5.0
Other	93.5	6.5
Education		
Secondary/diploma	92.3	7.7
Undergraduate	92.5	7.5
Postgraduate	88.7	11.3
Other	100.0	0.0
Income		
<20,000	100.0	0.0
20,000-39,000	92.3	7.7
40,000-69,999	93.0	7.0
70,000-99,999	93.3	6.7
>100,000	87.8	12.2
BMI category		
Underweight	100.0	0
Normal	91.2	8.8
Overweight	89.0	11.0
Obese	93.6	6.4

Use of Jamovi indicated no significant patterns between demographic information and belief that sugar was addictive. The total number of people who answered 3 or 4 and were placed in the 'Yes' group was originally 348. This number was adjusted to 350 after accounting for two participants who

answered 1 or 2, but later stated that they did believe sugar to be addictive. Of note, a significant proportion of participants believed sugar to be addictive overall (91.3%).

Deductive content analysis of the "Yes" group

Deductive content analysis was used to understand how participants' perceptions of sugar addiction aligned with relevant diagnostic criteria. Despite the necessity to use scientific literature prior to investigation to predetermine categories, data analysis uncovered important meaning units and codes used by participants. These gave context and meaning to how individuals in this study experienced sugar addiction. Table 6 outlines how each category was split into relevant meaning units and codes, alongside the number of times each category was mentioned.

Table 5

Organisation of Meaning Units and Codes into Categories, Number of Times Mentioned (n=350)

Meaning Units	Codes	Categories	*n* of times mentioned
Difficult to cut down sugar consumption once started Hard to stop consuming sugar despite the desire to	Short-term consumption	Compulsive Use	162
Eating sugar until it has a negative impact on self Eating sugar despite health problems/concerns	Long-term consumption		
Using sugar to experience pleasant sensations Sugar consumption as a form of instant gratification	Enhance positive affect	Psychoactive Effects	141
Eating sugar while feeling low Consuming sugar to help to improve mood	Alleviate negative affect		
Eating sugar because it tastes good Preference for sweet foods	Taste	Reinforcing Behaviour	102
Desiring sugar while feeling tired/unmotivated Eating sugar for the energy boost, 'fix', 'high'	Energy		
Craving sugar with no added context	Unspecified cravings	Urges and Cravings	227
Wanting sugar at certain times of day	Habitual cravings		
Specific cues cause sugar cravings	Triggers		
Needing sugar for food to taste good Increasing amount of sugar for same initial effect	Tolerance symptoms	Tolerance and Withdrawal	135
Physical symptoms without sugar, e.g. headache Negative emotions without sugar, e.g. irritability	Withdrawal symptoms		

Category: Compulsive Use

Participants who could not control their sugar intake, either short-term or long-term, explained how the *"struggle to reduce/give up"* [P18] over time demonstrated that sugar could be considered addictive. This was sometimes due to the presence of unwanted consequences resulting directly from sugar consumption.

Code: Short-term consumption

The most widely used expression within this group related to "*not being able to stop at one"* [P15]. A common theme was that once participants started eating sugar, they *"keep going back for more"* [P20]. Several participants shared similar ideas that *"if you don't consume then you don't desire"* [P11], yet *"if you eat even a little bit it sets you on a rollercoaster of sugar consumption"* [P6]. This may lead to undesirable behaviours, such as *"I will even raid someone else's stash"* [P11] and *"I sneak it when no one is looking"* [P3]. Some of the negative consequences that may come from short-term overconsumption of sugar could be emotional, like *"feeling guilty"* [P14], or physical, such as *"eating until I feel sick"* [P9] or experiencing *"headaches and fatigue"* [P19].

Code: Long-term consumption

Several participants talked about their sugar consumption over time, and how it had led to certain behaviours or health consequences. A few individuals described having to "*limit or not buy… particular sweet foods"* [P20] to control their consumption. However, others turned to maladaptive patterns of behaviour such as *"keeping a stash of snacks hidden"* [P16] and "*secretive eating so people don't see me eating it"* [P22]. A general understanding amongst this group was that sugar is *"hard to moderate"* [P4] and *"very hard to stop or limit"* [P20]. Participants who continued to overconsume sugar over time described health consequences such as *"most of my teeth went rotten"* [P2], experiencing *"weight increase"* [P19], or being *"pre-diabetic"* [P23].

Category: Psychoactive Effects

Some participants related sugar's potential to be addictive to the effect it can have on our emotional state. A desire to *"chase the feel-good feeling"* [P3] demonstrated how sugar may enhance

pleasant emotions. Needing *"an instant mood booster"* [P3] explained the consumption of sugar to alleviate negative emotions.

Code: Enhance positive affect

For this group of individuals, strong desire to consume sugar seemed to arise when participants wanted an *"instant uplift"* [P3] in the form of a *"quick fix"* [P2] or a *"short term rush"* [P21]. One participant simply claimed *"we take [sugar] to make us feel good"* [P4]. This is because sugar is able to give us an *"instant boost to the mood"* [P4] in the form of a *"dopamine hit"* [P8]. Several people alluded to the fact that sugar "*triggers part of the brain"* [P2] which in turn *"makes you happy at the time of consumption"* [P3]. This creates *"positive implications of having [sugar]"* [P1]. Several participants acknowledged the power of *"instant gratification"* [P3] in the potentially addictive nature of sugar.

Code: Alleviate negative affect

A common understanding amongst individuals in this group was that consuming sugar *"is a way to quickly feel better about oneself and one's situation at that time"* [P20]. Several participants explained that sugar consumption *"makes difficulties seem less so"* [P4]. Some people described the tendency they had to *"fall back to sugar when [feeling] bored or unmotivated"* [P20]. Stress seemed to be a common theme, with one participant stating "*if I'm really stressed out and over-tired I find I can't control my need for something sweet"* [P21]. Another individual explained that "*sugar can… provide a sense of psychological comfort – which can make it addictive to those who are seeking that comfort"* [P9].

Category: Reinforcing Behaviour

Individuals in this category experienced a reinforcing effect from the pharmacological properties of sugar sufficient to maintain consumption. These participants commonly used *"sugary sweets as a reward"* [P23] because of their sweet taste or ability to produce an energy boost.

Code: Taste

The inherent sweetness of sugar leads to its reinforcing nature for people who enjoy the taste. One individual described how they add sugar to their food because *"it makes food taste better and rewards me"* [P4]. Another said that they *"often use sweet things to add to the experience of a cup of tea or coffee. Like a reward"* [P22]. The consideration of sweet food as rewarding was shared by a few participants, while others described simply loving the taste of sugar; *"it's delicious and never enough. I keep going back for more"* [P3]. The sweet taste of sugar may lead to overconsumption, as one individual explained "*I often want something sweet even after I've eaten*" [P2].

Code: Energy

Several participants cited a boost in energy as the reason they found sugar to be reinforcing, and a portion were more likely to find their consumption to be *"linked to tiredness"* [P3]. Whether they were seeking a *"short-term rush"* [P21] or *"a bit of an instantaneous energy hit"* [P1], the fact that sugar *"gives you instant energy"* [P2] means that some people have the potential to "*become… lured to the sudden fix*" [P1]. One individual stated, *"your body likes the temporary jump in energy"* [P2] as sugar is known to *"raise blood sugar"* [P2]. This may be the reason that some people have the *"desire to eat sugary foods when tired"* [P15].

Category: Urges and Cravings

The words "urges" and "cravings" were used by many participants, and several of these needed to be distributed into the categories that aligned best with what was being described. The rest of the participants in this category were coded under unspecified cravings, habitual cravings, and triggers.

Code: Unspecified cravings

Some of the most common phrases found in the transcript related to participants experiencing *"acute cravings"* [P13] for sugar. Many did not give any reason for these cravings, they simply *"think about sugary things throughout the day"* [P13] and described how they *"keep wanting it"* [P11]. These cravings did not necessarily relate to hunger; as one participant explained they have *"urges for sugar after already eating meals"* [P20]. These cravings often led to participants *"finding [sugar]*

hard to resist" [P8], and one individual said *"when you are craving it, there is nothing that can replace it"* [P8].

Code: Habitual cravings

Habitual cravings often referred to *"wanting sugar at set times each day"* [P13] and some individuals gave specific times that these cravings occurred, such as *"4pm sag, reach for the cake…"* [P18] and *"desire to eat sugary food… when I wake in the night"* [P15]. A couple of participants believed their upbringing was responsible for their habitual sugar consumption, and one explained *"personally I feel cravings after my lunch as that habit I inherited from my family"* [P20]. Building a habit of sugar consumption *"is very easy to become accustomed to"* [P5] which makes it harder to break, as one participant explains *"willpower alone doesn't kick the habit"* [P1].

Code: Triggers

Some participants referred to certain triggers that they believed were responsible for causing cravings. For a few participants these triggers may be hormonal, with one describing, *"I crave sugar… mainly just before and at the start of my period"* [P14]. Others related the triggering effect of sugar to specific cues, such as experiencing *"temptations when walking through the supermarket"* [P14]. One individual explained, *"if sugar is advertised on TV, [I have an] urge to have something sweet"* [P22]. These triggers may cause physical symptoms associated with craving sugar, and one participant explained how they experienced their *"mouth watering when looking at or thinking about sugary foods"* [P17].

Category: Tolerance and Withdrawal

Participants in this category explained that they believed sugar to be addictive because it can produce tolerance symptoms i.e., needing more and more sugar in their food for the desired sweet taste, and withdrawal symptoms, i.e., removing sugar from the diet had negative physical and psychological effects.

Code: Tolerance symptoms

Changes in taste perception was the most common tolerance symptom noted by participants. As one individual explained, *"you get used to the taste and need things sweeter"* [P1]. This is because eating too much sugary food *"changes your taste perception"* [P2] and therefore there may create a *"loss of flavour in foods"* [P14]. One participant noted *"there seems to be a level of taste tolerance which encourages people to keen trying sweeter and sweeter flavours"* [P7].

Code: Withdrawal symptoms

Symptoms such as *"headaches when fully cutting [sugar]"* [P4] or *"feeling sick when off sugar for too long"* [P20] were the most common physical manifestations noted by individuals. These could last a while; as one individual explained, *"it took 4 days for headaches to go after stopping sugar"* [P3]. Psychological symptoms included individuals *"not being able to focus without sugar"* [P20] or experiencing *"lack of energy when sugar isn't present in the diet"* [P15]. Though sugar consumption is described as a *"hard habit to break without getting withdrawals"* [P4], several participants found *"if I take a break from sugar it is easier to maintain this"* [P4]. There is a cyclical nature involved, where sugar consumption *"gives you a high followed by a crash that you need more sugar to alleviate"* [P7].

Inductive content analysis of the "No" group

Inductive content analysis was conducted to discover the overarching reasons as to why 8.3% of participants did not believe sugar was addictive. Three main categories were found to encompass the majority of explanations provided in the short answers, as follows:

Sugar is Pleasurable: the innate characteristics of sugar, primarily its sweet taste and pleasant effects, makes it more enticing than other food.

Personal Experience: several participants used their own experience with sugar and/or addiction to explain why they believed sugar is not addictive.

Societal Norms: accessibility and convenience, combined with a lack of education, may lead to sugar overconsumption which can be influenced by a person's upbringing.

The three main categories outlined above were all made up of meaning units and codes, which collectively gave insight into rationale surrounding why sugar may not be considered addictive. The number of times each category was mentioned through meaning units and codes was tallied to give insight into the frequency of each category, and several participants alluded to more than one category in their answers. This is demonstrated in Table 5:

Table 6

Organisation of Meaning Units and Codes into Categories, Number of Times Mentioned (n=31)

Meaning Units	Codes	Categories	*n* of times mentioned
Sugar tastes good and satisfies the palate Some people have a preference for sweet taste	Taste	Sugar is Pleasurable	28
Emotional eating leads to sugar overconsumption Habitual eating leads to sugar overconsumption	Comfort		
I do not have a problem with sugar I can control my sugar consumption	Own experience with sugar	Personal Experience	17
Sugar is not bad enough to constitute an addiction Scientific understandings of addiction	Belief around sugar and addiction		
Bad diets in New Zealanders Patterns in families of sugar consumption	Upbringing	Societal Norms	19
People are ignorant of sugar's effects on health People aren't health conscious enough	Lack of education		
Sugary foods are cheap and easy to access TV ads and marketing push sugar consumption	Prevalence of sugar		

Category: Sugar is Pleasurable

The fact that sugar can produce pleasure through its sweet taste or its pleasant psychoactive effects means it could be considered *"habituating rather than an actual addiction"* [P29].

Code: Taste

There seemed to be a common understanding amongst both participant groups that the sweetness associated with sugar "*is highly palatable"* [P33], *"tastes pleasurable"* [P34] and "*satisfies*

the appetite/palate" [P38]. This is something we can become accustomed to, for example too much sugar in beverages can "*stimulate the palate to expect drinks to be sugary"* [P38]. One individual reduced their sugar intake to find that *"my palate for sweet stuff has reduced and I am unable to consume much even if I try"* [P24]. Having a *"preference for sweet taste"* [P33] was a common reason used by participants to explain why some people overconsume sugar.

Code: Comfort

The basis for sugary foods being used in emotional and habitual eating often seems to come down to comfort. As explained by one individual, sugar *"relieves stress and gives people something to do while bored"* [P39]. Another participant described sugar as having *"a familiar comfort flavour"* [P34] while another deemed sugary foods as *"an easy fix for feeling tired or stressed"* [P39]. Feelings of *"stress, anxiety, boredom"* are more likely to lead to *"familiar behaviour"* [P38] and therefore, eating sugary foods can be *"emotionally soothing"* [P34]. Put simply by one participant, *"when people are experiencing lower affect, sugary foods might be something they turn to to improve their mood"* [P38].

Category: Personal Experience

A portion of participants used their own experience to explain why, to them, "*sugar doesn't appear to be addictive"* [P32]. Others in this group brought up current scientific literature, or their own beliefs around addiction, to explain that *"calling it an addiction is going too far."* [P29].

Code: Own experience with sugar

A few participants simply used the fact that they *"don't have desire to eat it"* [P31] to explain why they did not believe sugar to be addictive. Similarly, participants who *"don't like sweet foods"* [P26] or *"don't have sugar cravings"* [P26] disagreed with the idea of sugar being addictive. Some participants acknowledge that "*sugar is certainly pleasant"* [29] and therefore it took *"good discipline"* [P25] to *"resist sugar"* [P26]. However, since these participants were personally able to cut back, they did not believe it could be classified as an addiction; rather, sugar consumption may be

considered *"more or less based on choice"* [P28]. Other's inability to reduce consumption therefore could be due to a "*lack of self-control*" [P34].

Code: Belief around sugar and addiction

Several participants used their prior understanding of addiction to explain why they did not believe sugar should be classified as addictive. One individual claimed that *"there are a whole heap of negative life implications from addiction that just aren't present in sugar cravings"* [P25]. A couple of participants reference their scientific understanding, with one stating *"I have some rudimentary understanding of the neuroscience of addiction, and I know that sugar has been debunked as an addictive substance many times"* [P24]. Another participant referenced the current diagnostic manual in saying "*according to the DSM 5 ... [sugar] is habituating rather than an actual addiction*" [P29].

Category: Societal Norms

The third reason that a subset of participants believed sugar to not be addictive relates to how prevalent sugar is within our society. This prevalence, combined with a person's upbringing and a general lack of education around sugar, can lead to people overconsuming sugar because they "*are not health conscious*" [P33].

Code: Upbringing

How you are raised can largely influence your behaviours later in life, and participants in this category believed sugar consumption early on could lead to overconsumption later in life. Upbringing may lead to *"developing a sweet tooth early on"* which *"seems to be a pattern in families"* [P35]. One participant claimed that *"I think it's a habit starting in my early childhood"* [P31] to explain why they personally overconsumed sugar. Socioeconomic background may influence diet also, as factors such as *"household expenditure constraints"* could mean there is *"insufficient healthy food available"* [P41] and so children may turn to sugary food instead.

Code: Lack of education

Lack of education surrounding the health effects of sugar may be a reason why some people overconsume sugar. Several participants explain that individuals who are *"not health conscious"* are less likely to have *"made an attempt to reduce their sugar intake"* [P33] because they are *"ignorant of [sugar's] effects on health"* [P38]. People who *"don't look at the health benefits"* [P36] of reducing sugar intake are more likely to have problems with overconsumption. This may be due to the fact that *"it's hard to know where [sugar] is in a lot of foods"* [P37], or because some people are *"not caring about [their] diet"* [P38]. Furthermore, there are some people who *"have very little education in preparing foods"* [P28].

Code: Prevalence of sugar

The prevalence of sugar in our society is given as one of the main reasons why participants believe some people overconsume sugar. As stated by one individual, "*sugary food is always easily available*" [P40]. The fact that sugar is "*readily available everywhere*" [P36] stems from it being *"relatively cheap and easy to access"* [P38] throughout our society. Sugar is known for the fact that it *"features largely in convenience foods"* [P25] and has been *"marketed very aggressively"* [P30], especially through *"TV ads [that] push it continuously"* [P40]. Sugar is especially used in *"a lot of processed foods"* and the widespread presence of sugar means that *"we don't know how much sugar is in the everyday things [that] we eat"* [P37].

Chapter 4: Discussion

This study examined current understandings surrounding sugar addiction from a New Zealand cohort. Participants were asked whether they believed sugar is addictive and to explain their reasoning through short-answer questions. A significant majority of participants drew upon their own or others' experiences with sugar to explain why it should be considered an addictive substance. These explanations were categorised using the preestablished scientific criteria of *Compulsive Use, Psychoactive Effects, Reinforcing Behaviour, Urges and Cravings* and *Tolerance and Withdrawal.* A smaller percentage of individuals used their observations and understandings of sugar to conclude that it did not suffice as an addictive substance. Inductive analysis was used to discover the underlying reasons that participants believed sugar was not addictive, and these were found to correlate most closely with the categories *Sugar is Pleasurable, Personal Experience* and *Societal Norms.* There were several overlaps and commonalities between the groups, as seen by participants in both groups using sugar's sweet taste and its comforting effects to explain their reasoning. Such overlaps reflect the way in which current scientific reviews on sugar addiction are divided, and may be influenced by a person's environment, upbringing, and other societal factors. A combination of inductive and deductive qualitative content analysis allowed for a rich sense of context to be drawn from the transcript, and a detailed summary is discussed in relation to current scientific literature. Findings of this study are discussed in terms of potential research implications, and limitations pertaining to subjective research methods are described. Directions for future research to gain a comprehensive understanding of individual experiences with sugar are explored.

Summary of qualitative content analysis findings

Difficulty in reducing sugar either short-term or long-term were the codes that gave meaning to *Compulsive Use,* and this inability to control or stop use could lead to negative consequences. Short-term consumption was characterised as experiencing a loss of control once consumption begins, also understood as bingeing (Davis, 2013). Loss of control is the first stage of compulsive use, whereby addictive substances can affect the brain to trigger pleasurable feelings and create an association between present stimuli and the substance's rewarding effects (USDHHS, 2016). All

addictive substances are known to produce feelings of pleasure by either directly or indirectly stimulating the dopamine system in the brain, giving importance to the criterion of *Psychoactive Effects* (Wise & Robble, 2020). Sugary foods do this by raising blood sugar, in turn stimulating the dopaminergic system, within a relatively short time (Robinson, 2022). This is significant because the faster a substance activates the pleasure centre in the brain, the more addictive it can be (Robinson, 2022). Foods high in glycaemic load, i.e., that raise the blood sugar quickly, also cause a drop in blood sugar relatively quickly compared to those with a lower glycaemic load (Schulte et al., 2016). This results in the brain suddenly needing more dopamine to stay at this heightened level, urging the body to take in more sugary food (Robinson, 2022). This can lead to compulsive consumption within a short period of time, even despite undesirable consequences (Davis & Carter, 2009). Thus, short-term sugar consumption can result in bingeing, explaining why some participants in the current study experienced a loss of control over their sugar intake.

The role of incentive salience should be acknowledged in understanding why people continue eating sugary foods over longer periods of time, despite experiencing maladaptive behaviours or negative outcomes (Berridge & Robinson, 2016; USDHHS, 2016). Incentive salience refers to experiencing urges or triggers for a substance even when the rewarding effects of the substance are no longer present, and it contributes both to *Compulsive Use* and *Urges and Cravings* (USDHHS, 2016). These urges are often result from a person learning to associate the pleasant feelings that a substance gives with outside stimuli (Berridge & Robinson, 2016). The stimuli can be anything, including places, people, visual cues, and mood states, and over time such stimuli can activate the dopaminergic system alone, motivating the individual to seek out the substance (USDHHS, 2016). Individuals diagnosed with substance use disorders reliably show greater sensitivity to drug-associated cues, demonstrating the impact of heightened incentive salience (Hester & Luijten, 2014). These findings have been replicated with obese individuals and food cues, suggesting that the motivation to eat sugary foods may stem from previously learned associations (Voon et al., 2014). As with drug addiction, heightened incentive salience may lead to the development of compulsive eating and food-seeking habits (Koob & Volkow, 2016). Participants in the current study who described having to keep sugar out of the house were probably referring to the way in which food cues motivated them to

seek out and consume sugary food despite the desire to reduce sugar consumption or quit sugar altogether.

Psychoactive Effects related to sugar's ability to induce positive feelings or to alleviate discomfort, and both groups of participants cited this to be a reason that they did or did not believe sugar was addictive. *Psychoactive Effects* play a crucial role in the initial stages of addiction, as dependence on a substance begins by discovering how a stimulus acts as a source of pleasure (Baumeister & Nadal, 2017). As previously discussed, this pleasure stems from a release of dopamine in the brain, which is indicated both in enhancing positive effect and alleviating negative effect (Blum et al., 2015). Neurotransmitters such as serotonin and opioids are also released with certain foods, contributing to the pleasurable experience of eating (Briguglio et al., 2018). Studies surveying the impact of stress on food choice commonly found an increase in highly sugary food consumption (Hyldelund et al., 2022; Oliver & Wardle, 1999). This may be because the hormones that are released after consumption of sugary foods can have the effect of reducing stress, leading to a desire for more comfort food (Jacques et al., 2019). Research has demonstrated that mood is a more influential predictor of eating behaviour than hunger, with negative affect identified as a leading factor preceding episodes of binge-eating (Hill, 2007). However, this may have detrimental effects on long-term psychological wellbeing, as longitudinal data shows that a diet consistently high in sugar may increase the risk of depression (Firth et al., 2020). This is possibly due to repeated, rapid increases and decreases in blood sugar levels following consumption of highly sugary foods (Salari-Moghaddam et al., 2018). Over time, sweet food may be consumed to alleviate unpleasant feelings caused by a drop in insulin, serotonin, dopamine, or blood glucose levels during a 'sugar crash', indicating symptoms of *Tolerance and Withdrawal* (Parnarouskis et al., 2022).

Sugar is innately pleasant to ingest, as explained by both participant groups in the study, and this leads to the question: where is the line between pleasure and addiction? Understanding where eating for pleasure ends, and potential addiction begins, is critical when examining prevention strategies and interventions addressing overconsumption (Greenberg & St Peter, 2021). In differentiating between addiction and pleasure, Robinson and Berridge (1993) proposed the incentive-

sensitisation theory, which poses that the motivation behind 'wanting' a reward differs from 'liking' the hedonic effects that same stimulus produces. This model explains how repeated use of a drug causes the neural systems associated with the drug to 'sensitise,' leading to decoupling of 'liking' and 'wanting.' Though understood as the pleasure transmitter, dopamine is often indicated in the role of 'wanting' more so than 'liking' (Olney et al., 2018). This is because while dopamine is widely recognised to stimulate reward-seeking, it is less often associated with the enhanced pleasure or 'liking' of those rewards (Olney et al., 2018; Rosell-Negre et al., 2016). Sensitisation of the mesolimbic dopaminergic system may cause a person to feel excessively motivated towards a stimulus, i.e., experiencing 'want' for the reward and its associated cues, due to the role of heightened incentive salience (Olney et al., 2018). The motivation or 'want' for the reward can occur despite experiencing decreased enjoyment from the stimulus, i.e., not 'liking' the effects of the reward (Olney et al, 2018). Using this theory, sugar addiction would occur when excessive 'wanting' becomes more important than 'liking' a drug (Robinson et al., 2013). Hence, the role of incentive-sensitisation may be used in understanding why the compulsion for sugar consumption could surpass the enjoyment of eating sugar.

The effectiveness of a substance in *Reinforcing Behaviour* relates to whether its pharmacological properties are sufficiently rewarding to maintain self-administration (Gearhardt & DiFeliceantonio, 2023; USDHHS, 1988). Sugar's properties of sweetness and energy-density were cited by participants in adding to its effectiveness in *Reinforcing Behaviour,* consistent with understandings of how sugar stimulates overconsumption through post-ingestive value and sweet taste (Ribeiro & Oliveira-Maia, 2021). Several participants in this study were divided on whether the reinforcing properties of sugar were sufficient to classify it as addictive, and such perspectives may be contingent upon personal preference. For example, there are interpersonal differences in the value we place on the pleasure associated with sweetness in our food (Tan & Tucker, 2019). People who prefer sweet tastes are more likely to have increased intake compared with those who do not have this preference (Cicerale et al., 2011; Dias et al., 2015). Variances in taste perception and neural systems may affect food selection and intake, explaining why some people may experience more self-control around eating certain foods (Tan & Tucker, 2019). There is neural evidence suggesting that overeating

may stem from poor inhibitory control (Hardee et al., 2020). For example, observation of high-calorie food cues on prefrontal inhibitory control regions shows decreased activation in obese compared to lean participants (Batterink et al., 2010). It is also understood that common biological mechanisms contribute to the reinforcing effects of sugary foods, which directly influences implicit attitudes around sugar (Davis et al., 2007; Hagger et al., 2017). This is significant in the attempt to understand overconsumption of sugar, as implicit attitudes towards sugar can be used to predict future consumption (Hagger et al., 2017).

Sugar differs from other substances of abuse because there is an evolutionary advantage to it naturally *Reinforcing Behaviour* (Wiss et al., 2018). Most psychoactive drugs are manufactured in a laboratory and designed specifically to reinforce behaviour through their *Psychoactive Effects* (Moncrieff & Cohen, 2009). Sugar, on the other hand, has properties that increase the likelihood of consumption because it was linked to survival from an evolutionary point of view (Schaefer et al., 2023). Taste may be considered as one of our most valuable senses during hunter-gatherer times, as it provided important information about which fruits were toxic and which ones were ripe and thus laden with glucose (King, 2012). After consumption, sugar is quickly converted into glucose which can be used for immediate energy (Hantzidiamantis & Lappin, 2022). This was beneficial when our survival relied on physically demanding activities (Kirchengast, 2017). Therefore, eating energy-dense, sweet food when it was available was evolutionarily advantageous during a time of scarcity (Johnson et al., 2023). The fructose survival theory hypothesises that genetic adaptations which occurred to assist survival may be 'backfiring' in our plentiful climate, explaining how evolution may unintentionally increase the risk for diseases such as obesity and diabetes (Johnson et al., 2023). Further, a disturbance of energy balance in our bodies can affect the reward pathways in our brain, triggering *Compulsive Use* of energy-dense foods (Volkow et al., 2013).

Urges and Cravings for sugary foods can also be understood in terms of their evolutionary benefit, as reward circuits in our brains evolved to recognise high energy foods as positively reinforcing (Epstein & Carr, 2021). Many participants cited experiencing cravings for sugar, either unspecified or due to habits or triggers. Unfortunately, New Zealand society today is characterised by

an overabundance of sugary and highly processed foods, such cravings do not have the benefit that they had previously (Rodgers, 2018). Food cravings are experienced by most young adults, and the more commonly craved foods are chocolate and sweets (Hill, 2007; Pretlow, 2011). Such cravings appear to be comparable to those which drug addicts experience with their preferred substance, with cocaine and nicotine addicts reporting their desire for palatable food to be as intense as their want for their drug of choice (Goldstein et al., 2008; Kober et al., 2010). Sugar cravings can be caused by a range of naturally occurring factors such as age, culture, and menstrual cycle (Hill, 2007). This may explain why some participants did not give reasons for their sugar cravings, as these cravings may not have been linked to anything cognitively tangible. Regardless of specific triggers, studies have found a strong, positive correlation between total energy intake and higher food cravings (Taetzsch et al., 2020). Habitual sugar consumption can also induce sugar cravings at certain times of the day, which is in line with evidence that a significant portion of our daily eating behaviours are controlled by habit (van't Riet et al., 2011). Habitual consumption patterns in the early years are strongly associated with adult eating behaviours, demonstrating how eating habits are relatively consistent over time (Nicklaus & Remy, 2013).

Incentive salience may also be used in understanding how food cues, otherwise known as triggers, cause *Urges and Cravings* for sugar (Olney, 2018; USDHHS, 2016). As discussed, incentive salience contributes to *Compulsive Use* as it helps to determine the motivational value of the food (Berridge, 2009). As the motivational value for a stimulus increases, so does the 'want' for that stimulus, driving the intensity of triggers surrounding the stimulus (Fraser & Janak, 2019). This is demonstrated by individuals with compulsive eating tendencies being more likely to have heightened incentive salience attributed to food triggers (Moore et al., 2019). Through incentive salience, palatable food cues can cause *Urges and Cravings* for sugar, increasing the likelihood for *Compulsive Use* (Martin et al., 2008). Binge-eating and overeating behaviours are commonly driven by a trigger for a specific taste, contributing to the effect of *Urges and Cravings* in *Reinforcing Behaviour* (Berridge, 2012; Morales & Berridge, 2020). This 'want' for a taste may persist despite no longer 'liking' the effects of the food, linking back to the incentive-sensitisation theory of addiction (Morales & Berridge, 2020). The role of incentive salience is also implicated in behaviour modification, as

amplified 'want' for a reward can be a predictor of relapse (Berridge, 2009). Relapse may occur despite no longer 'liking' the effect of the reward, demonstrating how *Urges and Cravings* can lead to *Compulsive Use* (Flack et al., 2019). Thus, the theory of incentive-sensitisation can be used to explain how food cues can trigger *Compulsive Use*, which may persist in the face of adverse outcomes (Berridge & Robinson, 2016). Persistent use despite negative consequences is understood as a central feature of addiction, as it can distinguish recreational from hazardous use (McNally et al., 2023).

Symptoms noted by participants that signalled potential physiological dependence were coded under the category *Tolerance and Withdrawal.* Tolerance is driven by neurological adaptations causing decreased responsiveness to a substance, which in turn increases the amount of substance needed to obtain the initial effect (Wiss et al., 2018). The tolerance effect has been demonstrated using animal experiments, whereby rats on a sugar-rich diet increase their intake over time (Modlinska et al., 2022). Additionally, neuroimaging in humans has demonstrated that repeated exposure to sugar-sweetened beverages can lead to diminished striatal activation, consistent with neural changes seen with drug tolerance (Burger, 2017; Gearhardt & Hebebrand, 2021). However, little research has been conducted on subjective perceptions of sweetness intensity, which was alluded to by most of the participants who were coded under tolerance symptoms. One study by Wise et al. found that that limiting the exposure to added sugars resulted in increased sweetness perception of sugary foods (2015). A recent literature review focusing on the impact of exposure to sweet taste found limited evidence suggesting the possibility of adaptations of transduction pathways or taste receptors to explain this tolerance effect (Appleton et al., 2018). However, whether addictive-like eating patterns are primarily due to sugar content or palatability in general is yet to be examined (Westwater et al., 2016). This gives credence to participants who explained that they did not believe sugar was addictive because it did not produce effects significant enough to be classified as an independent diagnosis by either the American Psychiatric Association (2013) or the World Health Organisation (2019).

Despite many participants in the study describing an increase in negative bodily sensations with reduced sugar consumption, there is a lack of human-based evidence to determine a causal link between sugar consumption and withdrawal symptoms (Parnarouskis et al., 2022). This further aligns

with participants who explained that sugar withdrawals did not produce the same level of life complications that can be found with drugs of abuse, an opinion echoed by several researchers (Greenberg & St Peter, 2021; Westwater et al., 2016). On the other hand, rats on sugar-rich diets exhibit potential signs of withdrawal when sugar is removed, as calculated by decreased body temperature, and increased agonistic behaviour (Galic & Persinger, 2002; Wideman et al., 2005). Rats with intermittent access to sugar show signs of opiate withdrawal when naloxone is administered, as demonstrated by body tremors, teeth chattering, and heightened anxiety (Colantuoni et al., 2002). These findings imply that sugar dependency in rats is plausible, but whether this can be extrapolated to humans is yet to be substantially investigated (Parnarouskis et al., 2022). Use of subjective measures such as the Highly Processed Food Withdrawal Scale and the YFAS for individuals with addictive-like eating patterns have indicated that a range of physical, cognitive and affective symptoms are commonly experienced during reduction of highly processed foods (Gearhardt et al., 2016; Schulte et al., 2018). Predominant symptoms reported using such measures include headaches, difficulty concentrating, fatigue, and irritability (Schulte et al., 2018). Similar manifestations were noted by participants in the present study, highlighting shared withdrawal experiences observed among participants from various studies.

Societal context is a primary influencer on what people choose to eat (Higgs et al., 2019). Participants who did not believe sugar was addictive referenced the way in which sugar prevalence, the impact of upbringing on diet, and lack of education involving sugar harms may all lead to the normalisation of sugar overconsumption. In New Zealand, the prevalence of sugar stems from its affordability, accessibility, and aggressive marketing (Nunn et al., 2021). Sweets and non-alcoholic beverages contribute to most of the added sugar in the New Zealand diet (NZ Nutrition Foundation, 2014). Research has highlighted that approximately 50% of food and beverage purchased by New Zealand households are on promotion (Ravensbergen et al., 2015; Riesenberg et al., 2019; Tawfiq et al., 2021). There is a greater prevalence in promotions for products with higher sugar content than their healthier counterparts (Tawfiq et al., 2021). One the other hand, higher prices for sugar-sweetened beverages are associated with lowered demand (Jani et al., 2018). This may explain why interventions aimed at promoting healthy food purchases through monetary incentives and increased

availability have been shown to be effective (Adam & Jensen, 2016). This demonstrates how marketing can influence the availability of sugary foods within New Zealand households, which in turn affects food choices of the younger generations (Brown et al., 2008).

The impact of food environment on childhood eating patterns is important because dietary consumption from infancy to adolescence has been shown to predict future nutrient intake, culminating in habitual food consumption (Cribb et al., 2012; Scaglioni et al., 2018). Such habits may begin as early as during the prenatal stage, as exposure to certain foods in the womb can impact a child's food preferences later in life (Anzman et al., 2010; Mennella et al., 2001; Schiestl et al., 2021). Although upbringing can establish the foundation for future eating habits, nutrition education has been shown to be largely effective in reducing added sugar intake, even in preschool-aged children (Evenson et al., 2017; Mumena et al., 2020; Yeom & Cho, 2019). This may give credibility to participants who believed some people overconsume sugar due to their upbringing or a lack of education. Conversely, while health consciousness predicts acceptance for sugar reduction interventions at a societal level, it does not necessarily predict lowered sugar consumption at an individual level (Konar et al., 2022; Mai & Hoffman, 2015; Oostenbach et al., 2019). This may be because decisions made around food choice are not always logical; context and preference are likely to have significance (Mai & Hoffman, 2015). Research involving societal factors that may lead to sugar overconsumption emphasises the relevance of upbringing, education, and accessibility relating to food choice (Gearhardt et al., 2011). It would therefore appear that attributing sugar overconsumption at a societal level to one aspect, i.e., addiction, would be oversimplifying the complex and multifactorial aspects of dietary selection (NZ Nutrition Foundation, 2014).

Numerous factors play a role in shaping the pleasures we seek out in our daily lives (Davis et al., 2007). Our environment is a significant determinant of our dietary choices and the frequencies with which we consume such foods (Davis et al., 2007). Widespread availability of highly palatable foods contributes to eating for hedonic purposes rather than to regulate energy homeostasis (Woods & Ramsay, 2011). Environmental cues, evolutionary incentives, and energy expenditure may combine to trigger the overconsumption of sugar (Wiss et al., 2018). The complexity of studying sugar as a

potentially addictive substance arises from sugar having inherently both hedonic and homeostatic components which add to its rewarding nature (Greenberg & St Peter, 2021). Whether sugar's pleasurable qualities are capable of fostering addiction currently remains unanswered. However, similarities in pattens of behaviours associated with substance use disorder and self-reported sugar addiction signifies the importance of examining sugar overindulgence within the context of addition potential (Vasiliu, 2022). Persistent use despite negative consequences is a key indicator of addiction, and numerous health implications of excessive sugar intake have been documented (NIDA, 2020; Pressler et al., 2022). The distinction between consumption of sugary foods for their pleasurable effects, and compulsive eating habits regardless of adverse outcomes, is significant in understanding where addiction may be indicated (Morales & Berridge, 2020). This highlights how the incentive-sensitisation theory of addiction may provide a framework for understanding the compulsive aspects of overconsumption which appear disconnected from aspects of pleasure (Morales & Berridge, 2020). This concept would explain that the 'want' to have sugar plays a significant role in maintaining overconsumption, which may persist despite no longer deriving any enjoyment from having sugar (Berridge & Robinson, 2017).

Research implications

Subjective experiences as outlined by the significant majority of participants in this study indicate a close alignment with several current criteria used to diagnose substance addiction. This suggests that food high in sugar can trigger a compulsive response through its rewarding nature, similar to some drugs of abuse (Davis & Carter, 2009). If sugar was to be acknowledged as a potentially addictive substance, this would have an impact on many levels of society, from policy makers to clinicians and the general population (Volkow & Wise, 2005, Wiss et al., 2018). The success of anti-smoking campaigns in behaviour change may be extrapolated to initiatives targeting the reduction of added sugars through educational programmes on health awareness (Sadeghi et al., 2020). Food environments are significant drivers of eating behaviours, and therefore government strategies should aim to increase their healthiness overall (Mackay et al., 2022). Barriers caused by socioeconomic status should be acknowledged in implementing food policies that can create equitable change (Mackay et al., 2022). However, as has been demonstrated in this study, there are a range of

biopsychosocial factors at play in considering whether sugar is genuinely addictive (Wiss et al., 2020). More convincing and compelling evidence is needed to implement solutions to sugar overconsumption based on a framework of substance dependence (Westwater et al., 2016).

Limitations

While exploration of participants' experiences and perceptions related to sugar addiction was essential for this study, relying on purely subjective measures has inherent limitations due to systematic biases (Jahedi & Méndez, 2014). For example, whether an individual has a positive or negative attitude toward sugar is likely to distort their judgement surround its addictive potential, a phenomenon understood as the 'halo effect' (Nicolau et al., 2020). The Likert-type scale was deemed necessary for the multi-choice question; however, Likert scales do not account for the level of knowledge by the participant, nor do they adequately capture the complexity of the response (Heo et al., 2022). An online survey was practical in terms of cost and time effectiveness, although an inherent issue with Internet surveys is population bias, with respondents more likely to be younger and have higher incomes (Chang & Vowles, 2013). Further, an individual's engagement in a survey is often dependent on interest, which may lead to overrepresentation of certain viewpoints (Ball, 2019). Women constituted a significant majority of participants in the current study, consistent with observations that women are more likely to engage in social-scientific surveys (Becker, 2022). Manifestations and indications of sugar overindulgence may differ across genders, and having a more equitable representation would be beneficial in future studies.

Future research

To gain a deeper understanding into individuals' real-life encounters with sugar addiction, a mixed-methods approach using an adjusted severity scale could be employed (Sardana et al., 2023). Diagnostic criteria for substance dependence in the ICD-11 and DSM-5 both emphasise the significance of duration and severity as indicators of addiction (American Psychiatric Association, 2013; World Health Organisation, 2019). Implementing a similar approach in the context of sugar consumption may shed a light on similarities and distinctions that may be useful in treatment

measures (Volkow & Boyle, 2018). Qualitative methods should continue to be utilised to uncover any disparities between sugar addiction and substance dependence, which will also be useful in conceptualising prevention frameworks (Paterson et al., 2019). Relapse is another key element of dependence, and future research should aim to comprehend how this relates to sugar addiction so that strategies can be tailored towards long-term recovery (Volkow & Boyle, 2018).

Conclusion

The prevailing belief amongst participants who participated in this study was that sugar could be considered addictive. Justifications for this perspective were categorised using the established scientific criteria of *Compulsive Use, Psychoactive Effects, Reinforcing Behaviour, Urges and Cravings* and *Tolerance and Withdrawal.* These criteria were found to encompass most reasons uncovered in the transcript, revealing that participants experiences with sugar were consistent with contemporary understandings of substance dependence. Conversely, some individuals highlighted how factors such as upbringing, education, and sugar's widespread accessibility and palatability have combined to normalise sugar overconsumption in our society. Currently the lack of substantial evidence to characterise sugary foods as addictive signifies the importance of continued research into the topic of sugar overindulgence. This study has accentuated the complex nature of sugar in contemporary society, demonstrating the many reasons that overconsumption may occur. We should therefore exercise caution when determining whether to place sugar amongst other recognised substances of abuse.

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Appendix A: Protocol Summary

Project: Personalised Feedback and Sugar Consumption

Methods

Ethics
- The study was approved by the University of Auckland Human Participants Ethics Committee on 21/07/21 for three years. Reference Number 22241.
- At follow-up participants were asked if they wanted to be emailed a summary of the study results once published. They were also referred to the website where the study results will be made available
- After study completion (2-month follow-up), participants in the control group could request to receive intervention (i.e. the 3 resources provided to the intervention group)

Trial design
- Randomized-Controlled Trial with parallel arm design comparing an intervention group with a control group. Enrolled participants were 1:1 allocated to the intervention arm, where participants received 1) a report on their sugar consumption in combination with Personalised Normative Feedback 2) a sugar reduction workbook, and 3) sugar reduction strategies. The control group only received a brief report with their personal scores but without any feedback.
- Participants were recruited to a baseline survey after which the intervention group immediately received the intervention. Follow-up surveys took place at 30 days and 2 months after the baseline survey
- See powerpoint "Sugar Study – protocol presentation"

Intervention
At the end of the first survey participants allocated to the intervention received a set of three resources and were additional fidelity questions.
See folder "Resources – Provided to participants"
Resource 1
The first resource was a personal report containing PNF. This report provided results with feedback on personal 1) sugar consumption in teaspoons (as calculated from the FFQ questionnaire), 2) mental wellbeing, 3) self-efficacy, and 3) craving (based on the WHO-5, WEL-SF, and CEQ questionnaires). The following feedback was provided on the personal scores:

- Sugar consumption PNF
  - Comparison actual and perceived sugar consumption of self.
    - Actual consumption was calculated from FFQ responses and converted to number of teaspoons.

- - Perceived consumption was based on the survey question: "*How many teaspoons of sugar do you think **you** have daily?*"
  - Comparison actual and perceived sugar consumption of others in NZ.
    - Actual consumption of others in NZ was based on the average sugar consumption as reported previously in a NZ population (Kibblewhite 2017).
    - Perceived consumption was based on the survey question: "*How many teaspoons of sugar do you think **other New Zealanders** have daily?*"
  - Comparison actual and perceived sugar consumption of others in NZ of the same gender.
    - Actual consumption of others of the same gender was based on consumption as reported previously in a NZ population (Kibblewhite 2017).
    - Perceived consumption was based on the survey question: "*How many teaspoons of sugar do you think **other [males/females] in New Zealand** have daily?*" where the question referred to the gender of the participant. Participants who responded to be gender diverse were prompted to answer to questions, one for perceived consumption of other females and one for males.
  - Comparison actual and perceived sugar consumption of others in NZ in the same age group.
    - Actual consumption of others in the same age group was based on consumption as reported previously in a NZ population (Kibblewhite 2017).
    - Perceived consumption was based on the survey question: "*How many teaspoons of sugar do you think **other New Zealanders in your age group** have daily?*"
  - Comparison actual and perceived limit of sugar consumption people should stick to.
    - Actual limit was based on WHO recommendations, i.e., limit of 10% of daily energy intake (6 teaspoons for females, or 9 for males → error report, these are actually AHA recommendations of *added* sugar).
    - Perceived limit was based on the survey question: "*How many teaspoons of sugar do you think the **World Health Organisation recommend [males/females]** to limit daily?*" where the question referred to the gender of the participant.
- - Mental wellbeing, self-efficacy, and craving feedback
  - Each score was followed by a short paragraph explaining what low and high scores entail.
  - This paragraph was the same for all participants receiving the intervention, regardless of differences in personal score

Resource 2
The second resource was a sugar reduction workbook (pdf). The workbook contained examples on how to plan for behavioural change and guided planning exercises to support participants in setting and reaching their sugar consumption reduction goals.

- For example pages sugar reduction guidelines see <u>Appendix D</u>

Resource 3
The third resource was an sugar reduction guidelines booklet (pdf). This booklet contained an overview with real-life examples of strategies that other people have implemented to achieve their sugar reduction goals. The booklets were design to optimise engagement and included exercises to help participants tailor strategies to their personal situation. Information on strategies was based on previous research (Rodda 2020) .

- For strategy paper (Rodda 2020) see folder literature
- For example pages sugar reduction guidelines see <u>Appendix E</u>

Participants
Participants and eligibility
- Participants were eligible for the study if they provided consent to participate in the study, were 18 years or older, living in New Zealand, and willing to complete both the initial and follow-up questionnaires.
- Participants who did not meet these conditions were excluded from the study
  - Participants who did not consent to participate were thanked for their interest in joining with a message that they did not meet the selection criteria, after which the survey was at its end
  - Participants who were under 18 years were excluded during data cleaning (if applicable: n=?)
  - Participants who did not live in NZ were retained in initial data cleaning if they provided consent. Depending on the study for which the data is used, these participants are removed from analyses (e.g., not living in NZ may be OK for the Qual studies?)
  - Participants who did not complete questionnaires were retained in initial data cleaning if they did provide consent. Depending on the study for which the data is used, these participants are removed from analyses (e.g.; for sugar consumption outcomes the FFQ needed to be completed)
- Additional exclusion criteria different by sub-study. For instance, for study 4 – *"A brief intervention to reduce sugar consumption: a randomised control trial"*:
  - For the baseline survey, a completion percentage of 52% was chosen as the cut-off, with participants who received the score report being included.
  - A completion percentage of 68% was chosen as the cut-off for the follow-up survey under the same rationale.
- Also see <u>Results section</u> for consort flow diagram of study enrolment and table of participant characteristics

Recruitment
- Advertising for the baseline survey ran from August 14th to August 31st 2021.
  - Online advertising was used for participant recruitment due to COVID-19 lockdown response
  - Paid advertising was done through Facebook, Instagram, and Facebook messenger

- Unpaid promotion through social media including Facebook page, program website and Twitter
- Promotion from University through recruitment website and email distribution
- Posts on local neighbourly mailing lists
- Advertising on other platforms and communities, including social media, email, and personal and organizational posts
- NZ$1207.53 was spent on 8 different advertisements over a 10-day period
- 106,298 New Zealanders were reached, with 3,950 engaging with the advertisements and 2,615 clicking on the survey link
- Attempts were made at
- Culturally appropriate email contact was attempted with 29 Maraes and 26 churches across New Zealand to target minority groups such as Maori and Pacifika
- Study enrolment took place from 15 August – 14 September 2021
  - Baseline survey was open from 14 August – 31 August 2021
  - 30-days follow-up survey: 14 September – 22 October 2021 (with participants first being emailed the link to follow-up survey 30 days after completion baseline study
  - 2-month follow-up survey: 20 November 2021 – 5 January 2022
- Participants did not receive koha for survey completion. However, those who completed the follow-up surveys could elicit to participate in a price draw to win a voucher of 50 NZ, or other prices.

Survey

- Online surveys built with Qualtrics XM web software. Qualtrics was customised to reflect the project theme, using colours, logos, and images reflective of each part of the survey
- Surveys included royalty-free imagery and Te Reo headings to improve engagement and acceptability in NZ context
- Recruitment links led to a brief welcome page about the study and then a participant information sheet (PIS) and consent form.
- See folder "Surveys"
- Randomisation occurred immediately at the end of the survey questions using a random number generator initiated by Qualtrics. Researchers were blind to the allocation.
- Participant who provided contact information during baseline survey where contacted several times during follow-up
  - Refresher (including copy of the resources for the intervention group) - 15 days after baseline survey,
  - Link to do FU survey (email) - 30 days after baseline survey
  - Reminder 1 (email) - 2 days after link provision
  - Reminder 2 (sms) – 4 days after link provision
  - Reminder 3 (email+sms) – 6 days after link provision
  - Reminders sent between 5-9 pm, each at time different from previous reminder(s)

- At the end of the follow-up surveys, all participants received their updated personal sugar score based on FFQ results from that survey.
- At the end of the intervention, three questions were asked to check fidelity:
    - How many teaspoons of sugar did your result indicate you have each day?
    - According to the World Health Organisation, how many teaspoons of sugar should you limit your daily amount to?
    - Were you surprised by the amount of sugar you consume daily?
    - After seeing your results, are you thinking about doing something to change your daily sugar consumption? (Item related to Theory of Planned Behaviour)
    - follow-up surveys, three questions
- At the end of the intervention, participants were asked whether they had other feedback, comments, or questions about the study or their results

Questions not directly related to PNF

The survey contained additional items that were outside of the PNF study.

- The beginning of the 30-day and 2-month follow-up surveys included items to assess covid impact (see Section 9 in Appendix A).
- The end of the 30-day and 2-month follow-up surveys included items to assess to what extent participants felt confident to implement strategies covered in the sugar reduction guidelines
- At the end of the 30-day and 2-month follow-up surveys included questions with Likert-scale response options were included to assess the degree to which resources were utilized: (See Appendix A section 12)

Outcomes
See Appendix A for exact survey items and response options.

SECTION	MEASURES	BASELINE	30-DAY FOLLOW-UP	2-MONTH FOLLOW-UP
1	INCLUSION, PARTICIPANT INFORMATION SHEET, CONSENT	X		
2	FOOD FREQUENCY QUESTIONNAIRE	X	X	X
	WHO-5 WELLBEING	X	X	X
3	WEIGHT EFFICACY LIFESTYLE QUESTIONNAIRE (SHORT-FORM)	X	X	X
4, 5	CRAVING EXPERIENCE QUESTIONNAIRE (S&F)	X	X	X
6	DEMOGRAPHICS & BMI	X	Only Weight (for BMI)	Only Weight (for BMI)
7	CONTACT DETAILS	X		
	RANDOMISATION	X		
8A	INTERVENTION GROUP	X	X	X
8A	RECAL	X		
8B	COMPARISION (ASSESSMENT-ONLY) GROUP	X		
9	COVID IMPACT		X	X

10	RESISTANCE (STRATEGY CONFIDENCE)		X	X
11	SUGAR REDUCTION RECOMMENDATIONS		X	X
12	FIDELITY/RESOURCE USAGE (PART OF INTERVENTION)		X	X
13	GOAL			X
14	SUGAR ADDICTIVE			X
	PRICE DRAW		X	X

See folders "Surveys" and "DATA" for more detailed information on survey questions and responses. Responses were formatted as multiple choice (e.g., gender, education), attitude-scales (e.g., CEQ-S, CEQ-F), continuous response options (e.g., age, estimated sugar consumption in teaspoons), and open questions (survey items for qual data).

Primary outcome

Food Frequency Questionnaire for sugar consumption

The study used an adapted version of the validated online FFQ (Forster 2014). Adaptations followed recommendations for use of FFQ in different study designs and settings (Cade 2002). Specifically, the list of included food items were changed to food items high in free sugar content which have been reported as commonly consumed in other studies conducted in New Zealand setting (Hamilton 2007, Kibbelwhite 2017, Mhurchy 2016) and shorted by removing items with low response rate in a another New Zealand study (Brittain 2021). The time frame ("over the past month") and frequency options (i.e., 1) never or less than once per month; 2) 1-3 per month; 3) 1 per week; 4) 2-4 per week; 5) 5-6 per week; 6) 1 per day; 7) 2-3 per day; 8) 4-5 per day; 9) 6+ per day) were left unchanged. The adapted list featured 27 food type categories which were organized under headings of broader food groups (i.e., breakfasts, beverages, snack foods, desserts, and food and drink additives). Each food type category was followed by an example of common items and portion sizes (For example under food group *Snack Foods* was listed the food type "*Pancakes/Pikelets. E.g., Chocolate chip pancake. 1 slice, 30g*"). Participants were required to select the amount and frequency by which they had consumed items in each category from a drop-down menu. Estimated free sugar content (hidden from participants) and serving sizes of each of the 27 food type categories was based on the NZ FOOD-Files database (ref) and the Australian Food Composition Database (AUSNUT) (ref). Sugar content was estimated by taking the median free sugar content across of food items listed under a specific food type category. For example, according to AUSNUT, *muffins, cake-style, berry, commercial* contain 24 g of free sugar per 100 g and *muffins, cake-style, chocolate chip, commercial* contain 27.1 g of free sugar per 100 g, giving a median of 25.55 g per 100 g of muffin. Based on a serving size of 60 g, the free sugar content of the food item category "*Muffins*" was thus estimated at 15.3 g (i.e., 0.60*25.55 g). To estimate daily free sugar consumption for a participant, the FFQ response for each food type was averaged to a daily frequency and multiplied by the median free sugar content per serving. For example, if a hypothetical participant's reported to consume none of the food type categories in the FFQ except for "*Muffins*" at a frequency of "*2-4 times a week*" this participant was considered to consume 6.6 g of sugar a day (i.e., on average 3 muffins containing 15.3 g of sugar a week, or 3*15.3 g/7 weekdays of sugar per day). Sugar consumption was also presented in number of teaspoons a day by dividing g by 4.2.

(Note: number of teaspoons as reported in PNF feedback report based on FFQ divided by 4)
See "FFQ CALCULATIONS.xlxs" in folder "FFQ"

Literature related to adapting FFQ:
- Willett et al (1985). Reproducibility and validity of a semiquantitative food frequency questionnaire. American Journal of Epidemiology: 122(1).
  - Development original Harvard FFQ
- Bingham et al. (1997). Validation of dietary assessment methods in the UK arm of EPIC using weighed records, and 24-hour urinary nitrogen and potassium and serum vitamin C and carotenoids as biomarkers. International Journal of Epidemiology: 26(1)
  - Adaptation Harvard FFQ for EPIC study
- Forster et al (2014). Online dietary intake estimation: the food4me food frequency questionnaire. J Med Internet Res 2014;16(6):e150. doi: 10.2196/jmir.3105.
  - Validation online FFQ (based on EPIC) used as format for this study
- Cade et al (2002). Development, validation and utilisation of food-frequency questionnaires: a review. Public Health Nutrition: 5(4), 567–587 DOI: 10.1079/PHN2001318
  - Review providing recommendations on how to use FFQ in local context
- Hamilton et al (2007). Food and nutrient availability in New Zealand: an analysis of supermarket sales data. Public Health Nutrition: 10(12), 1448–1455 DOI: 10.1017/S1368980007000134
  - popular sugars purchased in New Zealand supermarkets included in adapted FFQ this study
- Kibbelwhite et al (2017). Estimating free and added sugar intakes in New Zealand. Nutrients 2017, 9, 1292; doi:10.3390/nu9121292
  - New Zealand list of frequently consumed foods high in sugar content included in adapted FFQ this study
- Mhurchu, C. N., Mackenzie, T., & Vandevijvere, S. (2016). Protecting New Zealand children from exposure to the marketing of unhealthy foods and drinks: A comparison of three nutrient profiling systems to classify foods. The New Zealand Medical Journal, 129(1441), 41–53.
  - List of sugar products in study on marketing of unhealthy foods to NZ children including in this study

Secondary outcomes
WHO Well-Being Index
- 5-item measure
- Item scoring: 5 ("all of the time") to 0 ("at no time")
- Interpretation
  - Total score = sum score items (range 0-25) multiplied by 4
  - Continuous variable ranging from 0-100, where 100 represents best well-being
- See Topp 2015 in folder "Literature/Measures"

Weight Efficacy Lifestyle Questionnaire Short-Form (WEL-SF)
- 8-item measure
- Item scoring: 0 ("Not at all confident") to 10 ("Very confident")

- Interpretation
    - Total score =sum score items
    - Continuous variable ranging from 0-80, where 80 represents highest confidence
- See Ames 2015 in folder "Literature/Measures"

Cravings Experience Questionnaire

- Strength module of 10 items and Frequency module of 10 items
- Item scoring: 0 ("Not at all") to 10 ("Extremely")
- Interpretation
    - Total score (per module) = mean of the sum score items (sum score divided by 10)
    - Continuous variables (one for Strength, one for Frequency) ranging from 0-10, where 10 represents stronger/more frequent craving
- See May 2014 in folder "Literature/Measures"

Other variables/measures

Sociodemographic data

- Gender, age, ethnicity, education, employment, income, location (based on location coordinates from Qualtrics meta-data)

BMI

- Calculated from height and weight: weight (in kg)/height (in m^2)
- Continuous variable or categorised as:
    - underweight <18.5 kg/m^2,
    - normal range 18.5-24.99 kg/m^2,
    - overweight 25-29.99 kg/m^2,
    - obese >=30 kg/m^2

Covid items

Two items reflected questions related to the impact COVID-19 may have had on sugar consumption

- During this study, much of New Zealand was under various restrictions due to covid-19 and lockdown. Based on your experiences in the **past month**, how did your diet change compared with before lock-down?
    - Multiple choice answer
- Over the past month, what type of negative or positive impacts has covid-19 had on your diet, particularly your sugar consumption?
    - Answer open text
- See Appendix A section 9

Sample size

- Power calculation was done with an online A-Priori statistics calculator (Soper, 2023), using the conventional statistical power level of 0.8 and an alpha level of 0.05.
- Based on the 0.2 threshold for 'small' effect sizes of as outlined by Cohen (Cohen, 1988) and previous studies, the anticipated effect size for this study was estimated at

0.3 (Saxton, 2021; Brittain, 2020) and the expected attrition rate at 30% (Saxton, 2021; Meyerowitz-Katz, 2020).

- Intended total sample size was thus 362 participants, or 181 per study arm (control or intervention)

Literature for sample size

- Soper, D.S. (2023). A-priori Sample Size Calculator for Student t-Tests [Software]. Available from https://www.danielsoper.com/statcalc
- Brittain M. A Novel 30-Day Intervention to Reduce Free Sugar Consumption (Doctoral dissertation, ResearchSpace@ Auckland); 2020
- Cohen J. Statistical Power Analysis for the Behavioral Sciences. 2nd ed: Routledge; 1988.
- Meyerowitz-Katz, G., Ravi, S., Arnolda, L., Feng, X., Maberly, G., & Astell-Burt, T. (2020). Rates of Attrition and Dropout in App-Based Interventions for Chronic Disease: Systematic Review and Meta-Analysis. Journal of medical Internet research, 22(9), e20283. https://doi.org/10.2196/20283

Randomization

- Randomization occurred automatically at the end of the survey through Qualtrics using a random number generator
- Participants were unaware of being allocated to the intervention or control group. Both groups received their personal sugar score and scores on secondary measures while the intervention group additionally received feedback on their scores, a sugar reduction workbook, and sugar reduction guidelines.
- Researchers were unaware of participant allocation throughout the study period but there was no blinding of researchers in the analysis stage of the study.

Data management

Data storage

- Data collected in this study was exported from the Qualtrics survey software onto a password-protected University Dropbox. These data are stored indefinitely as they may require access to inform future projects involving personalised feedback and sugar consumption by the Change Strategies team.
- The study data was stored in the format of Microsoft Excel spreadsheets, following export from Qualtrics. The location of this data is in the Change Strategies shared Dropbox drive, in which a folder for this specific study data will be created. Only members of the Change Strategies team have access to the shared drive, and only the study researchers will have access to the data folder. As the PI manages the shared drive, the PI will be the only person able to grant to remove access to these folders. In addition, as this drive is managed by the University, it is backed up through the University server, added an extra layer of security in the event data is lost.
- In addition to data, consent forms were also be stored in this shared drive but in a different folder location to be separated from the study data. Only the PI has access

to these consent forms, which are kept for a period of 6 years. At the end of the 6-year period, the folder will be deleted from the drive, and the drive's rubbish bin will be emptied in order for them to be unrecoverable.

Data cleaning

- Excel spreadsheets imported to Stata for data cleaning
- Data collected in this study was de-identified, so no identifying information is to be linked when analysing or reporting the data.
- During analysis, the unique ID's given to participants were used in place of any identifying information. As a result, reporting does not link any participant information to data.
- Cleaned data was then exported to Excel spreadsheets to be analysed for different sub-studies.

Analysis

Qualitative methods

To be specified per study. Examples:

- Content analysis
- Thematic analysis

Quantitative methods

To be specified per study. Examples:

- Descriptive statistics (e.g.; means and SD, medians and IQR, …)
- Inferential statistics (e.g.; chi-square statistics, t-test, linear or logistic regression models, …)
- For primary and secondary outcomes
- For additional, subgroup, or sensitivity analyses
- Moderating variables

RESULTS

- Participant flow
  - For each group, losses and exclusions after randomization, together with reason
  - See preliminary flow diagram below
- Recruitment
  - Dates defining the periods of recruitment and follow-up (see Methods)
- Baseline data
  - A table showing baseline demographic and clinical characteristics for each group
  - See preliminary table below
- Numbers analysed
  - For each group, number of participants (denominator) included in each analysis and whether the analysis was by original assigned groups
- Outcomes and estimation
  - For each primary and secondary outcome, results for each group, and the estimated effect size and its precision (such as 95% confidence interval)
  - For binary outcomes, presentation of both absolute and relative effect sizes is recommended
- Ancillary analyses
  - Results of any other analyses performed, including subgroup analyses and adjusted analyses, distinguishing pre-specified from exploratory
- Harms
  - All important harms or unintended effects in each group (For specific guidance see CONSORT for harms)

Figure flow diagram

C O N S O R T
TRANSPARENT REPORTING of TRIALS

CONSORT 2010 Flow Diagram

Enrollment

Assessed for eligibility (n=2616)

Excluded (n= 2008)
- ♦ Not meeting inclusion criteria (n = 1999)
- ♦ Declined to participate (n=5)
- ♦ Other reasons (n=4)

Randomized (n= 608)

Allocation

Allocated to control (n=304)
- ♦ Received allocated intervention (n= 304)
- ♦ Did not receive allocated intervention (give reasons) (n= 0)

Allocated to intervention (n=304)
- ♦ Received allocated intervention (n= 304)
- ♦ Did not receive allocated intervention (give reasons) (n= 0)

Follow-Up (30-Days)

Lost to follow-up (give reasons) (n=24)
*Did not respond to follow-up emails
Discontinued intervention (give reasons) (n= 0)

Lost to follow-up (give reasons) (n=34)
*Did not respond to follow-up emails
Discontinued intervention (give reasons) (n=1)
* Emailed no longer wanting part of study (did not want to do follow-up – data removed)
*

Analysis

Analysed (n= 280)
- ♦ Excluded from analysis (give reasons) (n=0)

Analysed (n=270)
- ♦ Excluded from analysis (give reasons) (n= 0)

Table Participant characteristics at baseline (to be updated!)

	Control		Intervention		Total		Statistic
	N	%	N	%	N	%	
Total	**303**	**100**	**302**	**100**	**605**	**100**	
Gender							
Female	264	87.1	258	85.4	522	86.3	Pearson chi2(2) =
Male	37	12.2	40	13.2	77	12.7	0.8509 Pr = 0.653
Gender diverse	2	0.7	4	1.3	6	1	
Age							
18-29	78	25.7	69	22.8	147	24.3	
30-44	49	16.2	49	16.2	98	16.2	Pearson chi2(3) =
45-59	98	32.3	92	30.5	190	31.4	1.8918 Pr = 0.595
60+	78	25.7	92	30.5	170	28.1	
Ethnicity							
NZ European	207	68.3	223	73.8	430	71.1	
Māori	29	9.6	28	9.3	57	9.4	
Pasifika	8	2.6	3	1.0	11	1.8	Pearson chi2(5) =
Indian	17	5.6	9	3.0	26	4.3	5.4789 Pr = 0.360
Asian	19	6.3	17	5.6	36	6.0	
Other	23	7.6	22	7.3	45	7.4	
Education							
secondary/diploma	98	32.3	112	37.1	210	34.7	
undergraduate	106	35.0	104	34.4	210	34.7	Pearson chi2(3) =
postgraduate	96	31.7	84	27.8	180	29.8	1.9507 Pr = 0.583
other	3	1.0	2	0.7	5	0.8	
Employment							
employed	193	63.7	198	65.6	391	64.6	
not employed	26	8.6	26	8.6	52	8.6	Pearson chi2(3) =
student	47	15.5	34	11.3	81	13.4	2.7537 Pr = 0.431
other	37	12.2	44	14.6	81	13.4	
Income							
<20,000	17	5.6	19	6.3	36	6.0	
20,000-39,999	34	11.2	44	14.6	78	12.9	Pearson chi2(4) =
40,000-69,999	58	19.1	60	19.9	118	19.5	2.3643 Pr = 0.669
70,000-99,999	75	24.8	64	21.2	139	23.0	
>100,000	119	39.3	115	38.1	234	38.7	
BMI							
underweight	4	1.3	2	0.7	6	1.0	
normal	121	39.9	104	34.4	225	37.2	Pearson chi2(3) =
overweight	95	31.4	97	32.1	192	31.7	3.3769 Pr = 0.337
obese	83	27.4	99	32.8	182	30.1	

Discussion

Limitations

- o Trial limitations, addressing sources of potential bias, imprecision, and, if relevant, multiplicity of analyses
- o References on limitations self-reported food intake
  - Archer E, Hand GA, Blair SN (2013) Validity of U.S. Nutritional Surveillance: National Health and Nutrition Examination Survey Caloric Energy Intake Data, 1971–2010. PLoS ONE 8(10): e76632. doi:10.1371/journal.pone.0076632
  - Livingstone et al. (2003). Markers of the validity of reported energy intake. Journal of Nutririon Supplement Biomarkers of Nutritional Exposures and Nutritional Status.
  - Poslusna
  - Gemming et al (2014) Under-reporting remains a key limitation of self-reported dietary intake: an analysis of the 2008/09 New Zealand adult nutrition survey. European Journal of Clinical Nutrition (2014) 68, 259–264
  - Poslusna et al (2009). Misreporting of energy and micronutrient intake estimated by food records and 24 hour recalls, control and adjustment methods in practice. British Journal of Nutrition (2009), 101, Suppl. 2, S73–S85 doi:10.1017/S0007114509990602.
  - Stices et al (2015). Elevated BMI and Male Sex Are Associated with Greater Underreporting of Caloric Intake as Assessed by Doubly Labeled Water. J Nutr 2015;145:2412–8
- Generalisability
  - o Generalisability (external validity, applicability) of the trial findings
- Interpretation
  - o Interpretation consistent with results, balancing benefits and harms, and considering other relevant evidence
- Registration
  - o The "Personalised Feedback and Sugar Consumption" study was approved by the University of Auckland Human Participants Ethics Committee on 21/07/21 for three years. Reference Number 22241

Other information

- Protocol
  - o The study was approved by the University of Auckland Human Participants Ethics Committee on 21/07/21 for three years. Reference Number 22241.
- Funding
  - o Sources of funding and other support (such as supply drugs), role of funders

Appendices

PERSONALISED FEEDBACK & SUGAR CONSUMPTION QUESTIONNAIRES

SECTION	MEASURES	BASELINE	30-DAY FOLLOW-UP	2-MONTH FOLLOW-UP
1	INCLUSION, PARTICIPANT INFORMATION SHEET, CONSENT	X		
2	FOOD FREQUENCY QUESTIONNAIRE	X	X	X
	WHO-5 WELLBEING	X	X	X
3	WEIGHT EFFICACY LIFESTYLE QUESTIONNAIRE (SHORT-FORM)	X	X	X
4, 5	CRAVING EXPERIENCE QUESTIONNAIRE (S&F)	X	X	X
6	DEMOGRAPHICS & BMI	X	Only Weight (for BMI)	Only Weight (for BMI)
7	CONTACT DETAILS	X		
	RANDOMISATION	X		
8A	INTERVENTION GROUP	X	X	X
8A	RECAL	X		
8B	COMPARISION (ASSESSMENT-ONLY) GROUP	X		
9	COVID IMPACT		X	X
10	RESISTANCE (STRATEGY CONFIDENCE)		X	X
11	SUGAR REDUCTION RECOMMENDATIONS		X	X
12	RESOURCE USAGE		X	X
13	GOAL			X
14	SUGAR ADDICTIVE			X
	PRICE DRAW		X	X

SECTION 1. INCLUSION, PARTICIPANT INFORMATION SHEET, CONSENT FORM

PLEASE ANSWER THE FOLLOWING QUESTIONS TO CHECK IF YOU QUALIFY FOR THIS STUDY:

ARE YOU OVER THE AGE OF 18?	YES	NO
ARE YOU CURRENTLY LIVING IN NEW ZEALAND?	YES	NO
ARE YOU WILLING TO COMPLETE THIS ONLINE QUESTIONNAIRE FOR SUGAR CONSUMPTION, AND COMPLETE THE FOLLOW-UP QUESTIONNAIRE IN 30-DAYS?	YES	NO
CONGRATULATIONS! YOU ARE ELIGIBLE TO JOIN THIS STUDY! BEFORE ACCEPTING TO PARTICIPATE, PLEASE READ THROUGH THE PARTICIPANT INFORMATION SHEET*. THIS HAS DETAILED INFORMATION ABOUT THE STUDY, INCLUDING IMPORTANT SUPPORT AND	YES, I HAVE READ THE PARTICIPANT INFORMATION SHEET AND AM INTERESTED IN TAKING PART IN THIS STUDY	NO, I HAVE NOT READ THE PARTICIPANT INFORMATION SHEET OR AM NOT INTERESTED IN TAKING PART IN THIS STUDY

CONTACT INFORMATION. CLICK THE LINK BELOW TO OPEN THE SHEET IN A NEW TAB.		
(LINK TO PARTICIPANT INFORMATION SHEET - SEE SEPARATE DOCUMENT)		
(ONLINE CONSENT FORM EMBEDDED HERE - SEE SEPARATE DOCUMENT)	YES, I AGREE TO TAKE PART IN THIS RESEARCH	NO, I DO NOT AGREE TO TAKE PART IN THIS RESEARCH

THE PARTICIPANT INFORMATION SHEET WILL OPEN ON A SEPARATE WEBPAGE IN AN ONLINE PDF FORMAT, WHICH CAN BE DOWNLOADED AND KEPT BY PARTICIPANTS. See Appendix B.

IF INELIGIBLE OR UNWILLING TO CONSENT MESSAGE:

THANK YOU FOR YOUR INTEREST IN JOINING THIS STUDY. UNFORTUNATELY, YOU DO NOT MEET THE CRITERIA TO PARTICIPATE. PLEASE KEEP ON THE LOOKOUT FOR MORE STUDIES FROM THE FACULTY OF MEDICAL AND HEALTH SCIENCES.

SECTION 2. GENDER & FOOD FREQUENCY QUESTIONNAIRE

BEFORE WE BEGIN, PLEASE SPECIFY WHAT GENDER YOU MOST IDENTIFY WITH:	MALE	FEMALE	GENDER DIVERSE

MAHINGA HUKA
SUGAR CONSUMPTION

FOOD FREQUENCY QUESTIONNAIRES ARE USED TO UNDERSTAND A PERSON'S EATING HABITS, WHICH WE CAN USE TO ESTIMATE HOW MUCH SUGAR YOU HAVE.

BEFORE COMPLETING THE FOOD FREQUENCY QUESTIONNAIRE, PLEASE ANSWER THE FOLLOWING QUESTIONS USING THE SLIDER BELOW.

HOW MANY TEASPOONS OF SUGAR DO YOU THINK **YOU** HAVE DAILY?	[RESPONSE OPTIONS 0-30 TEASPOONS]
HOW MANY TEASPOONS OF SUGAR DO YOU THINK **OTHER NEW ZEALANDERS** HAVE DAILY?	[RESPONSE OPTIONS 0-30 TEASPOONS]
HOW MANY TEASPOONS OF SUGAR DO YOU THINK **OTHER MALES***	[RESPONSE OPTIONS 0-30 TEASPOONS]

IN NEW ZEALAND HAVE DAILY?	
HOW MANY TEASPOONS OF SUGAR DO YOU THINK **OTHER NEW ZEALANDERS IN YOUR AGE GROUP** HAVE DAILY?	[RESPONSE OPTIONS 0-30 TEASPOONS]
HOW MANY TEASPOONS OF SUGAR DO YOU THINK THE **WORLD HEALTH ORGANISATION RECOMMEND MALES TO LIMIT** DAILY?	[RESPONSE OPTIONS 0-30 TEASPOONS]

*NOTE: IF GENDER IS FEMALE OR UNSPECIFIED, WORDING WILL REFLECT THIS GENDER

PĀTAI PONO PĀTAI
FOOD FREQUENCY QUESTIONNAIRE

THE FOLLOWING IS A FOOD FREQUENCY QUESTIONNAIRE THAT ESTIMATES HOW MUCH SUGAR YOU HAVE DAILY BY ASKING YOU ABOUT YOUR AVERAGE INTAKE OF THE FOLLOWING FOOD ITEMS OVER THE PAST <u>MONTH</u>.

EACH FOOD ITEM HAS A SPECIFIED PORTION SIZE. IF YOU CONSUME MORE OR LESS THAN THIS SIZE, PLEASE ADJUST YOUR AVERAGE USE ACCORDINGLY. FOR EXAMPLE, IF YOU CONSUME ONE 500ML ENERGY DRINK PER WEEK, YOUR AVERAGE USE FOR ENERGY DRINKS WOULD BE 2-4 PER WEEK.

THERE ARE ALSO EXAMPLES FOR EACH FOOD ITEM TO HELP YOU UNDERSTAND THE TYPE OF FOOD OF EACH CATEGORY. WHEN ANSWERING, PLEASE INCLUDE ANY FOOD ITEMS YOU THINK FITS WITHIN THESE CATEGORIES.

FOR EACH FOOD LISTED, USE THE DROP-DOWN BOX TO INDICATE HOW OFTEN <u>ON AVERAGE</u> YOU HAVE USED THE AMOUNT SPECIFIED DURING THE PAST MONTH.

NGA KAI KAIPUTA
BREAKFAST FOODS

THINK OF THE FOODS YOU WOULD USUALLY CONSUME IN THE MORNING. DO YOU PUT USUALLY HAVE NUTELLA ON TOAST? HAVE A BOWL OF NUTRI-GRAIN? OR PREFER AN UP&GO?

BREAKFAST CEREALS E.G. NUTRIGRAIN. COCO-POPS	NEVER OR ONCE PER MONTH	1-3 PER MONTH	1 PER WEEK	2-4 PER WEEK
1 CUP, 250ML	1 PER DAY	2-3 PER DAY	4-5 PER DAY	6+ PER DAY

PANCAKES/PIKELETS E.G. CHOCOLATE CHIP PANCAKE	NEVER OR ONCE PER MONTH	1-3 PER MONTH	1 PER WEEK	2-4 PER WEEK
1 SLICE, 30G	1 PER DAY	2-3 PER DAY	4-5 PER DAY	6+ PER DAY
YOGHURT E.G. FRESH N FRUITY **1 POTTLE, 125G**	NEVER OR ONCE PER MONTH	1-3 PER MONTH	1 PER WEEK	2-4 PER WEEK
	1 PER DAY	2-3 PER DAY	4-5 PER DAY	6+ PER DAY
SPREADS E.G. NUTELLA, MARMALADE, JAM **1 TABLESPOON, 15G**	NEVER OR ONCE PER MONTH	1-3 PER MONTH	1 PER WEEK	2-4 PER WEEK
	1 PER DAY	2-3 PER DAY	4-5 PER DAY	6+ PER DAY
LIQUID BREAKFASTS E.G. UP & GO, FAST START **1 CUP, 250ML**	NEVER OR ONCE PER MONTH	1-3 PER MONTH	1 PER WEEK	2-4 PER WEEK
	1 PER DAY	2-3 PER DAY	4-5 PER DAY	6+ PER DAY

NGA INUINU (KORE-KAUPAPA)
BEVERAGES (NON-DIET)

NOW THINK ABOUT THE VARIOUS **NON-DIET** DRINKS YOU USUALLY HAVE ALONGSIDE OR BETWEEN MEALS. DO YOU HAVE USUALLY HAVE AN ENERGY DRINK BEFORE HITTING THE GYM, A SMOOTHIE AT LUNCH, OR A SOFT DRINK WITH DINNER?

PLEASE ALSO INCLUDE THE TIMES YOU MIX THESE BEVERAGES WITH ALCOHOL (E.G. VODKA WITH JUICE).

ENERGY DRINKS E.G. V, DEMON, RED BULL **1 CUP, 250ML**	NEVER OR ONCE PER MONTH	1-3 PER MONTH	1 PER WEEK	2-4 PER WEEK
	1 PER DAY	2-3 PER DAY	4-5 PER DAY	6+ PER DAY
SPORTS DRINKS E.G. POWERADE, GATORADE **1 CUP, 250 ML**	NEVER OR ONCE PER MONTH	1-3 PER MONTH	1 PER WEEK	2-4 PER WEEK
	1 PER DAY	2-3 PER DAY	4-5 PER DAY	6+ PER DAY
SOFT DRINKS & FLAVOURED WATER E.G. COLA, LEMONADE **1 CUP, 250 ML**	NEVER OR ONCE PER MONTH	1-3 PER MONTH	1 PER WEEK	2-4 PER WEEK
	1 PER DAY	2-3 PER DAY	4-5 PER DAY	6+ PER DAY
FRUIT JUICE, CORDIAL MIXES, AND FRUIT DRINKS	NEVER OR ONCE PER MONTH	1-3 PER MONTH	1 PER WEEK	2-4 PER WEEK
E.G. ORANGE JUICE, BLACKCURRANT FRUIT DRINK **1 CUP, 250 ML**	1 PER DAY	2-3 PER DAY	4-5 PER DAY	6+ PER DAY

SMOOTHIES E.G. MANGO SMOOTHIE **1 CUP, 250 ML**	NEVER OR ONCE PER MONTH	1-3 PER MONTH	1 PER WEEK	2-4 PER WEEK
	1 PER DAY	2-3 PER DAY	4-5 PER DAY	6+ PER DAY
FLAVOURED MILK DRINKS E.G. CHOCOLATE MILK, MILO. EXCLUDES LIQUID BREAKFASTS SUCH AS UP & GO - **1 CUP, 250 ML**	NEVER OR ONCE PER MONTH	1-3 PER MONTH	1 PER WEEK	2-4 PER WEEK
	1 PER DAY	2-3 PER DAY	4-5 PER DAY	6+ PER DAY

SNACK FOODS

NOW THINK ABOUT THE FOODS YOU USUALLY SNACK ON BETWEEN YOUR MEALS OR WHEN YOU'RE FEELING PECKISH. DO YOU USUALLY LIKE TO SNACK ON LOLLIES OR CHOCOLATE, OR PREFER TO STICK WITH A MUESLI BAR BETWEEN MEALS?

SWEET BISCUITS E.G. SHORTBREAD, CHOCOLATE CHIP COOKIES, TIM TAMS **2 BISCUITS, 30G**	NEVER OR ONCE PER MONTH	1-3 PER MONTH	1 PER WEEK	2-4 PER WEEK
	1 PER DAY	2-3 PER DAY	4-5 PER DAY	6+ PER DAY
CANDY AND LOLLIES E.G. MARSHMALLOWS, LOLLIPOPS, JELLYBEANS, PINEAPPLE LUMPS **1 HANDFUL, 50G**	NEVER OR ONCE PER MONTH	1-3 PER MONTH	1 PER WEEK	2-4 PER WEEK
	1 PER DAY	2-3 PER DAY	4-5 PER DAY	6+ PER DAY
CHOCOLATE AND CHOCOLATE BASED SWEETS E.G. TWIX, MARS, MILK OR DARK CHOCOLATE, CHOCOLATE ALMONDS **1 BAR/8 BLOCK SQUARES OR 1 HANDFUL OF CHOCOLATE BASED SWEETS, 50G**	NEVER OR ONCE PER MONTH	1-3 PER MONTH	1 PER WEEK	2-4 PER WEEK
	1 PER DAY	2-3 PER DAY	4-5 PER DAY	6+ PER DAY
MUFFINS E.G. CHOCOLATE MUFFIN, BLUEBERRY MUFFIN	NEVER OR ONCE PER MONTH	1-3 PER MONTH	1 PER WEEK	2-4 PER WEEK
	1 PER DAY	2-3 PER DAY	4-5 PER DAY	6+ PER DAY

1 MUFFIN, 60G				
DOUGHNUTS E.G. GLAZED DOUGHNUT **1 DOUGHNUT, 30G**	NEVER OR ONCE PER MONTH	1-3 PER MONTH	1 PER WEEK	2-4 PER WEEK
	1 PER DAY	2-3 PER DAY	4-5 PER DAY	6+ PER DAY
FRUIT AND NUT BARS E.G. MUESLI BARS **1 BAR, 40G**	NEVER OR ONCE PER MONTH	1-3 PER MONTH	1 PER WEEK	2-4 PER WEEK
	1 PER DAY	2-3 PER DAY	4-5 PER DAY	6+ PER DAY

<p style="text-align:center">TUHINGA
DESSERTS</p>

NOW THINK ABOUT THE TYPES OF FOOD YOU USUALLY TREAT YOURSELF TO AFTER A MEAL OR CELEBRATION. DO YOU LIKE TO ENJOY A WARM CHOCOLATE PUDDING? OR PREFER GETTING GET ICE CREAM WITH FRIENDS?

CAKES E.G. CHOCOLATE CAKE, CHEESECAKE, CARROT CAKE. **1 SLICE, 50G**	NEVER OR ONCE PER MONTH	1-3 PER MONTH	1 PER WEEK	2-4 PER WEEK
	1 PER DAY	2-3 PER DAY	4-5 PER DAY	6+ PER DAY
ICE CREAM & ICE BLOCKS E.G. SOFT SERVE, VANILLA ICE CREAM, LEMONADE POPSICLE **2 SCOOPS OR 1 ICE BLOCK, 100ML**	NEVER OR ONCE PER MONTH	1-3 PER MONTH	1 PER WEEK	2-4 PER WEEK
	1 PER DAY	2-3 PER DAY	4-5 PER DAY	6+ PER DAY
CUSTARDS, PUDDINGS & JELLIES E.G. CHOCOLATE PUDDING, VANILLA CUSTARD, STRAWBERRY JELLY **1 PUDDING OR 2 SCOOPS CUSTARD/JELLY, 100G**	NEVER OR ONCE PER MONTH	1-3 PER MONTH	1 PER WEEK	2-4 PER WEEK
	1 PER DAY	2-3 PER DAY	4-5 PER DAY	6+ PER DAY
DESSERT BREADS & PASTRIES E.G. BANANA BREAD, SCONES, TARTS, DANISH BUN, APPLE PIE **1 PIECE, 50G**	NEVER OR ONCE PER MONTH	1-3 PER MONTH	1 PER WEEK	2-4 PER WEEK
	1 PER DAY	2-3 PER DAY	4-5 PER DAY	6+ PER DAY

DESSERT SLICES E.G. GINGER SLICE, CARAMEL SLICE **1 SLICE, 45G**	NEVER OR ONCE PER MONTH	1-3 PER MONTH	1 PER WEEK	2-4 PER WEEK
	1 PER DAY	2-3 PER DAY	4-5 PER DAY	6+ PER DAY

NGA KAIWHIRI KAI ME TE INU
FOOD AND DRINK ADDITIVES

NOW THINK ABOUT THE VARIOUS FOODS AND DRINKS YOU USUALLY CONSUME THROUGHOUT AN AVERAGE DAY. IS THERE ANYTHING EXTRA YOU USUALLY ADD TO THESE FOODS AND DRINKS? DO YOU ADD DIFFERENT TYPES OF SUGAR TO YOUR COFFEE OR CEREAL? AND DO YOU USUALLY LIKE TO HAVE SAUCE OR DRESSINGS WITH YOUR FOOD?

SUGAR E.G. WHITE, BROWN, ICING OR RAW SUGAR **1 TEASPOON, 4G**	NEVER OR ONCE PER MONTH	1-3 PER MONTH	1 PER WEEK	2-4 PER WEEK
	1 PER DAY	2-3 PER DAY	4-5 PER DAY	6+ PER DAY
HONEY AND SYRUPS E.G. MANUKA HONEY, MAPLE SYRUP **1 TABLESPOON, 15G**	NEVER OR ONCE PER MONTH	1-3 PER MONTH	1 PER WEEK	2-4 PER WEEK
	1 PER DAY	2-3 PER DAY	4-5 PER DAY	6+ PER DAY
SIMMER AND COOKING SAUCES OR PASTES E.G. SWEET AND SOUR SAUCE, PASTA SAUCE **1/2 CUP, 130G**	NEVER OR ONCE PER MONTH	1-3 PER MONTH	1 PER WEEK	2-4 PER WEEK
	1 PER DAY	2-3 PER DAY	4-5 PER DAY	6+ PER DAY
COMPLEMENTARY SAUCES E.G. TOMATO SAUCE, MUSTARD **1 TABLESPOON, 15G**	NEVER OR ONCE PER MONTH	1-3 PER MONTH	1 PER WEEK	2-4 PER WEEK
	1 PER DAY	2-3 PER DAY	4-5 PER DAY	6+ PER DAY
SALAD DRESSINGS AND RELISHES E.G. FRENCH DRESSING, COLESLAW DRESSING **1 TABLESPOON, 15G**	NEVER OR ONCE PER MONTH	1-3 PER MONTH	1 PER WEEK	2-4 PER WEEK
	1 PER DAY	2-3 PER DAY	4-5 PER DAY	6+ PER DAY

SECTION 3. WHO-5 WELLBEING SCALE

TE PĀTAI WHAKAMAHI KI TE WHAKAMAHI I TE AO
MENTAL WELLBEING

THE FOLLOWING QUESTIONS WILL ESTIMATE YOUR OVERALL MENTAL WELLBEING, WHICH HAS BEEN KNOWN TO IMPACT EATING HABITS.

PLEASE INDICATE FOR EACH OF THE FIVE STATEMENTS WHICH IS CLOSEST TO HOW YOU HAVE BEEN FEELING OVER THE **LAST TWO WEEKS.**

	ALL OF THE TIME	MOST OF THE TIME	MORE THAN HALF THE TIME	LESS THAN HALF THE TIME	SOME OF THE TIME	AT NO TIME
1. I HAVE FELT CHEERFUL IN GOOD SPIRITS.	5	4	3	2	1	0
2. I HAVE FELT CALM AND RELAXED.	5	4	3	2	1	0
3. I HAVE FELT ACTIVE AND VIGOROUS.	5	4	3	2	1	0
4. I WOKE UP FEELING FRESH AND RESTED.	5	4	3	2	1	0
5. MY DAILY LIFE HAS BEEN FILLED WITH THINGS THAT INTEREST ME.	5	4	3	2	1	0

SECTION 4. WEIGHT EFFICACY LIFESTYLE QUESTIONNAIRE SHORT-FORM (ADAPTED)

NGĀ PĀTAI MAHI TUTU
CONFIDENCE TO RESIST SUGARY PRODUCTS

THE FOLLOWING QUESTIONS WILL ESTIMATE YOUR ABILITY OR CONFIDENCE TO RESIST SUGARY PRODUCTS IN DIFFERENT SITUATIONS. THIS CONFIDENCE CAN IMPACT YOUR EATING HABITS.

READ EACH SITUATION BELOW AND DECIDE HOW CONFIDENT (OR CERTAIN) YOU ARE THAT YOU WILL BE ABLE TO RESIST SUGARY PRODUCTS IN EACH OF THE DIFFICULT SITUATIONS.

ON A SCALE OF 0 (NOT CONFIDENT) TO 10 (VERY CONFIDENT), CHOOSE ONE NUMBER THAT REFLECTS HOW CONFIDENT YOU HAVE FELT OVER THE **LAST MONTH** ABOUT BEING ABLE TO SUCCESSFULLY RESIST THE <u>DESIRE TO EAT SUGARY PRODUCTS.</u> SELECT THIS NUMBER FOR EACH ITEM.

	NOT AT ALL CONFIDENT										VERY CONFIDENT
1. I CAN RESIST SUGARY PRODUCTS WHEN **I**	0	1	2	3	4	5	6	7	8	9	10

AM ANXIOUS (OR NERVOUS)										
2. I CAN RESIST SUGARY PRODUCTS ON **THE WEEKEND**	0	1	2	3	4	5	6	7	8	9	10
3. I CAN RESIST SUGARY PRODUCTS WHEN **I AM TIRED**	0	1	2	3	4	5	6	7	8	9	10
4. I CAN RESIST SUGARY PRODUCTS WHEN I AM **WATCHING TV (OR USING THE COMPUTER)**	0	1	2	3	4	5	6	7	8	9	10
5. I CAN RESIST SUGARY PRODUCTS WHEN **I AM DEPRESSED (OR DOWN)**	0	1	2	3	4	5	6	7	8	9	10
6. I CAN RESIST SUGARY PRODUCTS WHEN **I AM IN A SOCIAL SETTING (OR AT A PARTY)**	0	1	2	3	4	5	6	7	8	9	10
7. I CAN RESIST SUGARY PRODUCTS WHEN **I AM ANGRY (OR IRRITABLE)**	0	1	2	3	4	5	6	7	8	9	10
8. I CAN RESIST SUGARY PRODUCTS WHEN **OTHERS ARE PRESSURING ME TO EAT THEM**	0	1	2	3	4	5	6	7	8	9	10

SECTION 5: CRAVING FREQUENCY QUESTIONNAIRE (ADAPTED)

HEI MAHI
CRAVING STRENGTH

THE FOLLOWING QUESTIONS WILL ESTIMATE HOW <u>STRONG</u> YOUR CRAVINGS FOR A SUGARY PRODUCT HAS BEEN IN THE LAST WEEK. THIS COULD BE ANY SUGARY PRODUCT, SUCH AS A DOUGHNUT OR ICE CREAM. "IT" IN THE QUESTIONS BELOW RELATE TO THIS SUGARY PRODUCT.

THINK ABOUT A TIME IN THE **LAST 1 WEEK** YOU **MOST WANTED** A SUGARY PRODUCT.

FOR EACH ITEM, SELECT A CIRCLE TO MAKE YOUR RATING.

AT THAT TIME...	NOT AT ALL										EXTREMELY
HOW MUCH DID YOU WANT IT?	0	1	2	3	4	5	6	7	8	9	10
HOW MUCH DID YOU NEED IT?	0	1	2	3	4	5	6	7	8	9	10
HOW STRONG WAS THE URGE TO HAVE IT?	0	1	2	3	4	5	6	7	8	9	10
AT THAT TIME, HOW VIVIDLY DID YOU…											
PICTURE IT?	0	1	2	3	4	5	6	7	8	9	10
IMAGINE ITS TASTE?	0	1	2	3	4	5	6	7	8	9	10
IMAGINE ITS SMELL?	0	1	2	3	4	5	6	7	8	9	10
IMAGINE WHAT IT WOULD FEEL LIKE IN YOUR MOUTH OR THROAT?	0	1	2	3	4	5	6	7	8	9	10
AT THAT TIME…											
HOW HARD WERE YOU TRYING NOT TO THINK ABOUT IT?	0	1	2	3	4	5	6	7	8	9	10
HOW INTRUSIVE WERE THE THOUGHTS?	0	1	2	3	4	5	6	7	8	9	10
HOW HARD WAS IT TO THINK ABOUT ANYTHING ELSE?	0	1	2	3	4	5	6	7	8	9	10

TE HUAKAHAU KI TE TANGI
CRAVING FREQUENCY

THE FOLLOWING QUESTIONS RELATE TO HOW <u>FREQUENT OR OFTEN</u> YOUR CRAVINGS FOR A SUGARY PRODUCT HAS BEEN IN THE LAST WEEK. THIS COULD BE ANY SUGARY PRODUCT, SUCH AS A DOUGHNUT OR ICE CREAM. "IT" IN THE QUESTIONS BELOW RELATE TO THIS SUGARY PRODUCT.

PLEASE ANSWER **HOW OFTEN** THESE THINGS HAPPENED IN THE **LAST 1 WEEK.**

FOR EACH ITEM, SELECT A BOX TO MAKE YOUR RATING

OVER THE LAST WEEK HOW OFTEN…	NOT AT ALL										CONSTANTLY
DID YOU WANT IT?	0	1	2	3	4	5	6	7	8	9	10
DID YOU NEED IT?	0	1	2	3	4	5	6	7	8	9	10
DID YOU HAVE A STRONG URGE FOR IT?	0	1	2	3	4	5	6	7	8	9	10
OVER THE LAST WEEK HOW OFTEN DID YOU …											
IMAGINE ITS TASTE?	0	1	2	3	4	5	6	7	8	9	10
IMAGINE ITS SMELL?	0	1	2	3	4	5	6	7	8	9	10
IMAGINE WHAT IT WOULD FEEL LIKE IN YOUR MOUTH OR THROAT?	0	1	2	3	4	5	6	7	8	9	10
IMAGINE ITS TASTE?	0	1	2	3	4	5	6	7	8	9	10
OVER THE LAST WEEK, HOW OFTEN…											
WERE YOU TRYING NOT TO THINK ABOUT IT?	0	1	2	3	4	5	6	7	8	9	10
WERE THE THOUGHTS INTRUSIVE?	0	1	2	3	4	5	6	7	8	9	10
WAS IT HARD TO THINK ABOUT ANYTHING ELSE?	0	1	2	3	4	5	6	7	8	9	10

SECTION 6: DEMOGRAPHICS & BMI

DEMOGRAPHIC INFORMATION

FOR US TO GIVE YOU MORE ACCURATE FEEDBACK AT THE END OF THIS QUESTIONNAIRE,

WHAT AGE ARE YOU	[SLIDER OPTION 0-100 YRS]		
WHAT IS YOUR ETHNICITY? (MORE THAN ONE OPTION MAY BE SELECTED):	NEW ZEALAND EUROPEAN	MĀORI	PACIFICA
	ASIAN	INDIAN	OTHER
WHAT IS YOUR HIGHEST EDUCATION LEVEL?	BELOW YEAR 10	HIGH SCHOOL DIPLOMA	DIPLOMA
	DEGREE	MASTERS OR ABOVE	OTHER
WHAT IS YOUR CURRENT EMPLOYMENT STATUS?	EMPLOYED	NOT EMPLOYED	STUDENT
	OTHER		
WHAT IS YOUR TOTAL FAMILY HOUSEHOLD INCOME, IN THE LAST 12 MONTHS?	LESS THAN $20,000	$20,001-$39,999	$40,000-$69,999
	$70,000-$99,999	MORE THAN $100,000	
WHAT IS YOUR WEIGHT (IN KGS)?	[RESPONSE OPTIONS 40-160 KGS]		
WHAT IS YOUR HEIGHT (IN CMS)?	[RESPONSE OPTIONS 80-220 CMS]		

PLEASE PROVIDE US WITH THE FOLLOWING DEMOGRAPHIC INFORMATION:

SECTION 7: CONTACT DETAILS

BEFORE WE GIVE YOU YOUR RESULTS, PLEASE PROVIDE YOUR CONTACT DETAILS BELOW. WE NEED THIS INFORMATION TO CONTACT YOU TO COMPLETE THE FOLLOW-UP QUESTIONNAIRE IN 30-DAYS. WE WILL NOT CONTACT YOU OTHERWISE AND WILL STORE THIS INFORMATION SEPARATELY TO YOUR RESPONSES SO YOU CAN REMAIN ANONYMOUS.

FIRST NAME	[TEXTBOX]
LAST NAME	[TEXTBOX]
EMAIL	[TEXTBOX]
MOBILE NUMBER	[TEXTBOX]

SECTION 8A: INTERVENTION GROUP

[SEE SEPARATE DOCUMENT FOR INTERVENTION GROUP FEEDBACK REPORT AND OTHER RESOURCES]. See Appendix C, Appendix D, Appendix E.

TE WA KI TE WHAKAARO MO O HUA!
TIME TO REFLECT ON YOUR RESULTS!

HOW MANY TEASPOONS OF SUGAR DID YOUR RESULTS INDICATE YOU HAVE EACH DAY?	X TEASPOONS *(FROM RESULTS)*	7.75 TEASPOONS		16.25 TEASPOONS
ACCORDING TO THE WORLD HEALTH ORGANISATION, HOW MANY TEASPOONS OF SUGAR SHOULD YOU LIMIT YOUR DAILY AMOUNT TO?	6 TEASPOONS	9 TEASPOONS		*[RANDOMLY GENERATED NUMBER OF TEASPOONS]*
WERE YOU SURPRISED BY THE AMOUNT OF SUGAR YOU CONSUME DAILY?	YES		NO	
AFTER SEEING YOUR RESULTS, ARE YOU THINKING ABOUT DOING SOMETHING TO CHANGE YOUR DAILY SUGAR CONSUMPTION?	YES		NO	

SECTION 8B: COMPARISION (ASSESSMENT-ONLY) GROUP

[SEE SEPARATE DOCUMENT FOR ASSESSMENT ONLY FEEDBACK REPORT]. See Appendix F.

[IF YES TO ABOVE] PLEASE PROVIDE YOUR EMAIL ADDRESS TO BE SENT THE RESULTS SUMMARY	[TEXTBOX]
DO YOU HAVE ANY OTHER FEEDBACK, COMMENTS OR QUESTIONS ABOUT THIS STUDY OR YOUR RESULTS?	[TEXTBOX]

SECTION 9: DIETARY CONTEXT

HOROPAKI KAI
DIETARY CONTEXT

THIS FIRST SECTION WILL ASK YOU QUESTIONS RELATED TO YOUR EXPERIENCES IN THE **PAST MONTH.**

DURING THIS STUDY, MUCH OF NEW ZEALAND WAS UNDER VARIOUS RESTRICTIONS DUE TO COVID-19 ANDLOCKDOWN. BASED ON YOUR EXPERIENCES IN THE **PAST**	I HAD A LOT LESS JUNK OR SUGARY FOOD AND DRINK	I HAD LESS JUNK OR SUGARY FOOD AND DRINK	I HAD ABOUT THE SAME JUNK OR SUGARY FOOD AND DRINK
	I HAD MORE JUNK OR SUGARY FOOD AND DRINK	I HAD A LOT MORE JUNK OR SUGARY FOOD AND DRINK	

MONTH, HOW DID YOUR DIET CHANGE COMPARED WITHBEFORE LOCK-DOWN?			
OVER THE PAST MONTH, WHAT TYPE OF NEGATIVE OR POSITIVE IMPACTS HAS COVID-19 HAD ON YOUR DIET, PARTICULARLY YOUR SUGAR CONSUMPTION?	[TEXTBOX]		
MANY PEOPLE FOUND THEIR WEIGHT CHANGED DURING THE PAST MONTH. PLEASE GIVE US AN ESTIMATE OFYOUR CURRENT WEIGHT:	[SLIDER OPTION 40-160 KGS]		

SECTION 10: RESISTANCE (STRATEGY CONFIDENCE)

ADDITIONAL DETAILS

BEFORE WE GIVE YOU YOUR UPDATED FEEDBACK, PLEASE ANSWER THE FOLLOWING QUESTIONS:

THINKING BACK OVER THE **PAST MONTH,** ON A SCALE OF 1 TO 10, HOW CONFIDENT ARE YOU THAT YOU COULD USE THE FOLLOWING APPROACHES TO SUCCESSFUL RESIST SUGAR:

	NOT AT ALL CONFIDENT									**VERY** CONFIDENT	
AVOID BUYING OR ACCESSING SUGARY ITEMS	0	1	2	3	4	5	6	7	8	9	10
FOCUS ON GETTING HEALTHY LIKE INCREASING EXERCISE	0	1	2	3	4	5	6	7	8	9	10
SUBSTITUTE SUGAR FOR NON-SUGAR OR LOW SUGAR OPTIONS	0	1	2	3	4	5	6	7	8	9	10
IMPROVE SLEEP QUALITY AND LENGTH	0	1	2	3	4	5	6	7	8	9	10
PRACTISE SAYING NO TO UNWANTED SUGAR	0	1	2	3	4	5	6	7	8	9	10
USE AN URGE MANAGEMENT STRATEGY SUCH AS DISTRACT OR DELAY	0	1	2	3	4	5	6	7	8	9	10
GRADUALLY REDUCE YOUR CONSUMPTION OVER TIME	0	1	2	3	4	5	6	7	8	9	10
MANAGE PHYSICAL, PSYCHOLOGICAL OR	0	1	2	3	4	5	6	7	8	9	10

EMOTIONAL WITHDRAWAL SYMPTOMS										
ASK FAMILY, FRIENDS, OR PROFESSIONALS FOR HELP	0	1	2	3	4	5	6	7	8	9	10

SECTION 11: SUGAR REDUCTION RECOMMENDATIONS

IF YOU WERE TO GIVE ADVICE TO SOMEONE ELSE ON WAYS TO REDUCE SUGAR, BASED ON YOUR EXPERIENCESOVER THE **PAST MONTH,** WHAT WOULD YOU RECOMMEND?

[TEXTBOX]

SECTION 12: RESOURCE USE

PLEASE INDICATE HOW MUCH TIME YOU THINK YOU SPENT READING THE FOLLOWING STUDY RESOURCES OVER THE **PAST MONTH:**

FEEDBACK SCORE REPORT (QUESTIONNAIRE FEEDBACK)	NOT APPLICABLE (DID NOT RECEIVE)	NO TIME AT ALL	NOT VERY MUCH TIME
	MODERATE AMOUNT OF TIME	CONSIDERABLE AMOUNT OF TIME	A GREAT DEAL AMOUNT OF TIME
SUGAR CONSUMPTION WORKBOOK (PLANNING WORKBOOK)	NOT APPLICABLE (DID NOT RECEIVE)	NO TIME AT ALL	NOT VERY MUCH TIME
	MODERATE AMOUNT OF TIME	CONSIDERABLE AMOUNT OF TIME	A GREAT DEAL AMOUNT OF TIME
SUGAR CONSUMPTION GUIDELINES (STRATEGIES FOR REDUCTION)	NOT APPLICABLE (DID NOT RECEIVE)	NO TIME AT ALL	NOT VERY MUCH TIME
	MODERATE AMOUNT OF TIME	CONSIDERABLE AMOUNT OF TIME	A GREAT DEAL AMOUNT OF TIME

SECTION 13: GOAL

DIETARY CONTEXT

THIS FIRST SECTION WILL ASK YOU QUESTIONS RELATED TO YOUR EXPERIENCES WITH SUGAR

SINCE YOU COMPLETED THE PREVIOUS 30-DAY FOLLOW-UP QUESTIONNAIRE, WHAT HAS BEEN YOUR GOAL FORSUGAR CONSUMPTION?	TO REDUCE MY SUGAR CONSUMPTION FURTHER	TO MAINTAIN MY SUGAR CONSUMPTION AT THAT LEVEL
	TO INDCREASE MY SUGAR CONSUMPTION	I DIDN'T HAVE A GOAL FOR SUGAR CONSUMPTION

SECTION 14: SUGAR ADDICTIVE

BASED ON YOUR EXPERICNE, DO YOU THINK SUGAR IS **ADDICTIVE**?	STRONGLY DISAGREE	DISAGREE
	AGREE	STRONGLY AGREE
WHAT ARE THE REASONS YOU THINK SUGAR IS ADDICTIVE?	[TEXTBOX]	
WHAT SIGNS OR SYMPTOMS HAVE YOU EXPERIENCED THAT INDICATE SUGAR IS ADDICTIVE?	[TEXTBOX]	
WHAT ARE THE REASONS YOU THINK SUGAR IS **NOT** ADDICTIVE?	[TEXTBOX]	
WHAT IS YOUR VIEW ON WHY SOME PEOPLE OVERCONSUME SUGAR?	[TEXTBOX]	

Participant Information Sheet

Project Title: Personalised Feedback and Sugar Consumption

Principal Investigator: Dr Simone Rodda

Student Researcher: Mr Hiranya Khullar

This research is being conducted by Dr Simone Rodda (Senior Lecturer) and Mr Hiranya Khullar (Masters Student) from the School of Population Health, University of Auckland.

Project description and invitation to participate

Researchers at the University of Auckland are looking for 200 participants who are aged 18 years or over to investigate sugar consumption. The study investigates how much sugar people consume and then provides feedback on that consumption. It is a randomised controlled trial with two treatment arms, where half of the participants will receive detailed questionnaire feedback, and the other half will receive a copy of their results. Participation in the study is entirely voluntary and open to all adults in Aotearoa, New Zealand.

Project procedures

Participation in this study involves the completion of two online questionnaires on Qualtrics. Qualtrics is an online questionnaire building software licensed through the University of Auckland. One questionnaire will be completed at recruitment, and the other will be completed as a follow-up questionnaire after 30-days. Both questionnaires will ask questions relating to your intake of sugary products, your wellbeing, confidence to resist sugary products, and cravings for sugary products. The first questionnaire will also ask you for your demographic and contact details, which will be used to contact you to complete the follow-up questionnaire. The follow-up questionnaire will also include questions that ask you for feedback on the study. Participants are also expected to review their questionnaire results. All 200 participants who complete both the initial and follow-up questionnaire will be able to elect to enter the prize draw to win one of 10 $50 Countdown gift cards. Participants who do not complete the follow-up questionnaire within five days of receiving the link will be sent a reminder email and text. Overall, we estimate that the total time for completing both questionnaires and reviewing your results will be approximately 20 minutes.

Who can participate?

You can participate if you (a) are aged 18 years or older, (b) living in New Zealand, (c) are willing to provide contact details to complete the follow-up questionnaire 30 days after the initial questionnaire.
To participate, you will need to read and complete the electronic consent form. This form will be available after you are screened for eligibility for the study. To agree to the conditions of the study and thereby participate, you must check the appropriate electronic checkbox. Upon agreement, you will immediately be required to complete the initial questionnaire. If you do not wish to participate, there is also an option to so, which will result in the inability to continue onto the initial questionnaire.
Data storage and confidentiality

Data will be collected via Qualtrics software and stored in New Zealand. Your data will be encrypted, and you will be allocated a unique identifier. This means that your name or contact details will be stored separately to any other data you provide. Your consent to participate will also be stored separately from the research data and be accessible to only study researchers. Your identity will remain confidential outside of the study researchers, and any reporting will be done in a way that does not identify you as the source. Digital data from this study, along with your completed consent form will be stored on a protected location on the University of Auckland server. Your data will be stored indefinitely, and your consent form will be kept for a period of six years.

What are the possible risks and benefits of participating?

The questionnaires used in this study are based on strong research and have commonly been used to screen the various study measures in other studies. We will use the information from this study to identify whether providing personalised feedback is effective in helping people understand how much sugar they consume.
We do not anticipate any risks beyond usual day-to-day experiences. However, if you do experience any discomfort or distress from seeing your results, you can contact the study researchers using the contact details below or call Healthline on 0800 611 116. This service is free and confidential help that operates 24 hours a day, 7 days a week.

Right to withdraw from participation

Participation is entirely voluntary, and you can withdraw from the study at any time without giving a reason. Furthermore, you can withdraw yourself and any data you have provided for this study up until the 15th of October 2021. To withdraw, participants can email Dr Simone Rodda at s.rodda@auckland.ac.nz.

How can I find out the results of the research?

A summary of the findings of this study will be available on the Change Strategies website when they are available: https://www.changestrategies.ac.nz/ Participants can also opt in to be emailed a summary of these findings in the follow-up questionnaire. The results found using the data from this study will primarily be used for a masters' thesis; however, they but may also be used in future conferences and presentations.

Contact details

If you have any questions, concerns, or complaints or for further information about the study, please contact the Principal Investigator, Simone Rodda s.rodda@auckland.ac.nz, +64 9 923 6573. You can also contact the Head of Department, Social and Community Health: Dr David Newcombe, d.newcombe@auckland.ac.nz, 09-303 5932.
For any concerns regarding ethical issues, you may contact the Chair, the University of Auckland Human Participants Ethics Committee, at the University of Auckland Research Office, Private Bag 92019, Auckland 1142. Telephone 09 373-7599 ext. 83711. Email: humanethics@auckland.ac.nz. If you have any health concerns or experience any distress from this study, you can call Healthline for free advice and information at any time on 0800 611 116.

Approved by the University of Auckland Human Participants Ethics Committee on 21/07/21 for three years. Reference Number 22241.

MEDICAL AND HEALTH SCIENCES

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

To Urupare
Your Feedback

To kaute huka
Your Sugar Score

Your daily sugar intake is **35.2 teaspoons.** You estimated this to be 15 teaspoons.

In <u>New Zealand</u>, the average daily sugar intake is just over 14 teaspoons. For <u>females</u>, the average is just over 12 teaspoons per day. You estimated the New Zealand average to be 23 teaspoons, and the average for females to be 17.5 teaspoons.

In New Zealand, people in your <u>age group</u> have an average daily sugar intake of almost 18 teaspoons. You initially estimated your age group consumed 21.5 teaspoons per day.

According to the <u>World Health Organisation</u>, your sugar intake should not exceed 10% of your overall daily energy intake. For females, this means you should not have more than 6 teaspoons per day. You estimated this recommendation to be 7.5 teaspoons.

Additionally, the World Health Organisation also suggests you can receive greater health benefits if you limit daily sugar intake to just 5% of your daily energy intake, equivalent to 3 teaspoons for females.

To kaute hauora hinengaro
Your Mental Wellbeing Score

Your overall mental wellbeing is **40** out of 100.

A higher score means that you often wake up in the morning refreshed and excited to take on the day. It also means you can usually deal with the different types of challenges that come your way. Although we all have our bad days, the important thing is making sure we can get through them and that the number of good days outnumber the bad.

To huka māia kaute
Your Sugar Confidence Score

Your confidence to resist sugar is **43** out of 100.

A higher score indicates you believe in yourself and your ability to say no to sugary products across a range of different situations. Some people might find some situations to be more tempting than others. It may be that you believe in yourself when tempted by other people, but when in a bad mood or tired, maintaining self-control is much more difficult. Being able to stay confident in all these different situations is crucial to resisting sugary products in the long term.

To hiahia huka kaute
😝😝Your Sugar Craving Scores🫠🫠

Your sugar craving <u>strength</u> score is **50** out of 100.

A higher score indicates that your cravings are very intense or strong whenever you crave a sugary product. This means when cravings occur; you may become overwhelmed and struggle to think of anything other than the sugary product. This makes it extremely difficult to resist giving in to the temptation, which can be a barrier to long-term sugar reduction.

Your sugar craving <u>frequency</u> score is **58** out of 100.

A higher score indicates you experience cravings for sugary products very often over a given period of time. This means you have reoccurring thoughts about eating sweet treats, which can be tiresome and make giving into temptation more likely. As a result, high craving frequency may hinder your goals of reducing your sugary intake

Appendix D: Sugar reduction workbook – Example pages

Foreword

Kia ora, Malo e lelei, Talofa lava, Ki Orana, Fakatalofa atu, Fakalofa atu, Nisa bula vanaka, Malo ni.

Congratulations on starting the Change Strategies Project: Personalised Feedback and Sugar Consumption study. This workbook is a resource for making your plans and tracking your progress. With the right tools and right attitude we know you can do it.

This programme came about because many people told us that they wanted to reduce their sugar consumption but they gave up before reaching their goals. There are some useful steps that can be helpful:

- Turn the desire to reduce sugar into an action.
- Plan the action in detail to ensure it works well.
- Account for barriers and obstacles which can get on a way.
- Maintain motivation and patience along the way.

Our programme is the first of its kind in New Zealand and we are excited to share it with you.

The programme will help you to assess your reasons for change and set your goals, and then develop a plan to turn your goals into a reality. It will also help you to track how things have gone over 30 days.

If you need an advice or someone to talk to just drop us an email at changestrategies@auckland.ac.nz.

Nga mihi nui,

Simone Rodda
Dr Simone Rodda
FOUNDER OF THE CHANGE STRATEGIES PROJECT

Hiranya Khullar
Hiranya Khullar
MEMBER OF THE CHANGE STRATEGIES PROJECT

1. set your reasons

Working through your reasons to change can help with setting realistic and achievable goals. It can also strengthen your motivation when times get a bit tough. Make sure that your reasons are personal. A strong reason will feel emotional when you say it out loud.

✎ Write your reasons to change your sugar consumption here:

I have young children and I want them to grow up healthy. So I have to be a good example to them and cut down on my sugar. – Sefina

I just want to fit back into size 14. Since I started working in that cafe where we get free sweet treats I put on so much weight on. All my clothes are too small. – Judith

My wife has heart problems. They said she needs to lose weight. I want to support my wife so we both will go sugar-free so she can be healthier. – Tane

My mum and both my aunties have diabetes. I see them suffer so much, I don't want to get diabetes myself. My doctor said I have a high risk so I really need to watch my sugar intake. – Noelani

I went to a dentist and had 2 teeth pulled out and 7 teeth filled. That was so expensive! The dentist said it was all because I drink too many soft drinks. I don't want all my teeth to rot away. I need to do something. – Josh

2. choose your goal

Based on your reasons to change decide on a specific goal—how much sugar you are allowed to eat and on which occasions. The goal should be something you can achieve over the next 30 days.

how much sugar?

The World Health Organisation recommends no more than 6 teaspoons of sugar a day for women and 9 teaspoons of sugar a day for men.

This recommendation refers to 'free' sugar. Free sugar is all sugar added to foods by the manufacturer, cook, or consumer, plus sugars naturally present in honey, syrups, and fruit juices. It does not include naturally occurring sugar in fruits or vegetables (like kumara).

get things started

The first step in this programme is to turn your desire to cut down on sugar into a specific goal. Think carefully about where you want to be at the end of the 30-day programme. What level of sugar consumption would you be happy with?

recommended adult daily limits
sugar consumption

6 tsps

9 tsps

It can be tricky to know exactly how much sugar is in your food. This is because sugar is often hidden. Manufacturers will try to hide it by using different names like dextrose, corn syrup, maltose, nectar and agave.

Sometimes we just don't realise that some foods have lots of sugar. For example, a glass of orange juice has the equivalent of 5 teaspoons of sugar.

sugar content in common New Zealand foods*

How many teaspoons of sugar are found in some common food and drinks?

A bottle of energy drink

A bottle of sports drink

A can of fizzy drink

A cupcake with frosting

A container of sweetened yoghurt with fruit jam

A bottle of fruit smoothie

A slice of red velvet cake

Six pieces of chocolate covered marshmallow

A carton of liquid breakfast

A small can of baked beans

*Image sourced from the Royal Society of NZ

DAY 1	DAY 2	DAY 3	DAY 4	DAY 5
DAY 6	DAY 7	DAY 8	DAY 9	DAY 10
DAY 11	DAY 12	DAY 13	DAY 14	DAY 15
DAY 16	DAY 17	DAY 18	DAY 19	DAY 20
DAY 21	DAY 22	DAY 23	DAY 24	DAY 25
DAY 26	DAY 27	DAY 28	DAY 29	DAY 30

summarise your goals

Decide how much sugar you will have over the next 30 days and when you will have it. Use the chart on the previous page, and write the number of teaspoons you are allowed on each day in the calendar. Think of any special occasions or regular events like Sunday church lunch. We recommend that you start by focussing on reducing the obvious sugars - like those you can see on the chart.

Summarise your goals to reinforce your commitment:

Appendix E: Sugar reduction guidelines – Example pages

avoid sugars, places and events

Some sugary products can cause a loss of control in some people. Knowing your danger sugars is a key to avoiding them. Loss of control is also associated with specific people, places and situations.

What is it?

Avoidance can be of either certain trigger sugars as well as specific places or events. For some people avoidance of sugars, or a 'cold turkey' approach, is preferred because they would rather dive right in and get rid of it altogether.

how do I do this?

Avoid trigger sugars.

These are sugars that can cause loss of control or an inability to stop once started. Think about what your trigger sugars are. Are any of the following triggers?

- Sugary foods like soft drinks, snack bars, chocolate, deserts and sweets. This also includes adding sugar to foods like tea or coffee.

- Natural sugars with concentrated sugars such as honey, juice, dried fruit, maple syrup.

- Hidden sugars found in pre-packaged or processed foods (e.g., tomato sauce, salad dressing, stir fry sauces). To identify hidden sugars read the nutrition facts looking at the grams of sugar per serve.

- Reading labels will tell you whether a food is low in sugar (less than 2 grams per 100 grams) or high in sugar (>15 grams per 100 grams). All juices and sugar sweetened soft drinks are considered high in sugar.

- Artificial sweeteners include Splenda, aspartame and stevia. Although sweeteners contain no calories, research has found the sweetness can lead to cravings for other sugars.

- Simple carbs like white bread, rice and pasta because they are quickly converted into glucose in the body. This can make you crave more sugar.

Some people find it helpful to start off with avoiding obvious types of products high in sugar. Then when confident and comfortable with their approach can move on to eliminate other sources of sugar.

For example, start out avoiding sugars like soft drinks, juice, ice cream and pastries. Later on try avoiding less obvious sources of hidden sugars including pre-packaged foods.

Avoid hotspots.

This refers to those places, situations, and events that have involved excess sugar consumption for you in the past. When reducing sugar, it can be a good idea to leave some of your old habits behind.

- Avoid specific places. Some places are purposely created to subtly encourage excess sugar consumption. For instance, fast food restaurants often encourage you to upsize for a small cost or to get a value meal that includes a sugar sweetened drink. Other places may be those that are triggers for you, such as your favourite ice-cream or pastry shop, or the chocolate aisle at the supermarket. If you have a place that is better avoided, try taking a different route on your way home. If you find yourself in a trigger place leave immediately.

- Avoid specific events. You do not have to attend every celebration or event with your whanau and friends. It is ok to be selective. It is helpful to avoid events that will make it difficult to stick to goals. For example, if your friend invites you to go to a French market with lots of tempting sugary foods, suggest going to an equally fun place with more healthy options, such as a café – after all, it is more about socialising than eating.

- Avoid specific situations. If you are invited to a birthday party let the host know ahead of time that you will not be eating the cake and moving as far as possible from the cake when it is handed out. By doing this you will avoid a difficult and potentially embarrassing situation of explaining to everyone why you are refusing the cake and will you need less willpower at the time to refuse the cake.

Take some time off all sugars.

You do not have to reduce sugar forever. Take some time off instead and give your body and mind a break. You can decide how long you want the break to be. It can be as short as a week or as long as a year.

- This approach is similar to cold turkey. It means you will abruptly stop sugar for a period of time. To do this, consider the likelihood of experiencing withdrawal symptoms and plan for these. Check out the withdrawal guideline for more information.

- To support cold turkey, some people find it helpful to join a community or a challenge. For example, Feb Fast challenge participants go without any sugar for a month. Anyone can join these sugar fasts and there is no cost. This approach can be helpful to get through the first month of abstinence. After that time your taste buds and body will most likely have adapted to not having sugar.

- Cold turkey may be associated with giving up on your plan to reduce or give up sugar. This is because of feeling deprived or like you are missing out. To manage this issue within an abstinence approach, aim for 95% compliance. This allows for a rare treat or slip up and means you are still on track to reach your goals.

avoid sugars, places and events CONT.

why do this?

Avoidance is a popular approach for managing addictive behaviours. For some people they find when they start eating sugar they cannot stop. Having sugar even a few times a week may trigger an addictive like response for some people which makes them want more.

maintaining this strategy

Maintaining avoidance requires a particular mind-set. This mind-set is that you definitely will not have sugar (or a specific type of sugar). It means that you don't engage in arguments or discussions with yourself or others about 'will I – won't I'. You are firm and just don't. There might be a few difficult situations that come up but these can usually be managed.

- Keep an eye out for other people giving you sugar. Decide not to let anyone add sugar to your drinks or meals except for you.

- People will try to give you sugar and may even pressure you to have it. To mitigate this, immediately decline. Every time there is an opportunity, practice saying with confidence "thanks but no thanks". Before going to events or places where there might be sugar imagine yourself refusing the slice of cake. Imagine the feeling of being proud and developing confidence. Imagine yourself being strong and healthy.

- If people still try to give you sugar tell them you cannot have it. Generally, it is good to be truthful and honest but when under social pressure it may be ok to provide an excuse / or tell a white lie. This could be that you are full and couldn't eat another bite, that you are going on holidays and need to fit into your clothes or you could say that you are worried about diabetes. Be strong about the reason.
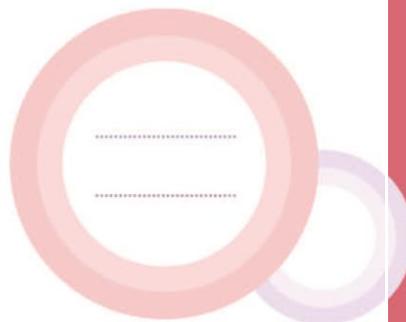
✍ map your hotspots

To maintain this strategy it is a good idea to know your hotspots.

Using the map below, write in your top sugars, events or places that you want to stay away from. Make a list of the hotspots and keep it on your phone. Remind yourself that these are sugars, places or events that you have decided not to go near for the next 30 days. Once you have made the map, pick the most important hotspot and focus on it for the next 30 days.

YOU

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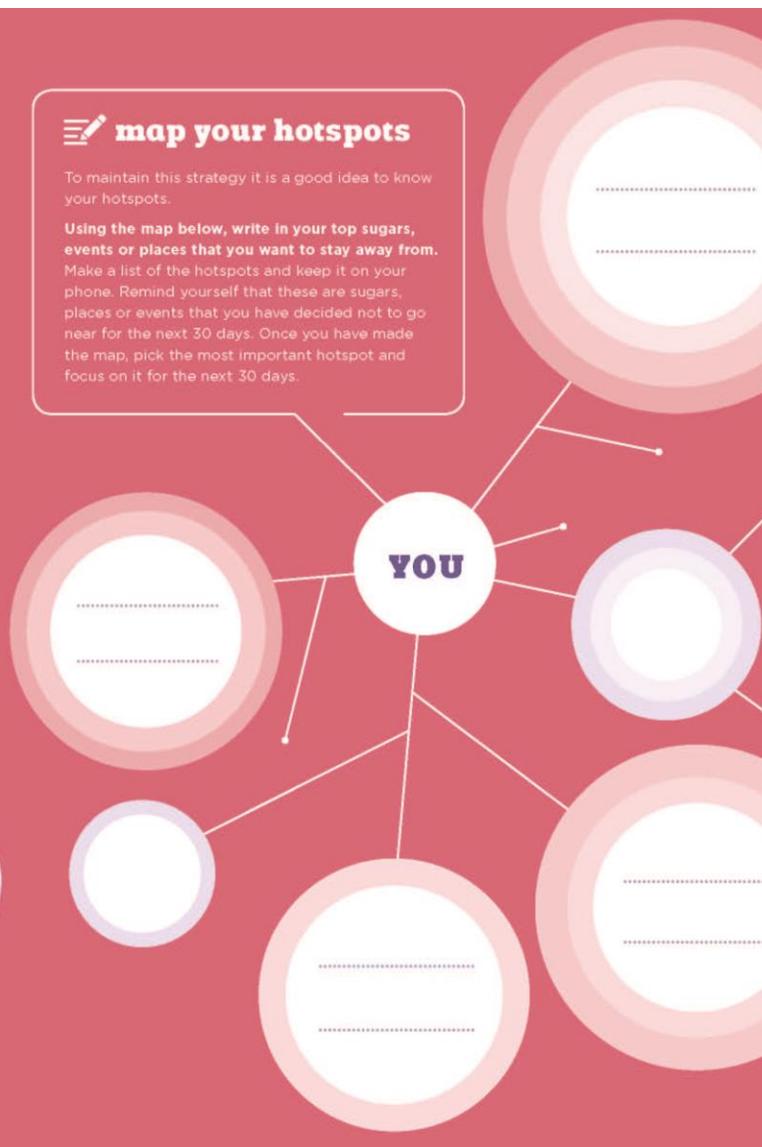
MEDICAL AND HEALTH SCIENCES

To Hua
Your Results

To kaute huka
🍩 🍩 Your Sugar Score 🍩 🍩

Your daily sugar intake is **14.6 teaspoons.**

To kaute hauora hinengaro
😃 😃 Your Mental Wellbeing Score 😳 😳

Your overall mental wellbeing is **20** out of 100**.**

To huka māia kaute
👍 👍 Your Sugar Confidence Score ✌️ ✌️

Your confidence to resist sugar is **34** out of 100.

To hiahia huka kaute
😋 😋 Your Sugar Craving Scores 🤤 🤤

Your sugar craving <u>strength</u> score is **76** out of 100.

Your sugar craving <u>frequency</u> score is **28** out of 100.