What are the risk factors and preventative strategies for cardiovascular disease among people from South Asia (SA) living in the Western world? An Integrative Review.

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Abstract

BACKGROUND: Cardiovascular disease is a leading cause of death worldwide; however, some population groups are more at risk. In New Zealand, this includes those who identify as Māori, Pacifica and South Asian. Little is understood about why the South Asian population is at risk; this lack of understanding, combined with a rapidly growing population, makes South Asians a critical group to understand and to plan interventions for that will mediate risk. **METHOD**: An integrative review enabled a blending of qualitative and quantitative literature to answer the research question. Data were collected between September 2021 and December 2021 using CINAHL, EBSCO and MEDLINE databases. After screening using PRISMA, ten articles met the inclusion criteria and were scanned for quality. Braun and Clarke's thematic analysis was used to identify codes and themes. **RESULTS**: Four themes were identified: Theme one found that the two major risk factors that place South Asians at risk for CVD are elevated BMI and diabetes. This theme also explores reasons for this phenomenon. The second theme highlights the need for a detailed algorithm explicitly highlighting the risks for SA. Theme three identified that the most preventative strategies were physical activity and cardiovascular protective medication. Increasing health literacy was the fourth theme needed to decrease cardiovascular risk. **CONCLUSION**: Targeted education is needed to increase health literacy for the South Asian population, particularly around the inter-relationships between obesity and diabetes and their significant contribution to cardiovascular disease. Application of risk assessment tools and targeted education are needed to help health professionals identify cardiovascular risk profiles early for South Asians so they can commence preventative strategies, including increasing physical exercise and early initiation of medications.

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Attestation of Authorship

Veena Ayiliath Valhothil, a student of AUT, is writing to attest that this dissertation is a piece of personal work, except the use of reference is acknowledged. By signing below, a declaration that all the above information is accurate and correct.

Signature Dated: 15/04/23

List of Abbreviations Table 1

AMI	Acute Myocardial Infarction
ACR	Albumin Creatine ratio
ADA	American Diabetes Association
ACR	Albumin Creatinine Ratio
BMI	Body Mass Index
BIA	Body fat from bioelectric impedance analysis
CRP	C-Reactive protein
CVD	Cardiovascular disease
CAC	Coronary Artery Calcification
CQ	Control quotient
CHD	Coronary Heart Disease
CAD	Coronary Artery Disease
CLD	Coronary Luminal Disease
eGFR	Estimated Glomerular Filtration Rate
ECG	Electrocardiogram
ETT	Exercise Tolerance Test
ECHO	Echocardiogram
EASD	European Association for the study of diabetes.
FTO	Fat, Mass, and Obesity-associated gene.
GWAS	Genome-Wide Association Studies
GTT	Glucose Tolerance Test
GS	Gene Scores
HRI	Heart Research Institute
JBS2	Joint British Societies 2
IHD	Ischemic Heart Disease
IQR	Inter Quadrantile Range
LTS	Log of the sum of triceps and subscapular skinfold thickness
LP(a)	Lipoprotein (a)
MOH	Ministry of Health
mIR	Micro RNA
Mets	Metabolic Syndrome.
MASALA	Mediators of Atherosclerosis in SA living in America
NCD	Non-communicable disease
NSTEMI	Non-ST segment elevation myocardial infarction

NZ	New Zealand
NHS	National Health Services
QRISK	Q Research Risk scores
ROS	Receptive oxygen species
SNP	Single Nucleotide Polymorphism
STEMI	ST-segment elevation Myocardial Infarction
SA	South Asian
T2DM	Type 2 Diabetes Mellitus
WC	Waist Circumference
WHtR	Waist-height ratio
WHR	Waist-hip ratio
WHO	World Health Organization
UK	United Kingdom
UKADS	United Kingdom Asian Diabetes Study

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Chapter 1 Introduction

This chapter overviews the prevalence of cardiovascular disease globally and within a New Zealand context. Statistics illustrate the South Asian community's growth in New Zealand, emphasising the risk South Asians have for experiencing cardiovascular disease. The PREDICT tool is an important New Zealand Cardiovascular risk assessment tool that acknowledges high-risk populations such as the South Asian population; however, even though the PREDICT tool acknowledges South Asians as being high-risk, there is a mismatch in knowledge and understanding around this. The research question, along with the research aims and significance are explored along with an overview of the chapter highlights.

Background

Cardiovascular disease (CVD) is one of the leading causes of mortality worldwide (WHO, 2021). Annually 17.9 million lives are lost, which equates to 32% of deaths globally- of these, 85% are due to heart attack and stroke (WHO,2021). The average crude presence of CVD worldwide in 2020 was 485 million cases (Virani et al., 2020).

These results extend to New Zealand, where it predicts that 132.4 per 100,000 of the population (MOH,2018) will die because of CVD, with specific population groups experiencing increased risk, for example, Māori, Pacific, and South Asians (WHO, 2021). Māori, Pacifica, and South Asians have a 13-48% higher risk of CVD than their European counterparts (Wells et al., 2017). Men also have a higher chance of developing CVD. The PREDICT 5-year CVD risk analysis shows that men have a 3.2% increased chance, whilst women have a 2.3% chance (Pylypchuk et al., 2018). In New Zealand, women are at a high risk of dying from cardiovascular disease, a risk five times greater than cancer (Pearce & Longhurst, 2021).

The health sector in New Zealand incurs costs proportional to the CVD rate. Daily, between $2500 and $3000 NZ are spent per patient in Coronary Care Units (WDHB Statistics, 2019-20). The typical length of stay for patients without complications for a Non-ST Elevated Myocardial infarction (NSTEMI) is two days, and for patients with an ST elevated myocardial infarction (STEMI), being three days (WDHB statistics, 2019-20). In 2020-2021, the Ministry of Health contributed approximately $20.27 billion to CVD care, while stroke treatment expenditures amounted to $1.1 billion (WDHB statistics, 2019-20).

The South Asian population.

According to the 2018 New Zealand census, six ethnic hierarchical classifications exist consisting of European (70.2%), Māori (16.5%), Asian (15.1%), Pacifica (8.1%), Middle Eastern/Latin American/African (1.5%) and (1.2%) 'other' (Stats NZ, 2018 a). From these above statistics, the Asian population is the third most populous group in New Zealand, with migration being the most significant contributor to this sustained growth (Stats NZ, 2022).

The Asian population is increasing substantially, rising from 9.2% in 2006 to 15.1% in 2018. By 2043, the Asian population is expected to reach 26%, a 10% increase from 2018 (Stats NZ, 2021). People from Asia have many reasons for migrating from their native country, including economic or the search for a better quality of life (World Economic Outlook, 2017), push and pull factors may include obtaining a better education or may be influenced by social media which show how comfortable living conditions are (Castelli, 2018). Other reasons may be sexual freedom, especially in countries that do not tolerate same-sex relationships or political instability in the country of origin that may make life more difficult (Castelli, 2018).

The SAARC (South Asian Association for Regional Co-operation) was founded in 1985 represents countries considered as the South Asian population includes Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka (SAARC, 2022). But in recent times a broad definition of what classifies as belonging to the South Asian (SA) population refers to individuals located in the southern region of the Asian continent. This broad definition covers vast geographical locations and can be subdivided into two further subgroups; 1) South Asian not further defined, which includes those who identify as Filipino, Cambodian, Vietnamese, Burmese, Indonesian, Lao Malay, Thai, Karen, and Chin. And 2) South Asian not elsewhere classified, which includes multiple subdivisions: A) Chinese not further defined, comprising populations from Singapore, Hongkong, Cambodia, Malaysia, Vietnamese Chinese, and Taiwanese. B) Indian not further defined includes Bengali, Punjabi, Sikhs, Anglo Indian, Indian Tamil, Fiji Indian, Malaysian Indian, and South African Indian. C) Indian not elsewhere classified. D) Sri Lankan not further defined includes Sinhalese, Sri Lankan Tamil. E) Sri Lankan not elsewhere classified. F) Japanese, Korean, Afghani, Bangladeshi, Nepalese, Tibetan, Pakistani, Bhutanese, Maldivian, Mongolian, Eurasian, and G) Asian not elsewhere classified (Stats NZ, 2018 a).

Statistics New Zealand developed these ethnicity-based classifications that would reflect how the people of New Zealand identified themselves, irrespective of citizenship (Stats NZ, 2019). This ethnicity classification enables an understanding of specific ethnic subgroups

within diverse populations and facilitates healthcare innovation, including adopting novel approaches to address healthcare workforce shortages (Rao et al., 2015). This understanding helps improve equitable health outcomes covering rural and primary care settings (Mc Beth, 2022).

A tool that has been instrumental in achieving equitable outcomes in identifying CVD risk is the PREDICT tool. This tool is a web-based CVD risk assessment initiative established in 2002 in New Zealand, which gathered data on modifiable and non-modifiable risk factors in response to statistics from 475,241 adults (175,283 women and 225,445 men) in primary care (MOH, 2018). The PREDICT tool identified that ethnic groups such as Māori, Pacifica, and South Asians are at a higher risk of CVD than other ethnicities (Wells et al., 2017). Most New Zealand data that informs practice comes from the PREDICT study, which reflects New Zealand's unique cultural makeup. In this study, Ethnicity was self-reported and prioritised groups were formed in order: Māori, Pacific, Indian (including Fijian Indian), Other Asian (including Chinese), European, Middle Eastern/Latin American/African (MELAA), other and unknown (Ahmad et al., 2001). This study identified Indians (90% of South Asians in New Zealand) at high risk (Selak et al., 2020).

From the data collected, it showed that although ischemic heart disease (IHD) mortality rates are highest in Māori and Pacific people, intermediate in Indians and lowest in Europeans and other Asians, IHD hospitalisation rates among females and males who identify as Indian are the highest (Grey et al., 2018).

Other significant findings were that although Pacific people have the highest rates of obesity together with Indian people, both groups have the highest prevalence of diabetes (Selaks et la 2020). Diabetes was most common for Pacific people (38% women, 23% men), followed closely by those who identify as Indian (33% women, 24% men), and elevated for Māori (23% women, 18% men) and Other Asian people (21% women, 15% men) compared to European people (12% women, 9% men) (Selaks et la 2020). Indian men have the highest rate of previous coronary heart disease of all ethnic groups, among men, mean TC: HDL was also highest among Māori (4.5), as well as Indian people (4.5) (Selaks et al., 2020).

Based on the data, PREDICT recommends that CVD monitoring starts early for Māori, Pacifica and SA, starting from 30 years among SA men and 40 years among SA women. There is a need to initiate an intensive CVD management plan (Wells, 2018). This data has enabled government health authorities to initiate healthy well-being initiatives and reduce risk factors in the SA population.

Research Significance

The health sector and government agencies must prioritise the SA population by initiating effective preventative strategies using ethnic-specific algorithm tools to help identify and prevent risk factors leading to CVD (Stats NZ, 2018b). To try and raise awareness around SA CVD risk, appropriate training in the use of the PREDICT assessment tool is needed; even with training around the use of the tool, uptake of users only increased from 3% to 11% over one year (Wells et al., 2017). There needs to be more information on whether this healthcare knowledge and tool use has improved over time. This lack of understanding, combined with an increasing SA population growth in New Zealand, means the health sector and the government must prioritise the SA population by initiating effective preventative strategies (Wells et al., 2017). Awareness is needed to understand the habits and knowledge that will promote health changes within high-risk communities (Akhtar et al., 2022).

Although government agencies focus resources on Māori and Pacifica health, the SA population is often overlooked and not understood by all health professionals (Wells et al., 2017). This integrative review aims to raise awareness of the risks SA face concerning CVD by identifying the most significant risk factors and what specific target initiatives to prevent risk factors will benefit the SA population. This information could help design an even more effective risk assessment tool and develop education and interventions that can specifically target SA and help to reduce CVD risk in SA who have migrated to Western countries (Tobias, 2016). It is essential to continue prioritising CVD risk, especially as many risks are modifiable through prevention and treatment (MOH, 2016).

Research questions

What are the most significant risk factors for cardiovascular disease among people from South Asian (SA) population living in the Western world?

What preventative strategies need emphasis to prevent CVD in the SA population living in the Western world?

Aim of the Study

This study aims to understand the main risk factors for the SA community living in Western countries that place them at a higher risk of developing CVD. This research also explores the relationship between CVD risk factors and preventative strategies.

Chapter overview

Chapter 1 Introduction

The introduction chapter has highlighted the extent to which cardiovascular disease impacts health globally and in New Zealand. Cardiovascular disease is rising and has financial implications for New Zealand's economy. The PREDICT tool has been instrumental in predicting people's five-year risk of developing heart disease and has highlighted populations at particular risk, mainly Māori, Pacific and South Asians. The South Asian population statistics in New Zealand emphasise the impact of an increasing population and CVD prevalence. This chapter has pointed out the need for the SA population to have a specific focus on CVD risk as outlined in the CV guidelines 2018; it is less understood why it is not more widely acknowledged so preventative programmes could better target the SA population.

Chapter 2 Literature review

The literature review section of this thesis describes the pathophysiology of cardiovascular disease and the complications that result from having CVD. The risk factors contributing to CVD are details emphasising why South Asians are at particular risk. This chapter also explores some novel reasons why South Asians are at a significantly increased CVD risk and detail treatment options and the current need to understand and work together as healthcare professionals to help reduce the statistics of cardiovascular disease in the South Asian population.

Chapter 3 Methods overview

Chapter 3 gives an overview of the integrative review methodology used. The chapter begins by discussing the philosophical worldview underpinning the research. Then it details the theory behind doing an integrative review outlined by Whittemore & Knafl and why this approach suits the topic. The five phases of the integrative review include 1) preparing the guiding question. 2) The literature search (including a PRISMA chart and a table outlining the inclusion and exclusion criteria). 3) data extraction and reduction (including a data extraction spreadsheet and data evaluation using the MMAT quality tool). 4) Data analysis outlines how the data was analysed using Braun & Clarke's thematic analysis, and finally, 5) The discussion and conclusion.

Chapter 4 Findings overview

This chapter outlines the ten articles in the integrative review detailing each study's country or origin and research methodology. The findings were synthesised into four main themes: major risk factors and preventative strategies. Major risk factors identified include increased BMI that leads to Type 2 diabetes and metabolic syndrome and lack of standardised assessment tools that acknowledge SA's high risk. Major preventative strategies include initiating early identification and comprehensive sustainable measures to curtail the CVD risk factors among the SA population, primarily physical activity, and initiating early medication therapy to delay the onset of CVD. Finally, promoting health literacy among the SA population significantly created healthy change.

Chapter 5 Discussion overview

This chapter includes an overall discussion of the main themes and discusses the strengths, limitations and concludes by making recommendations for future research.

Chapter 2 Literature review

Cardiovascular disease is the terminology used to describe the disease process that affects the heart and blood vessels (McCance & Huether, 2018). This chapter explores the pathophysiology of CVD, defines coronary artery disease (CAD), and describes many of the most common modifiable risk factors that contribute toward CVD and CAD, specifically regarding the South Asian population. Social and cultural factors, management, and health strategies help reduce CVD for at-risk populations.

2.1 CVD- its Significance.

Cardiovascular disease is a broad term encompassing many arterial diseases, including hypertension, aneurysm, embolism, peripheral vascular disease, and coronary heart disease (McCance & Huether, 2018). Atherosclerosis is a disease process that significantly contributes to cardiovascular disease and is caused by a build-up of fatty cholesterol deposits in the arteries (NIHCE, 2014). Atherosclerosis can result in numerous ischemic syndromes ranging from mild to severe and is the leading cause of CAD and cerebrovascular disease (McCance & Huether, 2018). 9.6 million people died from CVD in 2019, approximately one-third of all deaths worldwide (Roth et al., 2020). The number of deaths due to cardiac complications was estimated at 17.8 million (Peiris et al., 2021). Of these deaths, 32% were due to coronary artery disease (CAD), stroke, high blood pressure, and heart failure (Roth et al., 2020). CVD incidence has increased over time, with the total number of CVD cases doubling from 271 million in 1990 to 523 million in 2019 (Roth et al., 2020). Unless effective decisions to manage risk factors for CVD are adhered to, the United Nations (UN) estimates that there will be 7.8 million premature CVD deaths by 2025 (Sacco et al., 2016).

Coronary arterial disease or ischaemic heart disease is the most common type of CVD and has the most severe consequences leading to death (Bailey, 2019). In a large study, New Zealand had the highest age-standardised MI events across four countries, including New South Wales (NSW), Australia, Ontario, Canada, and the UK (Camacho et al., 2022). However, the rates of experiencing a Myocardial Infarction (MI) are declining in New Zealand; statistics show that 893 per 100,000 men died in 2002 compared to 536 per 100,000 men in 2015. Among NZ women, 482 per 100,000 died in 2002 compared to only 271 women in 2015 (Camacho et al., 2022). This mortality decrease is due to pharmacotherapy and lifestyle changes (Sigamani & Gupta,2022).

2.2 Pathophysiology of coronary artery disease

The cardiovascular system is a closed tubular system composed of the heart and blood vessels that transport blood throughout the body (Buckley, 2019). This system is vital to life, transporting nutrients, oxygen, hormones, and other substances to body tissues and removing waste products during cellular metabolism (McChance & Cunningham, 2019).

Three types of blood vessels responsible for this transport process are the capillaries, veins, and arteries (Buckley, 2019), of which the arteries play a crucial role in many vascular diseases (Sealock, 2019). The innermost layer - the endothelium must be healthy for the vascular, immune, and haemostatic systems to function appropriately (Ratliff, 2019).

Atherosclerosis is primarily responsible for CAD. In atherosclerosis, lipid deposits accumulate within the intima of the endothelium in the artery (Graham, 2019). Three circulating lipoproteins exist to transport lipids in the bloodstream. The three focused on the most are high-density lipoprotein (HDL), otherwise called "good" cholesterol, low-density lipoprotein (LDL), otherwise called 'bad' cholesterol and very-low-density lipoprotein (VLDL). Lipoproteins help transport lipids, and the ratio of cholesterol, triglycerides and other lipids reveals their chemical structure. The lesser the lipoprotein component, the more difficult it is for the cells to recognise and bind to the protein receptors to enable normal cellular function in the body (Feingold, 2021). Circulating lipoproteins that contain more lipids and fewer protein components cause plaque development within arteries, damaging the vascular walls and leading to plaque-producing atherosclerosis (Ambrose & Singh, 2015; Nukala et al., 2019).

Once the endothelial cell wall is damaged, LDL and VLDL get embedded in the artery walls. The damaged endothelium gets oxidised with the circulation of monocytes, cytokines, and leukocytes, which initiate the inflammatory process. The regular thrombolytic action within the endothelial cells created by releasing thrombolytic compounds is affected due to plaque formation (Babey & Manias, 2013). Over time, the plaque becomes stiffer and tortuous and contains calcium deposits over the smooth muscle layer. Consequently, the inner diameter of the artery reduces, leading to ischemia or a reduction in blood supply to vital organs. For example, angina pectoris results from a reduced blood supply to the heart muscle (Graham, 2019). In the artery wall, plaque accumulation interferes with the balance between vasoconstriction and vasodilation (Biswas & Gausal, 2020). A discrepancy in vascular tone results in increased arterial pressure, which can lead to microtears (Lieberman et al., 2021).

2.3 Complications of coronary artery disease

Coronary artery disease is the earliest lesion in a continuum of events that may advance to myocardial ischemia and acute coronary syndromes (McCance & Huether, 2018). Acute coronary syndrome (ACS) is an umbrella term for myocardial infarction (MI). ACS includes unstable angina, a non-ST-segment elevation MI (NSTEMI), or an ST-segment elevation MI (STEMI) due to a ruptured plaque or spasm in an artery, or an occlusion of the coronary arteries, however when the coronary arteries are entirely occluded, myocardial cell death occurs (Smit et al., 2020). ACS can cause myocardial rupture, papillary muscle rupture, cardiogenic shock (Schoen, 2015), and dysrhythmias (Zelman et al., 2011). As a result of myocardial cell death, the ability of the heart to pump effectively and transmit electrical impulses becomes impaired, resulting in arrhythmias such as fibrillation, re-entry tachycardia, ventricular arrhythmias, and further myocardial infarctions (Schoen, 2015). In 10-15 per cent of patients with ACS who present with hypotension, dysrhythmia, and cardiogenic shock, immediate revascularisation of the affected coronary artery is essential to prevent deterioration (WDHB, 2019-2020).

Other complications may result from arterial disease; for example, experiencing a stroke. A stroke occurs when a haemorrhage in the brain results in the death of brain cells or ischaemia in a part of the brain (Lewis et al., 2016). Stroke is the second leading cause of death worldwide (Avan et al., 2019). Socioeconomic status correlates strongly with stroke incidence and mortality. The global burden of diseases and risk factors study showed that the overall age-standardised incidence of stroke statistics has declined by 11.3%, the prevalence rate increased by 3.1% and the overall decrease in mortality rate to 33.4% (Dicker et al., 2017). In wealthier countries compared to low-income countries, stroke death rates have fallen by 25% (Virani et al., 2020). The disparity in the reduction of stroke deaths in wealthier countries is due to the management of modifiable risk factors (Virani et al., 2020), such as smoking, obesity, hypertension, Type 2 Diabetes Mellitus (T2DM) and excessive alcohol intake (Dicker et al., 2017). Therefore, the migration of various populations from low-income countries means they may not have the same awareness and access to management strategies as the host country, which is a concern.

2.4 Treatment

If severely affected by CAD, one of the cardiology interventions, angiography, may be used to re-vascularise the heart muscle in patients with ACS via the trans-radial approach (Bhat et al., 2017). The prognosis after a myocardial infarction has been promising, with early revascularisation showing a significant delay in myocardial death, enhancing prognosis

(WDHB, 2019-2020). Schoen (2015) states that the mortality rate after MI is 30% and increases by 3% to 4% every year a person lives. The mortality percentage has been reduced considerably due to heightened efforts to prevent secondary re-infarctions by including medications like aspirin (Mehran et al., 2019) and ticagrelor (Med Safe-Brillinta, 2019). Other necessary medications have helped prevent re-infarctions, such as angiotensin-converting enzyme inhibitors (ACE), which prevent heart remodelling, and beta-blockers, to prevent arrhythmias. Introducing nitrates helps avoid episodes of vasospasm and introduces statins to control cholesterol levels (Cestari et al., 2019).

2.5 Cardiovascular Risk factors

Risk factors for CVD include those that can be modified (Yusuf et al., 2020) and those that cannot be modified (Mohammednezhad et al., 2016). It is possible to modify a variety of behavioural factors, including cigarette smoking (Yusuf et al., 2020), sedentary lifestyles and high blood sugar levels (Raza et al., 2019), high cholesterol levels (Yusuf et al., 2020), high blood pressure (Mehta et al., 2018), stress, increased body weight, and metabolic syndrome (Mohammednezhad et al., 2016). However, there are several non-modifiable causes of coronary heart disease, such as age, gender, and genetics (Virani et al., 2020), and factors such as ethnicity and family history (Mohammednezhad et al., 2016). Modifiable risk factors contribute to 90% of the risk of MI observed worldwide (Mohammednezhad et al., 2016; Yusuf et al., 2020). It is possible to prevent approximately 25% of premature CVD deaths worldwide through a comprehensive effort to control, target, and reduce the effects of CVD risk factors (Roth et al., 2020).

2.2 Modifiable risk factors

2.2.1 Smoking

Smoking is the second largest cause of mortality and was responsible for about 8.1 billion deaths globally in 2017 (Verbeek et al., 2021). Smoking causes an alteration in the release of catecholamine in the blood, which causes an increase in free fatty acids in the bloodstream. As a result of excess fatty acids, bad cholesterol, and LDL levels in the bloodstream increase, while HDL remains low (Campbell et al., 2008).

Smoking is a modifiable risk factor contributing to CVD; fortunately, due to public health initiatives, smoking rates are trending downward. According to the 2018 New Zealand census report, 10.6% of the Asian population were regular smokers in 2003, and this tapered down to 6.7% by 2018 (Stats NZ, 2018). As of 2018, the smoking rate among the European population in 2003 was 17.5% and has decreased considerably to 10% by 2018. The PREDICT study found that most regular smokers live in the Auckland region. Smoking

was lowest within the Indian population, with approximately 10% of Indian men who smoke and only 1% of Indian women smoking compared to Māori, where 39 % of women and 35% of men smoke (Selak et al.,2020).JUUL -E cigarette causes changes to the platelet activation process and affects the bleeding times and haemostasis process thus increasing the risk of developing thrombotic events thus increasing risk of CVD related issues (Ramirez et al.,2020). Given the trend towards vaping which is replacing smoking has its own disadvantages and is not understood very clearly and the need for further studies needed to be done to understand vaping induced pathogenesis (Echeagaray et al.,2022).

2.2.3 Physical activity.

Physical activity is an effective measure to prevent CAD. Physical exercise reduces blood pressure and LDL levels in the blood without affecting triglyceride and HDL levels and is instrumental in maintaining a healthy weight and lowering the risk of acquiring Type 2 diabetes mellitus (T2DM (Bourdier et al., 2020). The more physically active an individual is, the better the balance of energy levels accumulated and expelled from the body. Physical activity plays a role in preventing fat accumulation in adipose tissue (Bourdier et al., 2020).

According to the Heart American Disease and Stroke Statistics, self-reported physical inactivity has increased significantly, from 26% of the population classified as inactive in 2005 to 40% in 2017 (Virani et al., 2020). Sedentary behaviour at work and lack of active leisure time contribute to this drop-in physical activity, along with passive modes of transportation (WHO, 2022). Other factors may contribute to this decline in physical activity. Barriers experienced by the general population in performing regular exercise include difficulty walking, hearing, seeing, cognition, self-care, and communication (Stats NZ, 2018 a). People with depressive symptoms are less likely to engage in physical activity and more likely to develop cardiovascular disease (Ludwig et al., 2018).

The Sports recreation and physical activity survey (2007/08) revealed that 79% of New Zealanders are involved in one sports event weekly, and 48% participate in moderate physical activity. Overall statistics also show gender differences, with 50% of men and 29% of women in New Zealand are physically active (Sports recreation and physical activity 2007/08).There is a disparity in physical activity participation across different ethnicities in New Zealand, with 75% of the European and 54% of the Pacific populations engaged in an active lifestyle, both of which are higher than 45% estimated for SA that are involved in sports (Urquhart et al., 2021).

Those residing in lower-income countries are more physically active than high-income countries, where just under 17% of the population leads an inactive lifestyle. In high-income

countries like New Zealand, 34% of the population is inactive (Shridhar et al., 2014). The level of physical activity among the SA youth population in Western countries tends to be less vigorous than those 60 years and older living in SA countries, where adults lead a more energetic day-to-day lifestyle (Shridhar et al., 2014). Moore & Shah (2020) found that SA's self-perception towards physical activity meant there was a lack of motivation and less importance given to this element which places them at risk of gaining weight. The reasons for such a high percentage of inactivity in developed countries due to easy access to daily life comforts, for example, less use of public transport, so walking to catch a bus to get to work, time spent on outdoor activities is less due to digital gadgets and watching television (Shridhar et al., 2014). Physical activity should take precedence over blaming poor diet, genetics, socioeconomic differences, and cultural variations in eating habits (Bourdier et al., 2020).

2.2.4 Hypertension

High blood pressure or hypertension is defined when the systolic blood pressure exceeds 20mmHg from the normal range of less than or equal to 130mmHg, and the diastolic blood pressure exceeds 10mmHg from the average target equal to or less than 80mmHg, high blood pressure plays a significant risk of developing cardiovascular disease (Daskalopoulou et al., 2018). The pathogenesis is due to damage to the endothelial lining in the vascular system, resulting in trauma to the vasculature of the artery wall. This trauma causes friction in the pressure within the artery leading to increased blood pressure to help circulate the blood to all vital organs within the body (Sealock, 2019). The global prevalence of hypertension was 26% in 2000, estimated to reach 29% by 2025 (Lim et al., 2012). Factors attributed to the increase in the prevalence of hypertension include population growth, the ageing population and behavioural risk factors such as being overweight or obese, low physical activity, smoking, poor diet, and harmful use of alcohol (WHO, 2013).

A Bangladesh study shows that less involvement in physical activity leads to increased abdominal circumference, which placed this subgroup SA population at risk of developing hypertension compared to the other SA populations who develop hypertension at later stages of their life (Islam et al., 2018). The recommendation is to start antihypertensive medication early for the SA population at a high risk to prevent the onset of CVD, as the American College of Cardiology (ACC) and the American Heart Association (AHA) recommended. However, studies show that SAs are less likely adherent to lifestyle recommendations focused on reducing cardiovascular disease (including HTN) risk (Ismail et al.,2020). And one study showed that adhering to a medication regimen is problematic in

this population with between 33%–68% of SA patients remaining non-adherent to their medications (Islam et al., 2018).

2.2.5 Dietary risk factors.

The Institute for Health Metrics and Evaluation (2018) advocate that dietary risk factors include low whole grain consumption, high sodium intake, and a lack of fruit consumption. It would benefit individuals to consume more mono and polyunsaturated food types, which would lower LDL cholesterol levels and foods containing less salt and sugar lower blood pressure and triglyceride levels in the body (Institute for Health Metrics and Evaluation, 2018). SA's dietary habits in their native countries show diversity, for example, vegan, vegetarian, or mixed diets (Key et al., 2003; Gilbert & Khokhar, 2008). Moreover, those practising vegetarianism ingest foods containing high plant stanols or sterols and high soluble fibres, which help reduce LDL and lower blood pressure, supporting cardiovascular health (Shridhar et al.,2014).The migration population from South Asia to Western countries has been associated with adverse metabolic effects, as migrants engage in imbalanced dietary habits with excessive consumption of sweets, fried snacks, and high-fat dairy products was associated with (Gadgil et al., 2015). Consumers of saturated or trans-unsaturated fatty acid-containing products for cooking, such as using clarified butter and hydrogenated vegetable oil, in their cooking places this population at an increased risk of CVD (Gupta et al., 2019).

2.2.6 Weight or obesity.

Obesity is a significant risk factor for CVD's early development (Goodarzi & Rotter, 2020). Obesity links to the development of diabetes; for instance, insulin resistance doubles as body fat composition increases and is a precursor to diabetes (Jones et al., 2015). Diabetes New Zealand stresses the need to prevent obesity by decreasing the risk of acquiring T2DM early in life (Urquhart, 2021). According to the national health and nutrition examination survey, approximately 38% of adults are obese, and 7.7% denote class 3 obesity, meaning the body mass index (BMI) equals or exceeds 40 kg/m2 (Virani et al., 2020).

People of Asian backgrounds (South Asian, East Asian, Southeast Asian) have higher visceral adipose tissue at a given body size and waist circumference (Lear et al., 2007). For South Asians, this higher visceral adipose tissue accounts for much of their elevated cardiometabolic risk compared with European-derived populations (Lear et al., 2012). There is a high prevalence of obesity among the SA group due to a lack of motivation to exercise

and cultural connotations that prevent an active lifestyle; for example, some of the SA population believe people over 50 are too old for physical activity (Goodarzi & Rotter, 2020).

Education on preventing obesity involves advice on healthy nutrition and doing a minimum of 150-300 minutes of active physical activity. The recommended physical activity for adults over age of 18 at least a minimum of 75 minutes of vigorous aerobic physical activity throughout the week (WHO, 2022). The mantra "prevention is better than cure" (Pandita et al.,2016, pg-83) is a more effective way of combating obesity by spending time promoting physical activity in the first place rather than trying to cure the problem of obesity among individuals (Sluyter, 2010). The government of New Zealand has placed various measures to prevent obesity, particularly among at-risk groups such as the SA, Pacific and Māori populations (MOH, 2023).

2.2.7 Diabetes.

Diabetes affects about 537 million adults of the world's population, and about 240 million adults live without knowing they may have prediabetes or undiagnosed diabetes, according to the (IDF) International Diabetes Federation (IDF,2021). The number of people affected by diabetes will rise to 643 million worldwide by 2030 and 2045 to 783 million (IDF,2021). In 2019, 263,938 people living in New Zealand were diagnosed with T2DM, equivalent to 50 people a day (Diabetes New Zealand, 2012). In New Zealand, an estimation reveals that 100,000 people have diabetes without a diagnosis yet (Pearce & Longhurst., 2021). SA men showed a 12.7% higher chance of acquiring diabetes than other population groups.The prevelance of diagnosed diabetes in Nepal is estimated to rise from 15.11 percent in 2015 to 17.49 percent in 2020 (Shrestha et al., 2015).

T2DM results from low levels of insulin secreted in the body due to anomalies in the beta cells of the islet of Langerhans. In diabetic patients, in the initial stages of the disease, much insulin is produced to counteract excessive glucose levels in the bloodstream due to glycogen synthesis (Dawson et al., 2010). During the advanced stages of diabetes, insulin receptors are deficient in numbers, decreasing the cells' ability to carry glucose. This deficiency in receptors causes low intracellular glucose levels and high extracellular glucose levels. An imbalance between reactive species and antioxidants in the human body's physiology reduces the amount of glucose in the intracellular space causing the breakdown of fat. It decreases protein synthesis, leading to diabetic ketoacidosis, cachexia, polyphagia, and impaired wound healing (Ullah et al., 2015).

Those who live in New Zealand, especially those residing in Low socioeconomic populations, mainly Māori, Pacific Islanders, and Indo-Asians, have a higher incidence of T2DM (Pearce & Longhurst, 2021). The first step in treating diabetes is metformin. Metformin helps control blood glucose levels and has additional anti-inflammatory and anticoagulant properties. Metformin reduces endothelial dysfunction. In diabetic patients, nitric oxide production reduces due to limited endothelial nitric oxide synthase. Low nitric oxide production triggers a reactive oxygen species response (ROS) which causes endothelial dysfunction (An et al., 2016). Thus, metformin increases nitric oxide production in diabetic patients by activating adenosine monophosphate-activated protein kinase (AMPK), thus inhibiting oxidative stress within endothelial cells (Ullah et al., 2015). The American diabetes association and the European Association for the Study of Diabetes suggest using SGLT-2 inhibitors like empagliflozin as a second option after metformin to control T2DM (Bloomgarden & Handelsman, 2020). This SGLT-2 inhibitor is currently available free for patients through filling out a unique authority form by the prescriber (PHARMAC, 2020).

2.2.8 High cholesterol.

Reducing serum lipid levels at the primary health care level is crucial to prevent cardiovascular disease at the earliest stage. Patients with serum cholesterol levels greater than 5.2 mmol/L receive treatment as soon as possible to prevent coronary artery disease (Graham, 2019). A level of LDL (low-density lipoprotein) in the blood equal to or greater than 3.5 mmol/L is considered intermediate risk (Graham, 2019). Therefore, statin therapy becomes necessary (Menon et al., 2015). The SA population needs regular blood tests for HDL, Total Cholesterol ratio and LDL values. These results will enable us to determine whether statin therapy should be initiated rather than merely focusing on LDL cholesterol levels (Hippisley-Cox et al., 2017).

Statin therapy has proven to be very efficient in reducing cholesterol. As a result of the statin therapy initiation using rosuvastatin among the SA population in the United States and Canada, there has been a decrease in LDL-C levels without any significant side effects (Menon et al., 2017). However, this differs in developing countries where a discrepancy exists in tackling CVD. For example, in a study done in India of 100,000 patients with hypercholesterolemia, only 8000 were eligible for statin therapy between 2006 and 2009, suggesting a discrepancy and an under prescribing of statins. However, statin therapy causes an increase in coronary artery calcium deposits by stimulating macrophage proliferation in the body; this high calcium deposition in the arteries constitutes a risk factor for having a myocardial infarction (Healy et al., 2020).

2.2.9 Metabolic Syndrome.

Metabolic syndrome is the co-occurrence of several known CVD risk factors that share underlying mediators, mechanisms, and pathways (Huang, 2009). These risk factors include hypertension, insulin resistance, abdominal obesity, high body mass index, impaired glucose metabolism, diabetes (Lieberman et al., 2021), and dyslipidemia (Silveira Rossi et al., 2022). All these factors can affect blood vessels and increase the risk of CAD, diabetes, and stroke. There is no consensus on the cause of the metabolic syndrome, but there is an opinion that it has a genetic component and inflammatory response (Moore & Shah, 2020). Due to their unique body composition and dietary patterns, SA's are at a higher risk for developing metabolic syndrome than Europeans (Lear & Gasevic, 2019). Excess adiposity, especially abdominal obesity, thick truncal subcutaneous fat, and fat in the liver are all associated with increased risk in SA (Misra & Khurana, 2009).

2.2.10 Non-modifiable risk factors.

Non-Modifiable risk factors include Age, Ethnicity, and Genetic factors (Mohammednezhad et al., 2016).

2.2.11 Emerging novel risk factors.

Many new and novel theories exist about why SA are at increased risk for CVD. Young SA adults with atherosclerotic cardiovascular disease have elevated homocysteine levels and elevated C reactive proteins (CRPs) (Bizheh & Jaafari, 2011) and high lipoprotein levels (Palaniappan et al., 2018). An assessment of genetic risk scores concerning insulin resistance, insulin sensitivity, low beta cell presence, and association with body mass index and lipid genetic risk scores to determine whether they contribute to the pathogenesis of T2DM would benefit the SA population (Goodarzi et al., 2020). Despite the limited research on ethnic-based SA populations, further studies might determine the effects on the ethnic group population (Goodarzi et al., 2020). A genetic factor impacting T2DM and CVD, known as the common soil hypothesis or pleiotropy, has significantly fewer studies and could be a topic for future endeavours (Moore & Shah., 2020).

The Mediators of Atherosclerosis in South Asians Living in America (MASALA) study conducted by Volgman et al. (2018) describes the SA population living in the United Kingdom (UK), United States of America (USA) and Canada as having higher rates of hospitalisation and high mortality rate with poor prognosis. The MASALA study also showed that among SA over 60 years of age, the calcium burden within the coronary artery is 10%

greater than among other ethnicities (Volgman et al., 2018). Angiogram findings in the SA population showed a smaller coronary luminal diameter and that the SA population had a higher prevalence of multivessel disease requiring coronary artery bypass grafting (CABG). The outcome of CABG in the SA population had a poorer prognosis than Percutaneous Coronary Intervention (PCI) (Volgman et al., 2018). Evidence suggests that the size of LDL cholesterol particles may increase the risk of CVD in the South Asian population. In addition, the SA population's blood vessels have smaller diameters when compared to those of European citizens, resulting in clear obstruction of blood flow within the arteries due to plaque or thrombus formation (Gupta et al., 2019).

2.6 Risk assessment tools for preventing cardiovascular disease.

The health sector has been able to consider risk factors and take appropriate measures to help prevent cardiovascular diseases (WHO, 2021). Globally risk assessment tools provide algorithms to help detect those at risk; these include the Framingham tool (Palaniappan et al., 2018), the modified Framingham tool, also referred to as the JBS2 tool (Eastwood et al.,2019) and the UKPDS tool (Gopal & Usher Smith, 2014).

Many risk assessment tools for CVD risk have been developed and implemented on ethnic-specific migratory populations. However, some of the available algorithms need more variables to evaluate the prospective CVD risk experienced by the SA population. Due to the lack of all these variables currently, these tools underestimate the risk of CVD among the SA population (Kulkarni, 2021). Early detection and prevention strategies are vital for identifying and mitigating CVD; identifying the risk factors for CVD in advance would help initiate treatment and prevent the overburden of the healthcare system (Raza et al., 2019).

The PREDICT risk assessment tool is a part of the Ministry of Health's efforts to prevent CVD in New Zealand (MOH, August 2018). Risk assessment in the high-risk population can assist in identifying a 5-year CVD risk level (Peiris et al., 2021). The recommendation is to repeat the CVD risk assessment ten years after the initial assessment if the level of risk assessment is less than 15% (Kerr et al., 2016). An annual CVD risk assessment is essential if the risk level is above 15%. In addition to monitoring clients' CVD risk, keeping a close observation of T2DM, cholesterol levels, weight management, smoking cessation, and lifestyle changes are important considerations (Pearce & Longhurst, 2021).

The PREDICT tool can categorise CVD risks based on ethnicity, enabling government health authorities to take healthy well-being initiatives (Wells et al., 2017). It helps guide health professionals to begin the risk assessment of South Asian, Māori and Pacific populations

earlier than the European population (MOH, Feb 2018). Performing this risk assessment on European men at 45 and European women at 55 years; when considering the SA population, the risk assessment starts at 30 years of age for men and 40 years for women (MOH, August 2018). This tool assists in assessing approximately 1.2 million New Zealanders annually (Wells et al., 2017). As mentioned in the introduction section of this thesis, although the SA population is a high-risk population, it is not understood why more preventative education programmes that target the SA population are less important and why more funding is unavailable for promoting preventative measures for this population group.

2.7 Social cultural Reasons for high CVD risk among the SA population.

People who identify as South Asian have a higher risk of cardiovascular disease than other country-based ethnic groups and their European counterparts (Ahmed & El-Menyar, 2015). Pylupchuk et al. (2018) estimate that migrated Indians were at a 13-48% risk of CVD, and their chances of developing CVD were higher if they lived in a socioeconomically depressed area.

The World Health Organisation (WHO) data reveals that CVD risks among low to middle-income (LMIC) developing countries like Central Asia, the Middle East, North Africa, Oceania, Eastern Europe, and the Asia-Pacific are becoming more prevalent (Roth et al., 2020). The disability-adjusted life years (DALY) rate indicates that this group dies younger than individuals living in European countries (Gupta et al., 2019). Not only are Asians not living longer in their country of origin, but this also becomes more pronounced upon migration to a Western country. The age-adjusted incidence of heart disease among the SA population living in the United States of America (USA) was estimated to be 6.1%, and coronary artery disease (CAD) was 7.2% among the male SA and 4.2% among SA women (Virani et al., 2020). SA migrants have a three to five times higher risk of developing an acute myocardial infarction (AMI) than those in their motherland. Changes in metabolism due to diet and lifestyle are risk factors for this rise in CVD (Mensah et al., 2020).

Migrants from SA are usually young and in excellent health, as seen in medical reports required before migration (Terragni et al., 2022). Migrants, such as labourers, are primarily responsible for the healthy migrant effect on the migrant population, where they are healthier than the domestic population (Helgesson et al., 2019). However, non-labour migrants like refugees and family reunion migrants might be prone to deterioration in their health outcomes as they adopt modern lifestyles, integrating with a host country's cultural and social norms and acclimatising themselves to the country's culture (Helgesson et al., 2019).

When the SA population moves abroad, processed food is often more accessible, so instant energy-dense takeaways are favoured because fresh vegetables are more expensive (Swinburn et al., 2011). Adopting new lifestyle habits, such as using the car to commute rather than taking the bus, leads to a less active lifestyle, which can lead to diabetes (Swinburn et al., 2011). In the SA population, the female gender is the primary cook for the household. Individuals especially when it is the male member of the household is taking the initial step to move to a different Western country are disadvantaged because they cannot cook meals for themselves. As a result of their lack of cooking skills, some migrants tend to rely on readily available fast food in takeaway shops and processed foods in their new country (Bourdier et al., 2020). Because the migrated population at the initial stages of migration often do not possess much money, they usually opt for cheaper food varieties which are usually energy-dense food with a combination of very little physical activity leading to obesity issues (Bourdier et al., 2020), another contributing factor to why this SA population is at increased risk of CVD is a sedentary lifestyle. This lifestyle increases the chance of developing central obesity and decreased muscle mass. Obesity promotes insulin resistance.

2.8 Overview of current interventions for CVD prevention

As CVD affects a vast selection of the population at a primary level, the role of nursing and multidisciplinary team members in sharing and imparting health education and awareness among vulnerable populations is paramount to improving health outcomes. It is essential to promote lifestyle programs that will change attitudes and avoid poor lifestyle choices among the SA population and reverse the adverse effects of a sedentary lifestyle (Clark, 2014). Healthy well-being initiatives include advocating regular exercise and adopting a heart-healthy diet (Sapp et al., 2020). Promoting quit-smoking programs encourages healthy behavioural change and is recommended (MOH, Feb 2018). An awareness campaign to encourage yearly monitoring of blood glucose and cholesterol and for weight management. Introducing early pharmacotherapy interventions for the identified high-risk group, especially beta-blockers, aspirin, and ACE inhibitors (angiotensin-converting enzymes), and emphasis on the importance of compliance will help prevent CVD (Wells, 2018).

Ways to mitigate CVD risk have shown to be effective; preventative strategies preventing Type II Diabetes Mellitus (T2DM) through reducing weight by promoting and giving free green prescription schemes to encourage physical activity are effective preventative strategies which are integral to reduce CVD health costs (Pearce & Longhurst, 2021). Quit-smoking programs, encouraging salt reduction, and creating awareness to control

hypertension using non-pharmaceutical techniques like mindfulness programmes and yoga are all preventative strategies (Pearce & Longhurst, 2021).

Cardiovascular disease affects everyone, but Māori, Pacifica and South Asians are more at risk. Much attention has focused on Māori and Pacifica populations, whereas the South Asian population are often under-recognised as being at risk (Wells et al., 2017).Considering South Asians' high risk and increased growth in New Zealand, more is needed to understand which risk factors are the most important to consider when educating and managing high-risk populations such as the SA population. It is also essential to establish the best targeted population-based interventions to assist in making change. This integrative review aims to identify what risk factors need urgent priority and what interventions needing for this specific group.

2.9 Summary

This chapter explained the pathophysiology behind cardiovascular disease (CVD) and coronary artery disease (CAD) and explored how tools such as PREDICT can help in the early assessment. This chapter also explored the risk factors contributing to CVD and how these risk factors mainly affect the South Asian population. Sociocultural factors that lead to South Asians having CVD, especially in the context of migration to Western countries, were described. Finally, the detailed chapter on solutions and the need for more education for health professionals and minority populations around the risk of CVD and management strategies. The next chapter will discuss the methodology used to address the research question.

3. Chapter Methods Overview

This chapter will discuss the philosophical worldview underpinning the integrative review and detail the five stages of the integrative review process, including the literature review process (PRISMA, inclusion-exclusion criteria, and the data abstraction table). It will describe how thematic analysis helps to synthesise the findings to develop themes to answer the research question: What are the risk factors and preventative strategies for cardiovascular disease among people from South Asia living in the Western world?

3.1 Methodology

It is essential to consider the philosophical worldview the researcher will apply to a study. Also, consideration needs prioritisation to the research design related to that worldview and the specific methods this approach can bring to practice (Creswell & Creswell, 2017). The worldview or paradigms are the ideas and beliefs that guide a researcher to help find an understanding and solution to a particular issue (Creswell & Creswell, 2017).

This research project draws on the worldview of pragmatism. Pragmatism arises out of actions and consequences to answer the research problem. All approaches are available to understand the problem; this works well with mixed methods studies mixed methods, which allows the researcher flexibility to view the problem and interpret findings from different viewpoints (Creswell & Creswell, 2017; Kaushik & Walsh, 2019). Pragmatists work in the belief that research occurs in social, political, and historical contexts and therefore uses a theoretical lens that is reflective of social justice (Creswell & Creswell, 2017). This fits well with the topic as South Asians are dying at a younger age, and more needs to be done from a socio-political level to help address this health disparity. The study included the South Asian population described by WHO definition

An Integrative review aims to review, critique, synthesise, and evaluate existing quantitative, qualitative, and grey literature, helping to explore and comprehensively understand healthcare issues (Whittemore & Knafl, 2005). As the integrative review synthesis of a specified topic helps to review and critique the literature in an integrated way, this aids in developing a new perspective, outlook, and framework on the subject (Torraco, 2005). This method is a mixed method as it enables using quantitative, qualitative, and grey literature to answer the research question (Whittemore & Knafl, 2005). The integrative review offers advantages, including assessing the strength of scientific evidence, analysing the gaps in current research, associating related research areas, and identifying the demand for future research (Whittemore & Knafl, 2005). Furthermore, integrative reviews address any inconsistencies in the literature to provide a new perspective on the current issue or

research question (Torraco, 2016). Integrative reviews, therefore, allow for the development of evidence-based nursing practices. Moreover, integrative reviews are a unique tool in healthcare as they can synthesise current investigations on a health problem and guide current practices based on scientific knowledge (Souza et al., 2010).

3.2 Design/Plan of Study and Data analysis.

This integrative review regarding CVD risks among South Asian Populations involves experimental and non-experimental literature reviews. The study aims to analyse the CVD risk specific to South Asians and help formulate a comprehensive treatment modality that addresses the problem. The integrative review will follow a rigorous five-step process identified by Whitmore & Knafl: 1) Preparing the guiding question, 2) Literature search, data extraction and reduction, 3) Data evaluation, 4) Data analysis, 5) Discussion and conclusion (Whitmore & Knafl, 2005). The guiding question for this review is the risk factors and preventative strategies for cardiovascular disease among people from South Asia (SA) living in the Western world.

3.3 Literature and Database search

The 2nd phase of the integrative review process is multifaceted; it first involves doing a well-defined literature search to enhance the research's rigour and avoid vague and biased searches (Cooper, 1998; Conn et al., 2003). Multiple databases helped to guide a detailed search; these included the Health Research premium collection, CINAHL complete, Interface EBSCO host research database, and MEDLINE complete databases. The data search took place between September 2021 and December 2021.

A comprehensive word search aided in covering all relevant literature. Search terms for each group will be combined using the Boolean operators 'OR' and 'AND' as appropriate. (See Table 1) Using a librarian was beneficial and helped gain knowledge on database searches using search terminologies.

Table 1 -Search term categories

MeSH Heading	Entry Terms
South Asian Population	Bangladeshi, Indian, Sri Lankans, Afghanistani, Pakistani, Burmese, British South Asian, American South Asian, Australasia population Asian, Indian in Fiji.
Asian Continental Ancestry Group	South Asian Immigrants, Genetics, Epigenetics, Cardiovascular among the ethnic migrant population, Unique geographical and climatic factors
Insulin Resistance	T2DM, Genetics, Cardiovascular risk models for the South Asian population, Insulin resistance, Intramyocellular lipid Obesity
Metabolic Syndrome	Type 2 diabetes mellitus, Cardiovascular disease Adipose tissue, Dyslipidemia, Risk factors, Urbanization Heart and diabetes, Body mass index, South Asian adiposity, Cardiovascular risk obesity.
Cardiovascular Risk models for the South Asian population	Asian Indian, Asian migrants, Coronary heart disease, Risk factors for CVD, Algorithm for South Asian population, Community-based research for the migrant population, Immigrant health, Cardiovascular health, Lifestyle change, Lifestyle modification, High-risk group for cardiovascular disease, Atherosclerotic cardiovascular disease
Cardio Protective Diet.	Nutrition therapy, Diabetes, Eating behavior, Prudent diet, Sarcopenic adiposity, Beta-cell protection, Obesity
Cardiovascular Interventions for the South Asian population	Pharmacotherapy, Drug therapy, Middle-aged South Asian, Blood pressure, health, All-cause mortality incidence, Health Risk Assessment, Epidemiology, risk factors among South Asian
South Asian adiposity cardiometabolic risk obesity	BMI, Minority and ethnic groups, Body size, Physical activity, Total cholesterol, Waist circumference, Clustered cardiovascular risk.
Lifestyle changes, Lifestyle modifications specific to the South Asian population	Exercise, Sedentary lifestyle, Initiation of pharmacotherapy to reduce lipid levels, A community-based approach to lifestyle modification

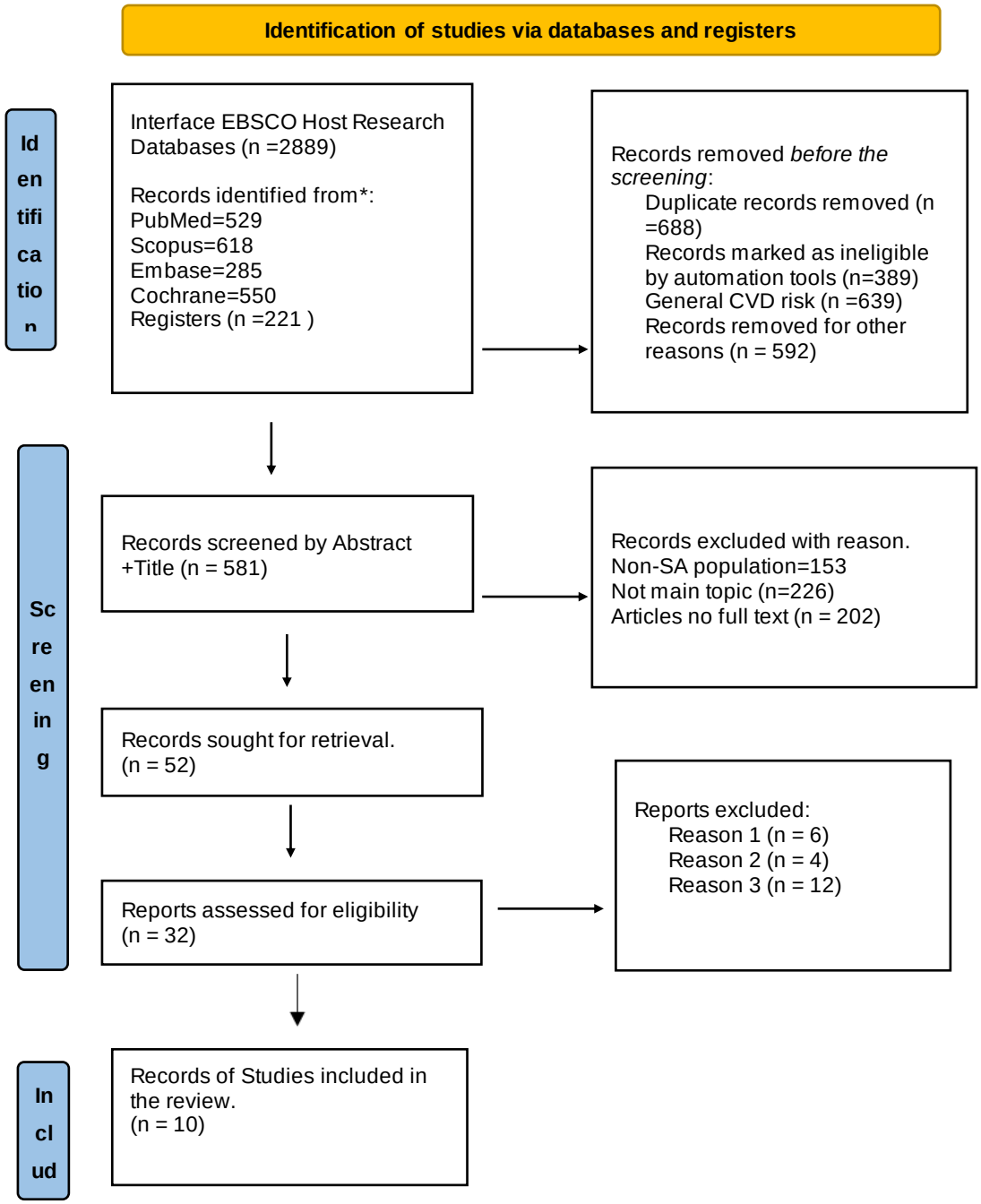
A detailed inclusion and exclusion criteria were applied to the search in order to find articles that would specifically answer the research question (see Table 2)

Table 2. Inclusion and Exclusion Criteria (See Appendix-B)

Inclusion	Exclusion
• Literature searches regarding the SA population with cardiovascular disease were between time frame 2014-2021 (To capture most recent research when this research started June 2021) • The SA population group who has migrated to western countries will be the selected population. • The study includes randomised and non-randomised studies, mixed method studies, qualitative and quantitative studies, and cross-sectional studies. • The participants in the research will be between 18-60 years of age. • Ethical committee-approved articles. • Research written in the English language.	• Literature that does not include the SA population • Studies that include populations <18 and > 6O years of age. • Research that does not include cardiovascular risk. • Articles written in other languages besides English.

A PRISMA (Preferred reporting items for systematic reviews Meta -Analysis) tool giudlines was used to document the articles that initially meet the criteria, and any literature rejected for inclusion (Liberate et al., 2009). (See Table 3)

Table-3. PRISMA Diagram



Reason 1 = Older than 10 years, Reason 2= Not including south Asian population, Reason 3=SA population not living in a western geographical country.

The 3rd phase of the integrative review process involved data evaluation to ensure that the quality of the published literature is strong. For this phase, the Mixed Methods Analysis Tool (MMAT) helps complete a quality review (Hong et al., 2018) (see Appendix A). In the final review, the ten articles met quality requirements scoring 95%. To ensure accuracy and minimise bias, the supervisor checked the articles to ensure they met the inclusion-exclusion criteria and the MMAT checklist.

Analysis began by creating a review matrix that summarised each article's aim, key findings, and demographics. (See Table 4). Data analysis occurs in Phase 4, where data from primary sources are ordered, coded, categorised, and summarised into a unified and integrated conclusion about the research problem (Dusi & Stevens, 2022). As a systematic process, the thematic analysis (Braun & Clarke, 2022) consists of six steps:

Step 1: Read through and become familiar with the data.
Step 2: Generating initial codes.
Step 3: Searching for themes.
Step 4: Review the themes.
Step 5: Defining the themes.
Step 6: Write up the themes.

The themes are selected and implemented in the final stage of Knalf & Whitmore's (2022) integrative review process. This process was again checked and discussed with the primary supervisor until a consensus was evident. Phase 5 included the discussion, recommendations, and conclusions.

TABLE 4- Articles selected for this Integrative Review (see Appendix-B).

Authors/Year/support country	Title	Research/Aim	Methodology	Age group &sample size	Main Results
1. Palaniappan et al. (2018) USA	South Asian Cardiovascular disease & cancer Risk: Genetics &pathophysiology.	SA population at high risk of developing CVD, diabetes, and increased abdominal fat involves a comprehensive literature review identifying the population genetic factors, anthropometry, disease pathophysiology, and cancer genetics among the SA population.	Comprehensive Literature review Randomized	Young immigrants who belonging to the SA population with increased weight, low levels of physical activity, and who are at a significant risk of CVD.	All traditional risk factors were high among the SA population, like dyslipidaemia, low HDL levels, elevated lipoproteins A levels, and LDL levels. The genetic components of developing diabetes include increased fat cells and central obesity. Metabolic syndrome (MetS) causes increased production of leptin levels and cytokines like tumor necrosis factor (TNFa), resulting in insulin resistance. More research is needed to understand the epigenetics and pathophysiological process of CVD risk among this population.
2. Eastwood et al. (2019) UK	Impact of kidney function on cardiovascular risk and mortality: A comparison of South Asian and European cohorts.	SA population Indians living in western countries in this study suggest high CVD risk relates directly to high levels of Albumin creatinine ratio (ACR) and low estimated glomerular filtration rate (eGFR) among this population	Cross-sectional and longitudinal follow-up	32 +_7 years. SA, n=1104. Europeans, n=1116.	This cross-sectional study involved two groups, the UK-based European versus UK-based South Asian population. The study showed that e GFR cystatin C levels plus ACR and a combination of diabetes and chronic kidney disease (CKD) pose a high risk for cardiometabolic disorder and CVD. In the SA population, high blood glucose and ACR levels go together. Endothelial dysfunction affects micro-circulation. The SA population involved chiefly of Indian origin. The conclusion summary reveals that the two groups' eGFR creat and cystatin levels were equal comparisons. Still, the ACR levels were

					high among the SA population, which directly affected CVD.
3. Ahmed et al. (2014).UK	South Asian ethnicity and cardiovascular risk: The known, the unknown, and the paradox.	The SA population poses a high risk of developing CVD due to modifiable risk factors like less fruit and vegetable intake, smoking, alcohol consumption, sedentary lifestyle, hypertension, and dyslipidemia. It affects the age group from less than 40 years and represents three folds higher than their UK counterparts and ten folds higher when compared with the Chinese counterpart in Singapore.	Critical appraisal narrative review text and opinion papers	From 40 years onwards	This narrative review compares the conventional risk factors (RF) to non-conventional risk factors among the SA population. There is little evidence that all the RFs result in CAD among the SA population. Still, it is considered a landmark for implementing preventative measures to prevent CAD among the SA population. Assessing the CVD risk factors and adjusting preventable early interventions is inevitable among the young SA population.
4. Villadsen et al. (2016). UK	Coronary atherosclerotic plaque burden and composition by CT angiography in Caucasian and South Asian patients with stable chest pain.	A comparative study between Caucasians and the SA population in a UK-based tertiary hospital who has stable angina. The degree of coronary artery stenosis was present using computed tomography coronary angiography (CTCA). This study showed the presence of blockage in the inner artery wall lining due to stenosis, calcification, and plaque burden. The age group chosen for the SA population was much younger than the comparing group.	Observational study. This study fits with the inclusion criteria chosen for this Integrative review.	SA Age =49 _+ 11years. Caucasian Age= 54 +_11 years	This study revealed that the Caucasian population had no marked difference when comparing the artery inner wall lining area, which was stenosed due to plaque burden P -.889. This P-value indicates there is not much evidence. The study's conclusion says that the plaque burden percentage was the same in the comparative groups. Still, the non-calcified plaque composition rate among the SA population was higher than in the Caucasian population. P<0.001, this P-value gives statistical significance to the finding.
5. Mehta et al. (2018). NZ	Development and validation of alternative	This study formulates a CVD risk equation to give a statistical update regarding individual risk	Mixed method Quantitative study	Age-30-74 years	The study involved 17.6 % of women and 15.5 % of the men falling under the high-risk ethnic group Māori, pacific

	cardiovascular risk prediction equations for population health planning: a routine health data linkage study of 1.7 million New Zealanders.	management scores for population health planning. New Zealand has a diverse population, and the study involved all the ethnic groups, including the SA population, to identify the CVD risks. This study facilitated the health planning team to tackle CVD incidence early.			population, and Indian migrants. This study did take place between 2007-and 2011.
6. Beaney et al. (2015) UK	Clinical Utility of a coronary heart disease risk prediction, gene score in UK healthy middle-aged men and the Pakistani population	This research emphasized the need to create a separate algorithm to classify the risk factors that lead to CAD among the SA population.	A prospective case-control quantitative study	Age 50-64 years	This study measured the SNP's (single nucleotide polymorphisms) in a genome among the SA population specific to the Pakistani population in the UK. The study compared it with its European counterparts in the UK. This study helped understand how the SA population is more prone to CAD. This population group detailed gene response to drug treatment. The study involved nearly 3000 clients; the follow-up was about 13.5 years. The study also recommends the need to create a different gene-specific algorithm for the SA population.
7. Peiris et al. (2021) AUS	Cardiovascular disease risk profile and management practices in 45 low-income and middle-income countries: A cross-sectional study of nationally representative individual-level survey data.	This study aims to identify the socioeconomic background directly impacts young individuals having CAD at an early age.	Cross-sectional study, linear mixed-effects model.	The median age for overall 10-year CVD risks was between 30 and 64 years, particularly for Indian ethnicity females 49 years and males 54 years.	The study identified various countries around the world with the CVD risk global distribution. The findings showed the LMIC (low-income and middle-income countries), especially populations of India, Bhutan, and Nepal, offered the age of women at risk of CVD was between 38-44 years and men between 30-54 years. The findings also mentioned that the population with low CVD risk took more BP (blood pressure) medication than those with higher CVD risk factors. In some

					countries, they found that the wealthy population with higher education tends to be more prone to CVD risks.
8. Grey et al. (2021).UK	Severe malnutrition or famine exposure in childhood and cardiometabolic non-communicable disease later in life: a systematic review	This study aims to find a link between childhood malnutrition in the age group between 0-9 years, which causes non-communicable diseases like metabolic syndrome, CAD, DM, and Insulin resistance in adult life aged 30-80 years.	A systemic review of works of literature.	Aged adult life between 30-80 years	The positive association between childhood famine exposure and adulthood development of Mets, DM, insulin resistance CAD. The study population involving Bangladesh, one of the SA countries, did not show a significant risk of developing glucose intolerance. Most studies in other countries show an association between childhood famine and the development of non-communicable diseases like Mets, DM, and insulin resistance CAD.
9. Dalton et al. (2014) UK	Ethnic group differences in cardiovascular risk assessment scores: a national cross-sectional study.	Study population South Asian men vs. white men on the QRISK2 CVD risk score versus Joint British Societies (JBS2) CVD risk score accuracy. The median estimate for CVD risk QRISK2 scores-6.6% compared with JBS2- 9.3%. The median risk score is 7.5% among the SA population compared with 3% of the European counterpart.	A cross-sectional study		QRISK2 CVD risk tool Confidence Interval (CI) 95% showed 19.1%= (16.2-22.0) in the SA population compared to their European counterpart led 95% 8.8% CI=5.9-7.8. The JBS2 risk tool showed the SA population's estimation of CVD risk was low. Overall, women's QRISK score had a lower median of 0.72 but was relatively higher when compared with JBS2, about 2%. This study aimed to understand that ethnicity plays a significant role in formulating a separate CVD risk assessment score chart, especially in the SA population.

10. Cainzos-Achirica et al 2019. Spain	Cardiovascular risk factors and disease among non-European immigrants living in Catalonia	Study Population- SA population living in Catalonia. Aim- Prevalence of CVD risk factors leading to CVD among the SA population and intake of medications to prevent CVD among the immigrant population.	Population based analysis.	Age- 18 years and above and<55 years	The prevalence of CVD among the young immigrant group was high compared to the local Spain population. The SA immigrants had high presence of T2DM, cholesterol, and obesity. HTN was present in the sub-Saharan African population and older local Spain population than the SA population. The recommendations were promoting aggressive tailored health interventions specific to this population to decrease the CVD risks.

3.4 Ethics

Ethical approval was not required for this research project as an integrative review does not collect personal or confidential information from the participants. This review included existing literature that is already published and publicly accessible (Gopichandran et al., 2016).

3.5 Summary.

This chapter outlined the integrative review process and why this method answered the research question and explored the theoretical underpinnings. The integrative review process was outlined, with accompanying tables showing the literature search, keywords used, inclusion and exclusion process, PRISMA, and the extraction process. Ethics was also briefly discussed. The next chapter will discuss the findings of the integrative review.

4. CHAPTER: Findings.

4.1 Introduction and descriptive Overview

This integrative review sought to understand the predominant risks leading to cardiovascular disease and the strategies to help prevent cardiovascular disease among people who identify as South Asian (SA) living in the Western world. Ten articles for this integrative review met the inclusion and exclusion criteria: one was from the United States of America (USA)- (Palaniappan et al., 2018), six from the United Kingdom (UK)- (Eastwood et al., 2019; Ahmed et al.,2014; Villadsen et al., 2017; Beaney et al., 2015; Grey et al., 2021; Dalton et al., 2014) one from New Zealand (Mehta et al., 2018); and one from Spain (Cainzos-Achirica et al., 2019). There was a mixture of methodologies, including two mixed-methods studies (Palaniappan et al., 2018; Eastwood et al., 2019) and eight quantitative studies (Villadsen et al., 2017; Ahmed et al.,2014; Mehta et al.,2018; Beaney et al.,2015; Peiris et al.,2021; Grey et al.,2021; Dalton et al.,2014; Cainzos-Achirica et al., 2019). Four themes were identified.1. Prominent risks and novel theories underlining CVD in South Asians. 2. The need to promote non-pharmaceutical interventions, especially physical activity and pharmaceutical ones. 3. Need for an ethnic-specific CVD risk algorithm for the SA population and 4. Barriers to Care.

4.1 Theme one -Prominent risks and novel theories underlining CVD in South Asians.

4.1.1 Prominent risks

All ten articles selected for this integrative review highlighted that being of SA ethnicity is a significant risk factor for CVD. Although ethnicity is a non-modifiable CVD risk factor (Dalton et al.,2014; Palaniappan et al.,2018), there needs to be more awareness among the SA population of their propensity to CVD risk when compared to the European population (Palaniappan et al., 2018; Cainzos-Achirica et al., 2019; Grey et al., 2020; Dalton et al., 2014; Eastwood et al., 2019; Ahmed et al., 2015; Villadsen et al., 2017; Mehta et al., 2018; Beaney et al., 2015; Peiris et al., 2021).

The predominant risk factor identified in this study contributing to CVD in the SA population is having a high BMI. Five articles stress that the SA population are prone to being overweight and have increased abdominal obesity (Palaniappan et al., 2018; Cainzos-Achirica et al., 2019; Grey et al., 2021; Dalton et al., 2014; Eastwood et al., 2019). Obesity prevalence among the SA population is (400 per 1000) compared to the local Spanish (<100

per 1000) population (Cainzos-Achirica et al., 2019). The adjusted normal BMI for the SA population is 23kg/m2 compared to >30kg/m2 for the general European population; this is 7kg/m2 less- therefore, having a BMI over this normal range is considered obese and is vital to acknowledge when assessing those who are SA (Palaniappan et al., 2018; Cainzos-Achirica et al., 2019; Peiris et al., 2021). (Table 5).

Table 5 Classification of weight

Classification weight	**General European Body Mass Index in Kg/m2**	**South Asian Population Body Mass Index in Kg/m2**
Underweight	<18.5 kg/m2	<18.5 kg/m2
Normal	18.5-24.9 kg/m2	18.5-22.9 kg/m2
Overweight	25.0-29.9 kg/m2	>23 kg/m2
Obesity Class1	30-34.9	>25 kg/m2
Class 2	35-39.9	-
Class 3	>40	-

(Palaniappan et al., 2018; Cainzos-Achirica et al., 2019; Peiris et al., 2021).

As a direct result of an increased BMI, and notably increased waist/abdominal circumference, SA's are at risk for developing T2DM (Palaniappan et al.,2018; Cainzos-Achirica et al.,2019; Grey et al., 2021; Dalton et al., 2014; Eastwood et al.,2019). Type II Diabetes is prominent in the SA population, with a seven times more common prevalence than in Europeans (Cainzos-Achirica et al., 2019). Statistics showed 280 per 1000 SA had diabetes, compared to 71 per 1000 locals in a USA study (Palaniappan et al., 2018). SA also experienced diabetes 7.4 years earlier than Caucasian populations, and the incidence of metabolic syndrome was higher among the SA migrant population (Peiris et al., 2021). Palaniappan et al. (2018) describes the influence of obesity towards diabetes, where excess fat in the body causes an inability of the adipose tissue to store excess fat leading to accumulation around the ectopic tissues, for example, around the heart, skeletal muscle and liver. This excess adipose tissue causes a chronic low-grade inflammatory process leading to insulin resistance and decreased production of insulin by the pancreatic beta-cells (Palaniappan et al.,2018). Having a diagnosis of diabetes places SA at risk for coronary syndrome; the risk assessment score for patients with diabetes who experience ACS (Acute

Coronary Syndrome) was 70% among the SA population compared to non-diabetic individuals whose risk rate was less than 35% (Palaniappan et al.,2018).

Not only is weight gain linked to diabetes but also to weight contributing to heart failure in SAs. Obesity causes an increase in the cardiac output and the total blood volume to meet the body's metabolic needs, which in turn causes high pressure in the left ventricles of the heart leading to dilatation of the left ventricles causing heart failure (Cainzos-Achirica et al., 2019). The prevalence of atrial fibrillation in the SA population is also apparent; high pressure in the left ventricle causes left atrial pressure to increase, causing enlargement of the atrium and leading to atrial fibrillation **(**Cainzos-Achirica et al., 2019).

Metabolic syndrome is another risk factor predominant in the South Asian population in four studies in this review. Having at least two or three of the combined metabolic syndrome risk factors (increased BMI, high blood pressure, obesity, increased waist circumference or abdominal obesity, high cholesterol, insulin resistance and T2DM) can lead SA's to be categorised as high-risk for CVD (Palaniappan et al.,2018; Cainzos-Achirica et al., 2019; Ahmed et al., 2015). Therefore, preventing the combination of metabolic risk factors can help delay the onset of CVD among the SA population (Cainzos-Achirica et al., 2019; Eastwood et al., 2019; Palaniappan et al.,2018; Peiris et al.,2021).

Prevalent issues such as diabetes, metabolic syndrome, and hypertension are mentioned in three articles as risk factors for CVD in SA (Grey et al.,2021; Peiris et al.,2021; Cainzos-Achirica et al., 2019). Hypertension can cause a decreased left ventricular outflow and reduce stroke volume causing systemic vascular resistance (Eastwood et al.,2019). SAs are diagnosed at a younger age (49 years for females and 59 years for males), whereas the European population are much older, between 64-74 years when diagnosed with high blood pressure (Peiris et al.,2021). Early identification and treatment of high blood pressure can delay or prevent a cascade of problems leading to CVD risk among the SA population (Cainzos-Achirica et al., 2019).

4.1.2 Novel theories underpinning CVD in South Asians

On examination as to why SA are more at risk of developing CVD, many theories exist. According to three authors in this integrative review (Grey et al., 2021; Ahmed et al., 2015; Peiris et al.,2021), diabetes and hypertension, which are more prevalent at younger ages,

can be linked to childhood poverty and famine. Grey et al. (2021) explain that 47 million children face famine and malnutrition in low-middle income countries; when these children become adults, there is evidence of a developmental origins of health and disease (DOHaD) hypothesis linking early childhood malnutrition with an increased risk of developing non-communicable diseases (NCD's) and contributing to long-term ill effects on health.

Another novel theory as to the propensity of SA towards CVD is due to this population having a susceptibility towards an Elevated Albumin Creatinine Ratio (ACR) as a contributory factor that leads to cardiovascular disease. Increasing ACR levels translate into impaired microcirculation and endothelial dysfunction leading to CVD-related mortality (Eastwood et al.,2019; Palaniappan et al.,2018). The main factor towards ACR in this population is increased glycemia, a significant biomarker in the pathway of chronic kidney disease (CKD) (Eastwood et al., 2019; Palaniappan et al.,2018). Palaniappan et al. (2018) explains that high levels of ACR in the SA population are related to high-fat diets. The higher the ACR levels, the lower the glomerular filtration rate (GFR), which leads to kidney impairment. Palaniappan et al. (2018) stress that European CKD markers are comparatively different from those of the SA population, though more studies are needed to validate this. These two factors can lead to heart disease, both of which are deadly (Cainzos-Achirica et al., 2019).

There is further hypothesis that high lipoprotein levels cause thrombogenesis and atherogenesis in young SA's, accounting for the CVD incidence seen in this population therefore it is essential that lipoprotein levels are recognised as a genetic variant and need to be included in risk model tools (Palaniappan et al.,2018). Genome-wide association studies (GWAS) that use gene scores (GS) determine how single nucleotide polymorphisms affect specific ethnic groups, thus addressing the standard type of genome link with T2DM that pertains to the SA population is recommended. Further DNA research (Deoxyribonucleic acid) methylation will be helpful, as this significantly affects the inheritance of the gene component of T2DM among SAs. The authors also mention that epigenetics could cause microRNA involvement in developing hypertension and dyslipidaemia among the SA population (Palaniappan et al., 2018).

4.2. Theme two-Need for promoting both non-pharmaceutical interventions especially physical activity alongside pharmaceutical interventions.

All ten articles; stress the need for early identification, but the initiation of prompt, comprehensive and sustainable measures to curtail CVD among the SA population. By promoting physical activity, weight loss, and healthy dietary interventions such as encouraging low carbohydrate and salt intake, CVD incidence can be reduced (Palaniappan et al., 2018; Cainzos-Achirica et al.,2019; Grey et al., 2021; Dalton et al., 2014; Eastwood et al.,2019; Ahmed et al.,2015; Villadsen et al., 2017; Mehta et al., 2018; Beaney et al., 2015; Peiris et al., 2021).

Although all interventions are essential, the most prominent intervention noted in this integrative review is the need to increase physical activity as a preventive strategy for CVD; weight reduction through promoting regular exercise help delay or prevent CVD risk complications in the SA population (Cainzos-Achirica et al., 2019; Eastwood et al., 2019; Palaniappan et al.,2018; Peiris et al., 2021), preventing high BMI's and metabolic syndrome (Peiris et al., 2021; Cainzos-Achirica et al.(2019).

Hypothesis about environmental and epidemiological factors due to migration can be confounder variables that relate to sedentary lifestyle, new habits, weight change and change in dietary composition in the migrant country, all of which have an impact on migrants, therefore encouraging physical activity is one of the recommendations in research to prevent diabetes (Eastwood et al., 2019). Peiris et al. (2021) state that many reasons can hinder the ability of the SA population to participate in physical activity; the stress of moving to a new country and fostering financial and social stability are just a few examples.
It is crucial to begin early medication therapy to treat high-risk populations after identifying CVD (Beaney et al., 2015; Mehta et al., 2018; Cainzos-Achirica et al., 2019; Ahmed et al., 2015; Palaniappan et al., 2018).

Early initiation of anti-hypertensives and cholesterol-lowering medications among the SA population would be beneficial (Palaniappan et al., 2018). It is acknowledging important to treat diabetic patients early with pharmacotherapy, hypertension with blood pressure lowering medications, and the use of antiplatelet therapy to reduce CVD risk (Mehta et al., 2018). Additionally, Mehta et al. (2018) highlight the necessity of promoting health education to accomplish this initiative; otherwise, preventative strategies will not be successful. Awareness that the atherosclerotic process begins many decades before the actual clinical manifestation of CVD will help with the compliance of qualifying clients to get treated for

elevated cholesterol, hypertension, and high blood glucose through the early introduction of medication (National Institute for Health and Care Excellence, 2014) cited in (Beaney et al., 2015).

4.3 Theme Three-Need for an ethnic-specific CVD risk algorithm for the SA population.

Six studies in this integrative review suggest it is imperative to develop an ethnically specific algorithm and risk tool conformance specific to SA populations to accurately identify and estimate CVD risk in primary and secondary care hospitals (Beaney et al., 2015; Dalton et al., 2014; Palaniappan et al., 2018; Mehta et al., 2018; Cainzos-Achirica et al., 2019; Eastwood et al.,2019).

Risk assessment tools enhance the health providers' ability to identify high-risk populations, such as the SA population and then take initiatives to delay or prevent CVD. Many risk tools have been developed in clinical practice specifically to identify CVD- however, fundamental diagnostic values mentioned in the risk tool model to predict CVD among the general population need alteration to estimate CVD risk factors among the SA population accurately (Palaniappan et al., 2018).

Modified diagnostic values will reflect what average range values are specific to the SA population compared to the target range for the general European population (Palaniappan et al., 2018). These values include a lower threshold for cholesterol levels, a need for SA ethnic-specific BMI and waist circumference (WC) measurements, blood glucose levels, and modified HbA1c, if altered to lower thresholds, will help prevent underestimation of CVD risk among the SA population (Palaniappan et al., 2018). It is also crucial that health professionals' knowledge is increased around ethnic differences in SA. This can be achieved through updating and raising awareness via in-service education sessions among primary and tertiary level clinicians regarding the use of a separate risk tool algorithm targeting the SA ethnic group is needed to help prevent poorer outcomes for the SA population (Palaniappan et al., 2018).

Four different CVD risk assessment tools were identified by researchers in this integrative review and included 1) The Framingham 10-year score initiated in the USA; 2) The modified Framingham score (NICE 2008), otherwise called JBS2 (Joint British Societies used in the UK, 3) The QRISK2 tool which is UK based, and 4) The PREDICT tool initiated in New

Zealand (see Appendix B). Although each of these risk tools has many standard variables that are essential to include for all, many of the tools were not specific to the unique needs of SAs. For example, Dalton (2014) critiques the JBS2 risk assessment tool because it places a significant emphasis on two variables - smoking and hypertension as the most prominent risk indicators leading to CVD; however, smoking and hypertension were not prevalent among the SA population, these risk factors were inconspicuous when compared to the European population (Dalton, 2014). Smoking is not that prevalent in all SA communities. However, one subset of the SA population, the Bangladeshi, has high numbers of smokers and higher incidence of hypertension when compared to the rest of the SA population from India, Burma, Nepal, Bhutan, Pakistan, Afghanistan, Malaysia, and Vietnam (Eastwood et al.,2019). Therefore, the only SA population which would benefit from using this JBS2 risk tool will be Bangladeshi SAs, which is an example of how accurate estimation of CVD risk for SAs, in general, will not prove effective among the whole SA population.

Ethnic differences exist and are seen when evaluating CVD risk assessment tools among the black, white and SA ethnic populations in the UK. In population studies, the JBS2 risk tool demonstrated that the SA population had a lower percentage of high blood pressure, predominantly in the African population. However, the SA population had a higher prevalence of T2DM than those who identified as black or European (Dalton, 2014). Hence the low incidence of HTN and increased prevalence of T2DM among the SA population meant that the JBS2 risk tool would therefore underestimate the incidence of CVD risk among the SA population. Dalton et al. (2014) argues that the two outstanding risk factors that they identified were weight and the presence of T2DM contributed to identifying the SA population as more prone to having a high risk for developing CVD. Both factors would have been detected if they had used the QRISK2 tool instead.

Peiris et al. (2021) used the Framingham risk assessment tool yet found limitations and suggested that to capture SA risk accurately; there is a need to include abdominal circumference, body weight and level of physical activity as variable factors in the risk tool assessment all measures specific to the SA populations high risk are not present in this tool.

Beaney et al. (2015) argue that the modified Framingham risk score (JBS2) only gives conventional risk factor scores for determining the presence of CVD risk factors and gives an estimation only as to whether a person who falls into this category will be at an increased risk of cardiovascular disease within the next ten years. However, advocates that there

needs to be the addition of the gene score (GS) variable as an added variable to improve identifying the clinical utility of CVD risk estimation among the SA population.

Two authors in this integrative review emphasised the need for risk assessment to begin at an earlier age for SAs. Dalton et al. (2014) explain that health inequalities are present in CVD incidence and the outcomes derived between different population sectors in migrant countries and stress the importance of addressing inequalities early among the SA population in the JBS2 and QRISK2 risk assessment tools. Mehta et al. (2018) also suggest that the SA population needs early identification than others, and screening should begin at 30 years of age. New Zealand's PREDICT tool provides age-adjusted algorithms to estimate accurate CVD risk predictions on the SA population.

Cainzos-Achirica et al. (2019) critiqued the JBS2 tool and made recommendations stating that gender is also a consideration that is important to include when evaluating CVD risk. The SA population prevalence of CHD among men was two folds higher, 224 per 1000, compared to the local population of 119 per 1000. CHD among women was even higher, about 3.5 folds higher, 137 per 1000 compared with 38 per 1000 for the regional population (Cainzos-Achirica et al., 2019). The authors also stress the importance of an ethnic-based algorithm tool which would identify risk factors unique to immigrant ethnic groups. For example, in Spain, health statistics reveal that a BMI threshold of 30 kg/m2 is considered obese Cainzos-Achirica et al. (2019). This measurement would not fit the migrant SA population as it would underestimate CVD risk. Another suggestion is to include data on how much physical activity is done by the SA population in their daily living (Cainzos-Achirica et al.,2019).

Two authors did not use any validated tools in their work; instead took the principal risk factors and modelled their findings based on their results. Villadsen et al. (2017) recommend CTCA (computed tomography coronary angiography) to give a more accurate picture of the composition of non-calcified plaque in the coronary arteries, which would help prevent an acute cardiovascular event. Villadsen et al. (2017) recommend including confounding factors like physical activity in the risk tool assessment. Thus, identifying physical activity among the SA population was deemed essential in assisting in prevention strategy initiatives to support this group.

Eastwood et al. (2019) study showed that the differences in ACR (Albumin creatinine ratio) levels between the European population and the SA population indicate the presence of

CVD risk predictions. The SA population has high ACR levels, which gives an estimate of why this population is more prone to the risk of developing CVD and recommends that this biomarker is included in the risk tool (Dalton et al., 2014).

All authors (Beaney et al., 2015; Dalton et al.,2014; Villadsen et al.,2017; Palaniappan et al., 2018; Cainzos-Achirica et al., 2019; Eastwood et al.,2019) recommend the need for a particular risk factor variables to be included in the risk assessment tool (see Appendix C) to help the health sector team in assessing for early detection of CVD among the SA group.

4.4 Theme four-Barriers to Care.

Although the migrant SA population have a high level of education, they are often less well-informed about health care and, therefore, more likely to be unaware of their CVD risks (Grey et al., 2021). Increasing health literacy and awareness is essential to influence change. Supportive influences can come from healthcare workers, stakeholders, and politicians; all will contribute to sustained behavioural change and encourage the SA population to incorporate physical activity into their daily lives (Cainzos-Achirica et al., 2019; Eastwood et al., 2019; Palaniappan et al., 2018; Peiris et al., 2021).

Recommendations to improve health literacy include screening resources using personalised prevention and screening techniques involving being present where ethnic groups gather and might prove a successful initiative towards health promotion. This initiative aids in the collective delivery of tailored cardiovascular risk education that will benefit the SA population, for example, culture-based daily physical activity, promoting weight loss and dietary interventions like encouraging less salt intake (Cainzos-Achirica et al., 2019).

There is a need to allocate sufficient resources to local and national governments in the migratory country to enhance aggressive cardiac rehabilitative interventions to help sustain the preventative aspect of CVD post-myocardial episodes (Cainzos-Achirica et al., 2019). More aggressive approaches to cardiac health promotion are needed to reduce CVD risks and make health professionals and SA people aware of the need for targeted CVD risk assessment for the SA population. Muilwijk et al's (2021) study found that a family focused lifestyle intervention was effective in waist circumference reduction and weight loss for family members over a 12-month period for a SA population diagnosed with diabetes.

Diet plays a significant role in cardiovascular disease among the SA population. This population has a high intake of saturated fat food, high-glycaemic food, and foods high in salt (Ahmed et al., 2015). The health sector must address these dietary issues as a part of the cardiac rehab programme to help the SA population understand the risk of such food habits using a non-condescending education approach and counselling to help the SA population understand the risks of CVD with such dietary habits increases the CVD risk (Ahmed et al., 2015). However, most residents of SA origin are vegetarians with a high risk of developing CVD. Cardiac rehab approaches for CVD awareness can be initiated by integrating with culturally appropriate initiatives like conducting health literacy programs in places of worship, like temples, where the SA population have social gatherings (Cainzos-Achirica et al., 2019). Education at such places yields a favourable response. A high success rate (Cainzos-Achirica et al., 2019), with the SA population sharing food after the ceremony in temples, which is a regular occurrence and encourages to increase their fruit consumption and consume less high-carbohydrate food can help practically, which can create awareness of healthy food options thereby reducing their CVD risk factors (Ahmed et al., 2015).

Politics can contribute to the increased risk of CVD. Political deterrents include barriers to accessing the healthcare system, unreliable health and food supply chains and restricted access for migrant populations (Peiris et al.,2021). For example, enrolling oneself on primary health care in a migrant country might prove difficult due to various reasons like illegal migration, residency status of the individual, and less motivation among the migrant individuals to enrol as there is a cost involved for non- resident health care service (Peiris et al., 2021).

Factors such as insufficient health workforce staff numbers to assist in the early detection of CVD are barriers to care (Grey et al., 2021). Low priority of funding to provide the necessary tools to assist the workforce prevents the health sector from identifying CVD risk factors early. For example, fewer initiatives by the local and national government to create awareness about healthy lifestyle advice through education leaves the SA migrant community less advantaged (Ahmed et al., 2015).

Socioeconomic factors such as living in low decile areas due to a low-income means individuals cannot afford healthy food options like fruits and vegetables and therefore choose energy-dense and processed food, which are more readily affordable and available (Ahmed et al., 2015). Unhealthy options like cheap energy-dense food intercoupled with minimal physical activity facilitate the progression of CVD risk (Peiris et al., 2021). Inadequate

income also becomes a problem for individuals who need to get prescribed medications (Grey et al., 2021).

Summary

This chapter has revealed the four themes in this integrative review in detail including that a high BMI and diabetes were significant risks contributing to CVD in this population and has also outlines some novel theories underlining CVD risk in South Asians. The second theme showed that there is a need to promote physical activity as a preventative strategy and that pharmaceutical interventions are necessary. The third theme showed a need for an ethnic-specific CVD risk algorithm for the SA population that has biomarkers that are different to other ethnicities. Theme four addressed barriers to care, mainly focusing on health literacy and illuding that barriers are also social and political. The next chapter will provide a discussion based on these findings.

5. Discussion

5.1 Introduction

This integrative review explored the significant cardiovascular risk factors among SAs living in Western geographical locations and the critical interventions. This chapter will discuss each of the four main themes in more detail as they relate to South Asians: Theme one will discuss the high-risk factors identified, which included an increased BMI and diabetes within the SA population; theme two identified that promoting physical activity and pharmaceutical interventions are vital interventions to reducing CVD risk will be discussed. In the third theme, the need for an ethnic-specific CVD risk algorithm for the SA population and the fourth theme identifies barriers to care, especially health literacy. This chapter also includes the strengths, limitations, future recommendations, and a conclusion.

5.2 Discussion

Prominent risks and novel theories underlining CVD in South Asians.

This integrative review found that the most significant risk factor SA face that contributes to CVD is an increased BMI (Palaniappan et al., 2018; Cainzos-Achirica et al., 2019; Grey et al., 2021; Dalton et al., 2014; Eastwood et al., 2019). Due to having a smaller bone structure and body mass, the World Health Organisation (WHO) recommends that the ideal BMI among the SA population is 23kg/m2 or below; anything over is considered overweight or obese. The recommended SA population's BMI is between 18.5 kg/m2 and 22.9 kg/m2; this is relatively lower than the 18.5 kg/m2 -24.9 kg/m2 recommended for Europeans. If SA, who migrate to a new country are compared to the standardised measures they will have a mismatched obesity definition, so an adjusted BMI calculator would help accurately estimate CVD risk in this population. The need for a separate BMI scale created explicitly for ethnic-specific groups to get accuracy for CVD risk assessment is imperative, and so too is educating the migrant SA population about these weight parameters that are specific to them (Raza et al., 2019). Early awareness through changing the obesity scale on the assessment tool will help more accurately predict CVD risk. With an individualised BMI tool specific to the SA population (see Table 5), early interventions in decreasing weight reduces CVD risk in future (Hossain et al., 2019).

The health issues that stem from obesity are prominent in this integrative review. High obesity rates within this population mean that SA is at high risk for developing T2DM (Aras et al., 2021) and is a crucial biomarker identified in this study that places SA at risk for CVD (Palaniappan et al.,2018; Cainzos-Achirica et al., 2019; Grey et al., 2021; Dalton et al., 2014;

Eastwood et al.,2019). Although there is a direct connection between obesity and T2DM for all population groups, the higher someone's BMI, the higher the chance of T2DM (Aras et al., 2021).High BMI also results in developing hypertension (Hossain et al.,2019).However, for those who identify as SA, there is a higher chance of being obese, with predictions that between 19-79% of SA have central obesity. A high BMI in association with a small body frame means that, as a population, the majority of SAs are definitively more at risk for acquiring diabetes (Aras et al., 2021),

One of the theories as to why SA experience this phenomenon of high BMI is the possibility of famine that the SA population might have experienced during childhood. Peiris et al. (2021) highlight that some migrants, especially those who were refugees prior to living in Western countries, more than likely would have faced poverty and malnutrition during childhood in their native country (Gomez-Verjan et al. (2020). This phenomenon places them at a high risk of developing obesity in adulthood. The famine theory depicts the body desperately storing fat because it thinks it will go into famine (Grey et al., 2021). Recent studies have also shown that maternal stressors during pregnancy profoundly affect offspring who suffer low-birth weight but have gained weight rapidly in childhood and adolescence; such individuals have a high chance of experiencing a CVD event in later life (Ahmed et al., 2015). There is also a connection with those that experience infancy malnutrition which can influence the chance of developing high blood pressure in adult life due to high concentrations of fibrinogen production, factor VIII concentration in the blood, which triggers the inflammatory process and the chance of developing risk factors leading to CAD (Ahmed et al., 2015). Another theory as to why T2DM is so prevalent among specific ethnic populations is due to a FTO (fat mass and obesity-associated) gene and familial clustering. This gene defect can determine whether a particular individual will develop insulin sensitivity or insulin resistance in future stages of their lifetime (Bennet et al., 2018).

Although this integrated review identified that a high BMI and diabetes were vital contributors to CVD risk in the SA population (Aras et al., 2021), metabolic syndrome is also a risk factor that plays an important part when evaluating CVD risk (Palaniappan et al., 2018; Cainzos-Achirica et al., 2019; Eastwood et al., 2019; Peiris et al., 2021; Ahmed et al., 2015). Metabolic syndrome has combined risk factors such as increased body weight, cholesterol levels, blood pressure, insulin resistance, and diabetes (Fallaize et al., 2017). It is essential to target education specific to weight loss and to prevent conditions such as diabetes and metabolic syndrome; weight is a modifiable risk factor for CVD, so identifying and taking early measures to prevent obesity needs to become a priority (Aras et al., 2021).

Other reasons contributing to an increased BMI are SA's adopting the new lifestyle of the migrating country. As mentioned in the literature review, initially, when migrants arrive in a host country, the majority of SA are young and in good health (Terragni et al., 2022). However, when a new country's more modern way of living and social norms is adopted, this population is exposed to habits that contribute to weight gain. For example, migrants who move from rural to urban areas; may achieve better economic growth so they can spend money on food items that they could not afford under normal circumstances and are more likely to use more alcohol because of its accessibility compared to their native country, which indirectly affects their health. Low socioeconomic populations tend to buy foods rich in energy, which is palatable, affordable, and filling; however, they may not be healthy, which promotes an obesogenic environment (Swinburn et al., 2011).

Addressing and encouraging the SA population to reduce the amount of salt and sugar intake and reduce deep-fried food would help this population reduce CVD. There needs to be a target education-focused approach to the CVD risk factors to create awareness among this population (Jensen et al., 2014). Young people do not take the possible future CVD risks seriously (Terragni et al., 2022). However, young SAs could benefit from early prevention messages through health education so they can make informed choices and help to reduce CVD in later life. In order to reduce obesity risk, health sector specialists recommend a culture-based intelligence approach that prioritises mutual respect to improve the quality of health care provided (Jensen et al., 2014).

CVD prevention courses are recommended to maintain quality of care through comprehensive lifestyle intervention programs explicitly designed to suit individual needs (Jensen et al., 2014). Weight loss measures tailored to individual needs with cultural adaptation successfully create behavioural changes and can reduce weight, decrease cholesterol levels, and lower BP in the affected individuals. Such strategies have shown positive and sustainable outcomes towards healthy, disease-free living (Brown et al., 2015). Encouraging government-funded access to free physical activities, for example, having access to swimming pools for activities like aqua walking and water-based exercise, would encourage the population to reach and maintain personalised weight goals without hurting their pockets (MOH-Green Prescription, 2017 a). Rigorous measures to encourage adopting physical activity or exercise through a preventative approach initiative involving the whole family would encourage this population to be motivated to do life-style changes in their daily life (Bourdier et al., 2020).

Obesity, however, is a broader systemic problem, and goals are needed to reduce high salt and sugar-laden food products—policies enforced on the food sector, including retailers, manufacturers, and caterers are needed. An example would be the labelling of salt content in commonly sold food items like bread and cheese; all would help consumers make informed choices before purchasing food items (Mohammednezhad et al., 2016). Initiatives such as reducing the price of saltless food and raising the price of foods that use excessive salt could also help. The legal limits of salt released into the national NZ market is estimated using an average adult salt consumption of 2300 mg of sodium per day; this restriction regulated to come into the national market saved NZ $1.1 billion towards health gains. Including a mandatory salt tax helps increase NZ revenue by $ 452 million annually (Nghiem et al., 2015). Thereby achieving substantial health gain savings and reducing ethnic health inequalities. The health sector should advise the government to urge the food sector to reduce saturated fat and trans-fatty acids. The farming sector needs incentives to produce high-quality fresh produce. Hence, there is abundant supply, which improves affordability among lower socioeconomic groups to choose healthier options. This initiative would improve food safety standards for the health and safety of the consumer (Cainzos-Achirica et al., 2019).

The government could also give more subsidies and incentives to proactive businesses which promote healthy lifestyles, and local and national governments can contribute to further reforming food environments; the reforming process should involve businesses dealing with food products, like the standard food commission, research teams in the health sectors, individual retailers, the media, and the farmers (Nghiem et al., 2015). Working with non-governmental agencies and the health sectors at the tertiary and primary levels would also be beneficial in promoting change (Vandevijvere et al., 2020). New Zealand's neighbouring Pacific nation Tonga placed a custom duty charge on purchasing animal fats and soft drinks in the view of prevention steps of non-communicable diseases (NCDs) in the year 2018-19. The purpose of initiating the NCD prevention programme is to reduce the intake of energy-dense food and harmful use of alcohol intake and to encourage more physical activity among this group. Some evidence indicates that these taxes have had impact in high-income countries, little data are available for lower-income countries like Tonga (Wright et al, 2017).

In the food and agriculture organisation of the United Nations study, it was found that Tongan participants perceived that food-related taxes (in particular, the fatty meat related taxes) did not impact them almost a year after their implementation (Food and agriculture organisation of the United Nations, 2017). Most of the Tongan population were not aware of

the initiative that government was taking in order to improve health incomes. The radio media which conveyed messages about the food taxation initiatives did not reach much of the public especially the youth who did not listen to the radio. It was also found that culturally for the Tongan community, food products containing fat like mutton flap was such an important dish in get-togethers that families would sacrifice other costs of living to put meat on their table (Food and agriculture organisation of the United Nations, 2017).

Introducing tax changes was also difficult to navigate politically. Taxation strategies implemented through political governance must work alongside marketing businesses, key stakeholders and nutrition institutions to design policies around the nutrient content on food items towards achieving best health outcomes. This process would help make non-biased decisions of which products nutrient content are healthy and therefore reduce taxes for such food items and ensure that food content with high fat incur charges (Food and agriculture organisation of the United Nations, 2017). The Tongan government's decision-making process became so fraught in deciding which food products should be charged with higher tax that the World Health Organisation were brought in to help to develop "nutrient profile models" which aided the Tongan government to formulate new tax policies (Osornprasop et al.,2020).

The NZ government can also take measures to curb purchases on unhealthy foods such as high-carbonated drinks to help with weight control and prevent the diabetes epidemic (Taumoepeau et al., 2021; Pagliai et al.,2021 as cited in Marino et al.,2021). Media marketing firms should be encouraged to downsize their campaigns by displaying advertisements that promote fizzy drinks such as Coke and chips to consumers. These marketing advertisements will primarily appear during popular drama telecasts (Mhurchu et al., 2014). Marketing firms should be encouraged to air advertisements after hours. Such action would reduce the chances of young people being tempted or attracted to unhealthy food choices (Mohammednezhad et al., 2016).

As mentioned by Mehta et al. (2018) & Cainzos-Achirica et al. (2019), the former recommends that governing health bodies should encourage a salt reduction in processed foods, and the latter suggests vigorous health interventions like healthy food options should be encouraged to prevent CVD among the high-risk SA population.

5.2.2 Need for promoting both non-pharmaceutical interventions like physical activity and pharmaceutical interventions.

This integrative review found that physical exercise was the most recommended non-pharmacological intervention to prevent CVD in the SA population (Cainzos-Achirica et al.,

2019; Eastwood et al., 2019; Palaniappan et al.,2018; Peiris et al., 2021). Three authors (Villadsen et al., 2017; Cainzos-Achirica et al., 2019., Peiris et al. 2021), suggest that physical activity be added to risk assessment tools as one of the risk assessment variables.

Those who reside in lower-income countries are more physically active compared to the high-income countries; statistics show that in lower-income countries, 17% of the population lead an inactive lifestyle; comparatively high-income countries like New Zealand, statistics show that 34% of the population are inactive (Shridhar et al., 2014). The level of physical activity among the SA youth living in Western countries tends to be less vigorous than those 60 years and older living in SA countries, where adults lead a more energetic day-to-day lifestyle (Shridhar et al., 2014). The reasons for such a high percentage of inactivity in developed countries could be due to easy access to daily life comforts, for example, the use of cars instead of public transport, so walking to catch a bus to get to work is limited and time spent on outdoor activities is less due to time spent on digital gadgets and watching television (Shridhar et al., 2014). Physical activity should have precedence over blaming poor diet, genetics, socioeconomic differences, and cultural variations in eating habits (Bourdier et al., 2020).

Government policymakers and stakeholders must implement parallel policies and initiatives to encourage the adoption of physical activity, along with affordable foods rather than easy, energy-dense foods (Bourdier et al., 2020). The influence of sustained cardiovascular group education input from all levels of the health sector, such as primary, secondary, and tertiary, in promoting physical activity and creating motivation and willingness to work with the growing diverse population worldwide is imperative to reduce CVD risk (Swinburn et al., 2011).

Urquhart et al. (2021) recommend using Habermas' Theory of communicative action. This theory uses a critical hermeneutics yarn tool for communication. The use of this type of communication while assessing the risk assessment for CVD would be beneficial for ethnic communities that hold a different cultural, social, and personal perspectives. Findings revealed that using this type of communication style the ethnic community were able to express that they felt that their way of living was less valued due to the Westernised health systems (Urquhart et al., 2021). This understanding can prevent oppression and help bridge the gap between traditional practices towards healthy living with more contemporary evidence-based NCD prevention techniques. This understanding of the culture would encourage the ethnic communities to embrace the current evidence-based healthy lifestyle.

It would reduce health disparity and inequality in these countries involving the ethnic community, help promote CVD prevention, and blend it with their traditional practice. The Yarn communication tool helps to understand the various reasons experienced by the ethnic population which hinder their ability to perform and sustain traditional methods of staying fit and traditional methods of food practises by blending ancient ethnic population's healthy living practices from the past (Urquhart et al., 2021).

Many community programmes can help increase exercise within New Zealand; some examples include Zumba, gardening groups, and joining community patrol groups that do safety checkpoints within the community. Patrol groups help in community building and encourage ethnic communities to mix with other members of the public whilst staying healthy through walking (MOH-PA., 2023). These community activities can be promoted through brochure distribution within local suburban areas which may encourage the general public to join these free sessions and benefit from staying fit (MOH-Green Prescription., 2017 a). The New Zealand government also has initiatives that promote the welfare of the Pacific and Māori communities through education programmes. Sponsorship is available at the university level to increase knowledge by completing courses in medical, allied health and nursing education fields (MOH Pacific workforce., 2023). This promotion and support towards acquiring knowledge among the ethnic population specifically it can encourage ethnic community members upon completion to work within their communities and, in turn, advocate the importance of leading a healthy lifestyle and increasing well-being within their community in a culturally safe manner (MOH Pacific workforce., July 2022). However, these initiatives are not available for the SA's population but could be an area for future investment.

This integrative review found that it is essential to initiate medication early as a preventative strategy to reduce CVD in SA (Beaney et al., 2015; Mehta et al., 2018; Cainzos-Achirica et al., 2019; Ahmed et al., 2015; Palaniappan et al., 2018). Treating, controlling, and preventing T2DM through initiating early lifestyle changes like regular exercise and early drug therapy is an effective intervention to prevent the early onset of CVD in the SA population (Swinburn et al., 2011). The American diabetes association and the European Association for the Study of Diabetes suggest using newer medications such as SGLT-2 inhibitors like empagliflozin as a second option after metformin to control T2DM. They effectively prevent cardiovascular risk (Bloomgarden & Handelsman, 2020). However, estimation shows that 33%–68% of SA patients remain non-adherent to their medication regimes (Palanisamy & Sumathy, 2009). The most recent guidelines from the American heart association/American College of

Cardiology (AHA/ACC) suggest a need for starting lipid-lowering medications to ensure preventative cardiology is sustainable; the recommendation to start lipid-lowering medications needs to match the client's acceptance (Papaioannou et al., 2020).

A client-centred approach toward early pharmacological interventions for people at risk of CVD, a point raised by (UKPDS) United Kingdom prospective diabetes study (Van Dieren et al., 2010); if the SA population does not embrace health awareness and acceptance of early intake of medications, the joint effort towards reducing CVD risk will not transpire (Van Dieren et al., 2010).

5.2.3 Need for an ethnic-specific CVD risk algorithm for SA population

It became apparent in this integrative review that there is much variety in the standardised assessment tools used to assess CVD risk and that there need to be additional biomarkers added for those who identify as SA (Beaney et al., 2015; Dalton et al., 2014; Palaniappan et al., 2018; Mehta et al., 2018; Cainzos-Achirica et al., 2019; Eastwood et al.,2019).

It was noted in the ten articles that there need to be lower thresholds for cholesterol, a need for SA ethnic-specific BMI and waist circumference (WC) measurements, blood glucose levels and modified HbA1c to help prevent underestimation of CVD risk (Palaniappan et al., 2018). Peiris et al. (2021) agreed and identified a need to include abdominal circumference, body weight, and the level of physical activity someone does as a variable that needs inclusiveness in a risk tool assessment for SA populations. Beaney et al. (2015) advocate that a gene score (GS) must be added as an added variable to improve identifying the clinical utility of CVD risk estimation among the SA population.

Two authors in this integrative review emphasised the need for risk assessment to begin at an earlier age for SA (Dalton et al., 2014; Mehta et al., 2018). Mehta et al. (2018) specify that the SA population needs screening and should begin at 30 years of age for SA males. Cainzos-Achirica et al. (2019) made recommendations that gender needs to be a consideration when evaluating risk, with both genders requiring early identification, especially for SA men. They also suggest that the lower BMI threshold needs to be included, along with assessing physical activity in their daily living (Cainzos-Achirica et al.,2019).

Villadsen et al. (2017) recommend computed tomography coronary angiography to give a more accurate picture of the composition of non-calcified plaque in the coronary arteries, which would help prevent an acute cardiovascular event. Eastwood et al. (2019) recommend that Albumin creatinine ratio levels in CVD risk predictions. Based on these findings

amalgamating all these suggestions into one tool specific to SAs would be desirable. Modified diagnostic values will reflect what average range values are specific to the SA population compared to the target range for the general European population (Palaniappan et al., 2018).

Having an ethnic-specific separate algorithm will help to prevent this group from missing essential healthcare treatment. It will ultimately help SAs qualify for funding, such as free access to green prescriptions for physical activity. Through tailored ethnic education programmes for the SA population, health awareness and health-conscious attitudes will enable this population to have regular pre-health checks for CVD risk. GPs should encourage the SA population to get CVD risk assessments when they visit their general practices (Raza et al., 2019). Early identification of CVD risks and creating awareness of the need for a specific ethnic-specific risk model algorithm is essential. It will prevent the burden on the health system to treat CVD and complications like stroke. The global burden of NCDs is on the rise, and identifying the risks for CVD early among the SA population would help achieve sustainable goals to reduce premature mortality (Peiris et al., 2021).

Two risk assessment tools noted in this integrative review were the most comprehensive in assessing the SA population's risk for CVD. These tools included QRISK 2 (Dalton et al., 2014) and New Zealand's PREDICT tool (Mehta et al., 2018). Each can identify CVD risk among the SA population, thereby reducing the healthcare system's burden (Mehta et al., 2018). However, specific SA risk assessment model calculators will only be practical if health personnel are educated in their use to assess the SA population. Health professionals' knowledge around ethnic differences for SA must be increased by updating and raising awareness through in-service education sessions among primary and tertiary level clinicians regarding the use of a separate risk tool algorithm targeting the SA ethnic group is needed to help prevent poorer outcomes for the SA population (Palaniappan et al., 2018).

5.2.4 Barriers to Care.

Numerous barriers to care in CVD prevention were noted in this integrated review, particularly the need for increased health literacy within the SA population (Cainzos-Achirica et al., 2019; Eastwood et al., 2019; Palaniappan et al., 2018; Peiris et al., 2021). The migrant population have high education levels but does not necessarily possess health literacy skills (Reid & White., 2012). It is essential to promote health literacy to educate the population about CVD-related risks so they can make informed decisions about their health (Cainzos-Achirica et al.,2019), especially among the new migrant SA population might aid in preventative measures to delay CVD risk (Reid & White., 2012).

Nurses who conduct nurse-led clinics and nurse-directed case management strategies have an essential role in preventing CVD (Berra et al., 2017). Many patients show up at the later stages of CVD because they do not know the symptoms; health professionals need to address this knowledge deficit by understanding issues such as illiteracy and poor socioeconomic backgrounds that may limit access to care (Gupta & Yusuf, 2019). Migrant populations who move to a new country usually domicile in low-decile areas and require more support and input; understanding this will help clinicians estimate CVD risk across the SA population (Mehta et al., 2018).

Education around making lifestyle changes will help reduce complications associated with diabetes (Swinburn et al., 2011); the health sector could then formulate a public health initiative to increase awareness of obesity and use of nurse-led clinics in the primary care sector and tertiary care units need to include health education about obesity (Crengle et al., 2018). Early initiation of antihypertensive, antidiabetic, and anti-cholesterol medications within primary health care is an additional initiative to prevent or delay CVD occurrence (Pearce & Longhurst, 2021). Promoting health literacy among high-risk CVD populations must be prioritised (Crengle et al., 2018).

Addressing health issues in a culturally sensitive way is paramount for gaining concordance among the targeted ethnic group (Ashraf et al.,2017).The measures taken to prevent or delay CVD risks will not succeed unless the transformation begins within the individual in creating self-awareness and self-efficacy around adopting healthy living. A hermeneutic approach is valuable for medical and health sector staff to use in delivering CVD assessment skills (Urquhart, 2021). This approach considers a person's internalisation of an event and considers the psychological and sociocultural dynamics of the migrant population; this approach can help the health system to plan and educate the high-risk population in a pro-active efficient manner ensuring equity in the social determinants of health (Urquhart, 2021).

Prevention is better than cure is a driving Mantra adopted by government agencies and a focus for health budgets that focus on preventative costs rather than on treating diseases (Auckland, Waikato, Wellington Council, 2013). The ethnic population's well-being can be given importance by targeting early risk factors, which originate due to behavioural factors of everyone; for example, the lifestyle that leads to weight gain, high sugar intake and salt intake; hypertension, and smoking prevention by adopting specific goals tailored and targeted to counter these issues to delay CVD among the SA population (Pearce & Longhurst, 2021).

Ashraf et al. (2017) describe that by creating awareness and educating the SA population through supportive measures would enable acceptance of early pharmacological treatment. Raising awareness about heart ailments among the SA population via volunteer-driven health promotion programs in a religious setting is advantageous, encouraging interaction and facilitating cooperation and acceptance of the most beneficial health outcomes; this initiative empowers the SA population to take steps towards healthier options in a culturally safe manner (Ashraf et al., 2017).

Cardiovascular disease requires long term ongoing specialised care. For this purpose, nurses play a variety of roles across different contexts including primary, community and tertiary level (Krowczyinska & Jankowska., 2020). With the close contact that they have with patients, nurses are ideally positioned to deliver 'heart healthy' advice to patients. . Research demonstrates that nursing involvement reduces barriers to accessing advice and support and extends involvement to the multidisciplinary team supporting the best health outcomes (Krowczyinska & Jankowska.,2020). The primary nurse in the clinical areas need to emphasise more on health education by providing counselling on healthy behaviour change and promoting healthy lifestyle (La sala et al., 2017). Nurses play an important role in teaching patients about self-care including symptom monitoring, medication compliance and encouraging them to get help from the medical team at an early stage (La sala et al., 2017).

Nurse Practitioners can be involved in promoting health awareness by providing patient-centred care which can help patients adhere to evidence-based recommendations (O'Toole et al., 2020). O'Toole's study demonstrated that using a mobile app along with the expertise of a nurse practitioner-led team improved the compliance and awareness of CVD risk (O'Toole et al., 2020). Shi et al's (2022) article also showed that using a mobile app for assessing exercise compliance as part of the management post CVD improved self-awareness and improved motivation for participants to exercise on follow-up post myocardial infarction treatment (Shi et al.,2022).

5.3 Conclusion

The SA population has five times the risk of developing CVD than their European counterparts, which is a concern not only for those who identify as SA but for the health care system and government agencies. This integrative review identified that the most significant risk factors contributing to this endemic are raised BMI, T2DM and metabolic syndrome, where smoking and hypertension are less prevalent. Targeting weight reduction is vital and physical activity is the suggested nonmedical intervention that can achieve this, along with

current pharmacological interventions. Developing a newly revised ethnic-specific population risk calculator containing modified risk factor values specific to the SA population are imperative. Recommendations include health checks that include blood pressure, weight and blood tests that begin as young as 30 in males and 40 years in females. However, health professionals must understand and know when to utilise them. For any intervention to be successful, it is essential to increase health literacy; this can be achieved by raising awareness within the SA community using culturally appropriate approaches and educating the health care team.

5.4. Strengths and Limitations

This integrative review has many strengths; the integrative review process was rigorous, following inclusion-exclusion criteria and PRISMA reporting guidelines. MMAT screening and theme identification by two authors which helps with reproducibility. There was a mixture of methodologies, including two mixed-methods studies and eight quantitative studies to answer the research question. The study has highlighted the most critical risk factors and the preventative strategies for preventing CVD; this is important as often this population are not well understood, so this integrative review helps to define and look at the reasons why CVD is so prevalent in those who migrate and acknowledgement for health equality for CVD prevention in New Zealand is raised. This Integrative review has some limitations. The inclusion criteria only focused on studies in the English language and papers from Western countries, which may limit the inclusion of articles published in other languages or that focused on CVD risk in South Asian countries that could identify risks and interventions. Selection bias is possible as only a single author completed the initial screening of articles.

5.5 Recommendations for future research.

This integrative review showed variation between risk assessment tools currently used, and many fell short in assessing those who identify as South Asian. This integrative review recognised many ethnic-specific variables and would be beneficial to include in a newly developed risk assessment tool to assess SAs accurately. A future study that blends all these suggestions into creating an SA-specific algorithm ensuring validity would be beneficial.

Nurse delivered initiatives should be promoted in future qualitative studies, helping assess health literacy specifically among the SA populations around CVD risk. This understanding of the level of health literacy among the SA population helps the health sector define the

level of guidance that the health staff need to place more quality input to increase health literacy awareness among the high CVD risk SA population.

Many of the authors in this integrative review identified future studies that will be beneficial in analysing why SAs are at risk. Using techniques such as deoxyribonucleic acid (DNA) methylation could show the role of gene inheritance on T2DM among the SA population (Palaniappan et al., 2018). Advanced research to address how epigenetics affect the microRNA, a genetic component involved in developing hypertension and dyslipidaemia among the SA population, calls for future research studies into the impact that early initiation of anti-hypertensives and cholesterol-lowering medications play in reducing CVD among the SA population would help bridge existing gaps and enhance our understanding of this population's benefit from early initiation of drug therapy.
Another example is the need for further understanding through follow-up studies to evaluate the benefits of health promotion campaigns in influencing behaviour and attitude change and a quantitative study that evaluates health professionals' knowledge and understanding of South Asian risk factors would be beneficial.

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Appendices.

Appendix A: Mixed Methods Appraisal Tools (MMAT), version 2018.

Appendix B: Summary of the reviewed articles.

Appendix C: Authors recommendation for adding risk factor variables to the assessment tool

Appendix A MMAT results

	Screening Questions		**Qualitative Studies**					
Author/Year	**S1. Are there straightforward research questions?**	**S2. Do the collected data allow us to address the research questions?**	**Is the qualitative approach appropriate to answer the research question?**	**Are the qualitative data collection methods adequate to address the research question?**	**Are the findings adequately derived from the data?**	**Do data sufficiently substantiate the interpretation of results?**	**Are qualitative data sources, collection, analysis, and interpretation coherence?**	**Comments?**
Palaniappan et al., 2018	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**85%**

Screening Questions and Qualitative studies

Mixed Methods Appraisal Tool Mixed methods studies.

	Screening Questions		Mixed Methods Studies					
Author/Year	Are there straightforward research questions?	Do the collected data allow us to address the research questions?	Is there an adequate rationale for using a mixed-methods design to address the research question?	Are the different components of the study effectively integrated to answer the research question?	Are the outputs of the integration of qualitative and quantitative components adequately interpreted?	Are divergences and inconsistencies between quantitative and qualitative results adequately addressed?	Do the different parts of the study adhere to the quality criteria of each tradition of the methods involved?	Comments
N/A								

Mixed Methods Appraisal Tool Non-Randomized Studies

	Screening Questions		Non-randomized Studies					
Author/Year	S1. Are there straightforward research questions?	S2. Do the collected data allow us to address the research questions?	Are the participants representative of the target population?	Are measurements appropriate regarding both the outcome and intervention (or exposure)?	Are there complete outcome data?	Are the confounders accounted for in the design and analysis?	Was the intervention administered (or exposure occurred) as intended during the study?	Comments
Eastwood et al., 2019	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100%

JBI Critical appraisal checklist for text and opinion papers.

Author/year Ahmed et al.,2014 Record Number https://doi.org/10.11770003319714541323.

		Yes	No	Unclear	Not applicable
1.	Is the source of the opinion identified?	√□	□	□	□
2.	Does the source of opinion have standing in the field of expertise?	√ □	□	□	□
3.	Are the interests of the relevant population the central focus of the opinion?	√□	□	□	□
4.	Is the stated position the result of an analytical process, and is there logic in the opinion expressed?	√□	□	□	□
5.	Is there a reference to the extent of literature?	√□	□	□	□
6.	Is any incongruence with the literature/sources logically defended?	√□	□	□	□
	Overall appraisal: Include √□		Exclude □		Seek further info □
Comments (Including reason for exclusion)		Yes meet.			

Mixed methods appraisal tool quantitative studies.

Author/Year	Is the sampling strategy relevant to addressing the research question?	Is the sample representative of the target population?	Are the measurements appropriate?	Is the risk of non-response bias low?	Is the statistical analysis appropriate to answer the research question?	Comments
Villadsen et al., 2017	Yes	Yes	Yes	Yes	Yes	100%
Mehta et al., 2018	Yes	Yes	Yes	Yes	Yes	100%
Beaney et al., 2015	Yes	Yes	Yes	Yes	Yes	100%
Peiris et al., 2021	Yes	Yes	Yes	Yes	Yes	100%
Grey et al., 2020	Yes	Yes	Yes	Yes	Yes	100%
Dalton et al., 2014	Yes	Yes	Yes	Yes	Yes	100%
Cainzos-Achiraca et al., 2019	Yes	Yes	Yes	Yes	Yes	100%

Appendix B: Summary of reviewed articles

Tool Name	**Framingham 10yr score USA**	**Modified Framingham Score (NICE2008) JBS2 (Joint British societies2) UK**	**QRISK2** **UK**	**Predict NZ-Sex-specific Cox model**
Authors	Beaney et al., 2015 Palaniappan et al.,2018	Cainzos-Achirica et al. (2019) Dalton et al. (2014)	Dalton et al. (2014)	Mehta et al.,2018
Common General Risk Factors Identified in the various tools are	had four typical risk factors age, gender, smoking history and systolic blood pressure.	had four typical risk factors age, gender, smoking history and systolic blood pressure.	had four typical risk factors age, gender, smoking history and systolic blood pressure.	Web based risk assessment platform to estimate accuracy of CVD risk prediction.It includes 8 datasets like demographic, inpatient visits, primary care enrolments, community lab requests, outpatient appointments, community pharmacy dispensing.
Additional Risk Factors variables	**Plus** Diastolic BP, total cholesterol, HDL cholesterol, left ventricular hypertrophy, diabetes.	**Plus** standard multiplication factor of 1.4 for SA men to calculate risk of CVD.	**Plus** T2DM Cholesterol levels, BMI, family history of CHD, social	**Plus** Sex-specific Cox model algorithms to understand and predict the risk of CVD in the

		T2DM, ethnicity, and deprivation status	deprivation status, ethnicity, rheumatoid arthritis, CKD & AFib	next five years.This includes gender ,age, ethnicity, levels of deprivation, diabetes, prior hospitalisation with AFIB,any intake of BP lowering medication,a cholesterol-lowering medication, antiplatelet and anticoagulant therapies.

Appendix C- Authors recommendation for adding risk factor variables to the assessment tool.

Authors	**Recommendations for adding risk factor variables to the assessment tool.**
Dalton et al.,2014	Need for including risk variable choices specific to address ethnic inequalities in CVD. Need for adding T2DM and Weight variables to the risk assessment tool. Need for adding ACR levels to the risk assessment tool.
Peiris et al.,2021	Need for adding abdominal circumference, weight and level of PA to the risk score tool.
Palaniappan et al.,2018	Need for modified diagnostic values & anthropometric measurements specific to SA population. Reducing the age for assessing CVD risks. Emphasis for updating awareness in regards to use of separate algorithm for SA population
Cainzos-Achirica et al.,2019	Include CHD for both genders separately in the risk factor variables. Need for using ethnic specific algorithm.

	Modified BMI values To include questionnaire about how much of PA is performed by the SA population.
Mehta et al.,2018	Target Age group starting from 30 years in SA population. Include demographic information, inpatients hospital visits, primary care enrolments, community lab requests, pharmacy dispensing details.
Villadsen et al.,2017	No specific risk tool format was followed but recommendationto add CTA results to risk tool (Coronary computed tomography angiography) for prevalence of coronary stenoses. Need for including a set column to identify how much PA is done by this population.
Beaney et al.,2015	To include gene score (GS) to the variables in risk tool to easily identify CVD risk among the SA population.