Risk of Cardiovascular Disease in Women with a History of Complications of Pregnancy: From Awareness to Management

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Certificate of Original Authorship

I, Farnoosh Asghar Vahedi, declare that this thesis is submitted in fulfilment of the requirements for the award of Doctor of Philosophy, in the Faculty of Health at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise referenced or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis. This document has not been submitted for qualifications at any other academic institution. This research is supported by the Australian Government Research Training Program.

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Who always had belief in my abilities and supported my dreams.

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Overview of the Thesis

This thesis is organised into 9 chapters, with each chapter addressing a specific aspect of the study:

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Chapter 2: This chapter covers the theoretical framework of the study, including definitions of health, health literacy, health promotion, and health behaviour theories and frameworks. Additionally, this chapter explores how knowledge and risk perception affect health behaviours among individuals.

Chapter 3: This chapter presents a literature review of the risk of cardiovascular disease in women with a history of specific complications of pregnancy. It includes 3 literature reviews: the first addresses cardiovascular disease risk in women with a history of pregnancy loss (miscarriage and stillbirth); the second focuses on the associations between hypertensive disorders of pregnancy and future cardiovascular disease among women; and the third synthesises evidence on the association between gestational diabetes and cardiovascular disease in women's later life.

Chapter 4: This chapter describes the methodology of the study, including the research design, study instruments, population from which data were collected, approach to sampling and participant recruitment, data collection methods, data analysis, and ethical considerations.

Chapter 5: This chapter presents the results of the study, focusing on the knowledge and health-related behaviours of women with a history of complications of pregnancy about cardiovascular disease risk associated with their obstetric history.

Chapter 6: This chapter presents the results of the study, focusing on the knowledge and practices of healthcare providers regarding cardiovascular disease risk in women with complications of pregnancy.

Chapter 7: This chapter provides an overall discussion of the main findings of the women's study and the healthcare providers' study and finalises the findings of this thesis.

Chapter 8: This chapter presents the conclusion of the study, identifies its strengths and limitations, sets out the implications of the findings, and makes recommendations for clinical practice, education, policy, and future research.

List of Abbreviations

ASCVD	atherosclerotic cardiovascular disease
BMI	body mass index
BP	blood pressure
CAD	coronary artery disease
CHD	coronary heart disease
CVD	cardiovascular disease
CI	confidence interval
GDM	gestational diabetes mellitus
HR	hazard ratio
HDP	hypertensive disorders of pregnancy
HDL-C	high-density lipoprotein cholesterol
IHD	ischemic heart disease
T2DM	type 2 diabetes mellitus
LDL-C	low-density lipoprotein cholesterol
MI	myocardial infarction
NHDL-C	non–high-density lipoprotein cholesterol
TG	triglyceride
UK	United Kingdom
USA	United States of America
WHO	World Health Organization

Publications Related to this PhD Study

Asgharvahedi, F., Gholizadeh, L., & Siabani, S. (2019). The risk of cardiovascular disease in women with a history of miscarriage and/or stillbirth. *Health Care for Women International, 40*(10), 1117-1131. https://doi.org/10.1080/07399332.2019.1566332

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Definition of Terms for this Thesis

Cardiovascular disease

Cardiovascular disease is a group of disorders that affect the heart and blood vessels. It includes conditions such as coronary heart disease, cerebrovascular disease (stroke), and peripheral artery disease (World Health Organization [WHO], 2021a).

Complications of pregnancy

Complications of pregnancy are conditions or pathological processes that may occur during or after pregnancy. These can include gestational diabetes, pre-eclampsia, ectopic pregnancy, miscarriage, and stillbirth. Some complications may be preventable through appropriate prenatal care and lifestyle changes, while others may require medical intervention (Cunningham et al., 2014).

Coronary heart disease / ischemic heart disease

Coronary heart disease, also known as ischemic heart disease, is a condition in which the arteries that supply blood to the heart become narrowed or blocked, typically due to a build-up of plaque (WHO, 2021a).

Disease prevention

Disease prevention refers to actions and methods aimed at reducing the likelihood of a disease or disorder affecting an individual. This can include primary prevention, which involves preventing the disease from occurring in the first place, and secondary prevention, which involves detecting and treating the disease early to prevent complications (WHO, 2014).

Health

Health refers to a state of complete physical, mental, and social wellbeing and not merely the absence of disease or infirmity. It encompasses a range of factors, including lifestyle, environment, genetics, and access to healthcare (WHO, 2012).

Health behaviour

Health behaviour refers to the actions and habits that individuals engage in to maintain, restore, or improve their health and prevent illness. These behaviours can include exercising regularly, eating a healthy diet, getting enough sleep, and avoiding risky behaviours such as smoking and substance misuse. Health behaviours reflect individuals' health beliefs (Conner & Norman, 2017).

Health education

Health education refers to programs and initiatives designed to educate individuals and communities about healthy behaviours and disease prevention. This can include information on healthy eating, exercise, and disease screening and prevention (Sharma, 2021).

Health knowledge

Health knowledge refers to the knowledge and understanding that individuals have about health-related issues. This can be acquired through education, personal experience, and exposure to health information (Gellert & Tille, 2015).

Health literacy

Health literacy is the ability to access, understand, evaluate, and communicate health information effectively in order to make informed decisions about one's health. This includes the ability to navigate healthcare systems, understand medical terminology, and interpret health-related information (Gellert & Tille, 2015).

Health promotion

Health promotion is the process of enabling individuals and communities to take control of their health by addressing the social, economic, and environmental factors that influence health. This can include initiatives to promote healthy behaviours, improve access to healthcare, and create supportive environments for health (Sharma, 2021).

Risk perception

Risk perception refers to an individual’s subjective assessment of the likelihood and potential consequences of a particular event or behaviour. This can be influenced by a range of factors, including personal experience, cultural background, and the availability of information about the risks and benefits of a particular behaviour (Ferrer & Klein, 2015).

Abstract

Cardiovascular disease (CVD) is the leading cause of death worldwide, and women who experience complications during pregnancy, such as pregnancy loss (miscarriage and stillbirth), hypertensive disorders of pregnancy (HDP), and gestational diabetes (GDM), have a significantly higher risk of future CVD. Increasing awareness of CVD risk among these women and healthcare providers is crucial for effective engagement in risk reduction programs. This study aimed to identify knowledge gaps of Australian women with a history of complications of pregnancy and healthcare providers regarding CVD risk associated with one or more complications of pregnancy, and to explore women and healthcare providers' practice towards the management of the risk. Three literature reviews were conducted to synthesise evidence on the association between complications of pregnancy and future CVD in women. Two cross-sectional surveys were conducted, recruiting 299 women and 397 healthcare providers in Australia. Data were collected through face-to-face and online surveys and analysed using quantitative descriptive and inferential statistical procedures.

The literature reviews consistently demonstrated that women with a history of pregnancy loss, HDP, and GDM are at an increased risk of developing CVD in the future. The results of both surveys demonstrated that study populations, including both women and healthcare providers, had suboptimal levels of knowledge about the increased risk of CVD associated with complications of pregnancy. A significant number of women were not aware if they had CVD risk factors and were not engaged in behaviours and programs to reduce their risk. Also, healthcare providers showed insufficient practice and attitudes towards the assessment, prevention, and management of CVD risk among these high-risk women. The study identified knowledge and practice gaps among women and healthcare providers regarding the increased risk of CVD associated with a complicated pregnancy. It was shown that CVD risk in this group of women was mismanaged by healthcare providers. The study

highlights the need for education, support, and future research to increase awareness and knowledge of CVD risk among women and healthcare providers, and to improve their attitudes and practices towards managing CVD risk in this high-risk group of women.

Chapter One: Introduction

Introduction to the chapter

The aim of this chapter is to introduce the thesis including its aims and research questions and provide a background to the topic under study. The background includes an overview of cardiovascular disease (CVD) and its risk factors; the risk of CVD in women in general and in women with a history of complications of pregnancy; gender differences in cardiovascular assessment and management; and the healthcare system in Australia. Finally, it will present the significance of the study.

Study aim

The study aimed to investigate the knowledge and awareness of CVD risk in women with complications of pregnancy and their engagement in behaviours to reduce the risk of CVD. This study also aimed to investigate the knowledge of healthcare providers of the associated risk and the way they manage the risk in this group of women. The ultimate aim of this study was to improve assessment and management of CVD risk among women with complications of pregnancy.

Study questions

1. What is the level of knowledge and awareness regarding the risk of CVD among women who have experienced complications during pregnancy?
2. What are the current behaviors and practices related to reducing CVD risk among women who have a history of pregnancy complications?

3. What is the level of knowledge and awareness among healthcare providers regarding the risk of CVD in women, particularly in those who have experienced complications during pregnancy?
4. What are healthcare providers' current practices towards the assessment, prevention, and management of CVD risk in women with a history of complications of pregnancy?

Background to the study

CVD refers to a group of conditions and diseases that affect the heart and blood vessels. This includes several specific conditions such as coronary heart disease (CHD)/ischemic heart disease (IHD), cerebrovascular disease, peripheral arterial disease, rheumatic heart disease, congenital heart disease, deep vein thrombosis, and pulmonary embolism. Acute events such as heart attacks and strokes are often caused by blockages that prevent blood from flowing to the heart or brain (Australian Institute of Health and Welfare, 2019b; WHO, 2017). Coronary heart disease (CHD) is the most common manifestation of CVD and accounts for 30–50% of all CVD diagnoses (Korczak et al., 2021; Wilson & Douglas, 2015). It develops when plaque build-up blocks the coronary arteries, which are responsible for supplying oxygen-rich blood to the heart muscle (Wilson & Douglas, 2015).

CVD is a major global health concern and the leading cause of death, accounting for approximately 30% of all deaths worldwide (Mozaffarian D et al., 2015; WHO, 2021a). In 2019, almost 17.9 million deaths were attributed to CVD globally, with a 21.1% increase from 2007 (Virani et al., 2020; WHO, 2021a). In the United States of America (US), CVD was the leading cause of death in 2017, with 365,914 people dying of CHD, the most common type of CVD (Virani et al., 2020). The age-adjusted prevalence of all types of CVD was 10.6% in the same year (Tsao et al., 2022).

Among CVD-related deaths in the US, CHD has the highest mortality rate at 42.6%, followed by stroke (17.0%), high blood pressure (10.5%), heart failure (9.4%), vascular diseases (2.9%), and other minor CVD causes combined (17.6%) (Virani et al., 2020). According to the American Heart Association (AHA), the prevalence of CVD is projected to increase by 9.9% in the US by 2030, with heart failure and stroke prevalence expected to grow by approximately 25% (Mozaffarian et al., 2015). Based on these projections, the total direct healthcare cost of CVD is expected to rise to US$818 billion, and the total indirect cost due to lost productivity is expected to reach US$275 billion (Mozaffarian et al., 2015).

In line with the international trends, CVD remains the leading cause of death in Australia, accounting for about 30% of all deaths (Australian Institute of Health and Welfare, 2020b). The prevalence of CVD among Australians was around one in 20 (4.8%) in 2017–2018 and has remained almost unchanged since then (Australian Institute of Health and Welfare, 2020b). In 2017, there were 43,477 deaths attributed to CVD in Australia, which accounted for 27% of all deaths in this country in the same year, comprising 26% males and 28% females (Australian Bureau of Statistics, 2018a). Therefore, on average, 119 Australians died every day – or one person every 12 minutes – from CVD in 2017 (Australian Bureau of Statistics, 2018a). Similarly, in 2012, 43,900 deaths in Australia were due to CVD, which means the rate of death due to CVD remained constant from 2012–2017 (Australian Bureau of Statistics, 2018a). Also, among Australian Aboriginal and Torres Strait Islander people, CVD was the second leading cause of death, after cancer, accounting for 23% of deaths in 2014–2018 (Australian Institute of Health and Welfare, 2020a). Indigenous Australians alone had CVD hospitalisation and death rates that were over 50% higher than non-Indigenous Australians in 2017–2018 (Australian Institute of Health and Welfare, 2020b). However, in Australia, data propose significant discrepancies in the prevalence rates of CVD in different population groups, geographical areas, and socioeconomic statuses (Australian Institute of

Health and Welfare, 2020b). For instance, the statistics vary across different geographical regions, with the prevalence rates ranging from 123 deaths per 100,000 people in the Australian Capital Territory to 187 per 100,000 people in Tasmania (Australian Bureau of Statistics, 2018a).

Furthermore, the CVD death rate in remote and very remote areas is about 1.4 times higher compared with other areas (Australian Institute of Health and Welfare, 2020b). Also, the death rate is 1.5 times higher in the lowest socioeconomic areas compared with the highest socioeconomic areas (164 and 112 per 100,000, respectively) (Australian Institute of Health and Welfare, 2020b). Similarly, Aboriginal and Torres Strait Islander people, those living in regional and remote areas, and individuals from lower socioeconomic groups generally experience higher rates of CVD-related hospitalisation and death than other Australians (Australian Institute of Health and Welfare, 2020b). Overall, regardless of geographical areas, Aboriginal and Torres Strait Islander people have higher rates of CVD-related deaths, with the mortality being more than double that of the rest of the population (Australian Institute of Health and Welfare, 2020a; Nichols et al., 2016).

The prevalence of CVD is rising in Australia, irrespective of the advances in medical technology and the improvement of prevention and management strategies (Australian Institute of Health and Welfare, 2020b). CVD places a considerable burden on healthcare systems as well as on individuals (Australian Institute of Health and Welfare, 2020b). In Australia, CVD accounted for about 13% of the total disease burden in 2018, slightly lower than its 15% in 2015 (Australian Institute of Health and Welfare, 2021). In 2018–2019, an estimated 8.7% of the total allocated expenditure in the Australian health system (A$11.8 billion) was attributed to CVD (Australian Institute of Health and Welfare, 2021). Also, in 2012–2013, the cost of healthcare services to patients admitted to hospitals with CVD was A$5 billion. This accounted for 11.1% of the total hospital cost, the largest share of health expenditure of any disease group (Australian Institute of Health and Welfare, 2017). In 2013–2014, the cost of cardiovascular system medication was about A$1.6 billion, which was 17% of the total of the Pharmaceutical Benefits Scheme paid in that year (Nichols et al., 2016). Regarding indirect costs, about 1.4 million Australians (6.9% of the population) have a disability associated with CVD (Australian Institute of Health and Welfare, 2017). Based on years of life lost or premature death, CVD was responsible for 25.8% of Australia's total disease burden in 2010, which is lower than that of other high-income countries (Australian Institute of Health and Welfare, 2017).

Cardiovascular risk factors

Several risk factors contribute to the development of CVD. The leading risk factors contributing to the total CVD burden in 2018 included high blood pressure (36%), dietary risks (31%), overweight (including obesity) (22%), high cholesterol (21%) and tobacco use (11%) (Australian Institute of Health and Welfare, 2021). CVD risk factors are categorised as modifiable and non-modifiable risk factors (Choudhury et al., 2015; Yusuf et al., 2020). The impact of these risk factors in the development of CVD is explained in the following section.

Non-modifiable risk factors

Age is a non-modifiable risk factor and one of the most influential for the development of CVD. About 80% of CVD deaths occur in people aged 65 and over (Rathore et al., 2018). Men tend to develop CVD at earlier ages than women (Huma et al., 2012; Rathore et al., 2018). In women, the protective effect of oestrogen against CVD results in approximately an 8–10-year delay in the onset of the disease (Saeed et al., 2017). After menopause, however, the risk of developing CVD increases similarly across genders (Saeed et al., 2017).

Family history is another non-modifiable CVD risk factor. A positive family history is a strong predictor of future CVD, and there is about a twofold increase in the CVD risk in the presence of a positive family history (Choudhury et al., 2015; Rathore et al., 2018). In a case–control study in India, a family history of CVD was strongly associated with premature CHD (odds ratio [OR] 9.0; 95% Confidence Interval [CI] 4.7 to 17.3), independent of age, sex, and other major risk factors (Chacko et al., 2020). Also, an earlier study indicated that among individuals with hypertension, a family history of CVD was independently associated with incidence of CVD and mortality (Valerio et al., 2016). Hence, a positive family history of CVD could reflect an underlying genetic predisposition related to CVD (Valerio et al., 2016). In addition, people of particular races and ethnic groups are at higher risk of CVD. Ethnicity refers to people with the same cultural background or geographic ancestry and race (Muncan, 2018). An ethnic group or race can carry a specific genetic makeup and environmental effects predisposing its members to CVD (Muncan, 2018). Individuals from the same ethnicity share many of the same genes, which explains how family history and ethnicity are closely linked to the development of CVD (Muncan, 2018). For example, Aboriginal Australians and people of African or Asian descent are at higher risk of developing CVD (Aambø & Klemsdal, 2017).

The risk of CVD events and death from this disease is also significantly higher in people with a previous personal history of CVD (Govender et al., 2019; Jernberg et al., 2015; Johansson et al., 2017). A systematic review found that at both 1–3 years and 3–5 years after myocardial infarction (MI), the relative risks for all-cause death, recurrent MI, and CVD-related deaths were at least 30% higher for those with previous MI compared with general reference population (Johansson et al., 2017). The risk of recurrent CVD events is particularly high within the first year after the index MI (Jernberg et al., 2015; Johansson et al., 2017).

Modifiable CVD risk factors

The common modifiable risk factors of CVD include hypertension, diabetes mellitus, obesity, hyperlipidaemia, smoking, nutrition, and physical inactivity (Ballotari et al., 2017; Banks et al., 2019; Ibekwe, 2015; Last et al., 2017; Ortega et al., 2016; Yu et al., 2016; Yusuf et al., 2020). Hypertension is a strong and independent risk factor for CVD (Huma et al., 2012; Yusuf et al., 2020). It is a chronic medical condition involving the elevation of arterial blood pressure, requiring the heart to work harder than usual to circulate blood through the blood vessels (Ibekwe, 2015). Based on new guidelines by the American College of Cardiology and the AHA, blood pressure categories are:

1. normal: blood pressure < 120/80 mmHg
2. elevated: systolic between 120 and 129 mmHg and diastolic < 80 mmHg
3. stage 1: hypertension (systolic between 130 and 139 mmHg or diastolic between 80 and 89 mmHg), and stage 2: hypertension (systolic ≥ 140 mmHg or diastolic ≥ 90 mmHg) (Flack & Adekola, 2020).

Hypertension is the primary cause of CVD morbidity and mortality worldwide (Ahmad & Oparil, 2017). The relative risk of CVD is estimated to be almost four times higher for a person with a blood pressure of 160/90 mmHg compared to normotensive individuals (Choudhury et al., 2015). The prevalence of hypertension varies between men and women globally (Ahmad & Oparil, 2017). Younger women (< 65 years old) are generally less likely to develop hypertension compared with men of the same age; however, hypertension is more common in older women (65 years and older) than older men (Ahmad & Oparil, 2017). This suggests that oestrogen may have a vascular protective effect in premenopausal women by maintaining vasodilation and regulating blood pressure (Saeed et al., 2017). Menopause is associated with a twofold increase in the risk of hypertension, with the prevalence rate of 75% in postmenopausal women in the US (Ahmad & Oparil, 2017).

Diabetes mellitus is another modifiable CVD risk factor that can be prevented or controlled. Diabetes mellitus refers to a group of metabolic disorders characterised by hyperglycaemia over a long period of time resulting from the defects in insulin secretion, insulin action, or both (American Diabetes Association, 2022). Extensive evidence supports the association of diabetes mellitus with CVD development and outcomes (Ballotari et al., 2017; Humphries et al., 2017). People with diabetes mellitus have more than twofold higher risk for death from CVD than those without diabetes mellitus (Larsson et al., 2018; Schmidt, 2019). CVD-related mortality accounts for more than 75% of all-cause mortality in people with diabetes mellitus (Larsson et al., 2018; Schmidt, 2019). According to the report by World Health Organization (WHO), the global prevalence of diabetes has increased consistently over the past three decades (Humphries et al., 2017), and this disease is the fifth and ninth cause of death in women and men, respectively (Ballotari et al., 2017). Affecting at least 8% of the adult population globally, diabetes mellitus is a significant public health issue with an increasing prevalence worldwide (Ballotari et al., 2017).

Obesity, defined as abnormal or excessive fat accumulation, is another modifiable CVD risk factor (WHO, 2021). It is a multifactorial disease with a complex pathogenesis related to biological, psychosocial, socioeconomic, and environmental factors and heterogeneity in the pathways and mechanisms by which it leads to adverse health outcomes (Powell-Wiley et al., 2021; WHO, 2021b). Body mass index (BMI) is a simple weight-for-height index commonly used to classify obesity and overweight in adults. BMI between 25 and 29.9 is classified as overweight and BMI $\geq$ 30 as obese (WHO, 2021b). The positive association between CVD incidence and obesity has been confirmed in several studies (Carbone et al., 2019; Mandviwala et al., 2016; Powell-Wiley et al., 2021). In addition, obesity contributes to the development of other CVD risk factors, such as hypertension, hyperlipidaemia, and diabetes (Ortega et al., 2016; Powell-Wiley et al., 2021). The prevalence of obesity has increased over the past two decades globally (Mandviwala et al., 2016). WHO reported that in 2016, 39% and 13% of adults aged 18 years and over were overweight, and obese, respectively (WHO, 2021b).

The modifiable CVD risk factors also include hyperlipidaemia, which is a condition that encompasses various genetic and acquired disorders that describe elevated lipid levels within the body (Hill & Bordoni, 2022). There are different types of cholesterol, including low-density lipoprotein cholesterol (LDL-C), which carries cholesterol particles throughout the body and builds up in the walls of the arteries. The normal range of LDL-C is between 1.7 and 3.5 mmol/L. Increased level of LDL-C is associated with elevated risk of CVD. High-density lipoprotein cholesterol (HDL-C) picks up excess cholesterol and carries it to the liver; thus, HDL-C is associated with a lower risk of CVD. The normal range of HDL-C is between 0.9 and 2.1 mmol/L. Triglycerides (TG) are the most common type of fat in the body and provide it with energy; however, high levels of TG increase the risk of CVD. The normal range of TG is between 0.5 and 1.7 mmol/L (Hill & Bordoni, 2022; Victor Chang Cardiac Research Institute, 2022). Hyperlipidaemia is a known risk factor for CVD (Hedayatnia et al., 2020; Zhang et al., 2019). The prevalence of hyperlipidaemia varies geographically. It is estimated that more than 50% of the adult population has hyperlipidaemia worldwide (Hedayatnia et al., 2020). Elevated LDL-C levels and TG, and low HDL-C levels are associated with an increased risk of CVD in women and men (Saeed et al., 2017). The American Heart Association guideline recommends that lipid-lowering drugs, such as statins, are effective for the primary and secondary prevention of CVD (Last et al., 2017).

Smoking is a leading preventable cause of CVD morbidity and mortality (Banks et al., 2019). The risk of CVD increases with longer duration and greater intensity of smoking (Pirie et al., 2013). Being a current smoker doubles the risk of many types of CVD, including cerebrovascular disease (Banks et al., 2019). Smoking seems to be a stronger CVD risk factor in women than in men. According to the AHA, although women are less likely to smoke than men, a recent meta-analysis of 75 cohort studies involving 2.4 million individuals showed a 25% greater risk of CVD in women who smoke cigarettes as compared with men who smoke (Mozaffarian et al., 2015).

The risk of CVD is also affected by eating habits. Diet is a multi-component combination of many nutrients, which may interact with each other (Yu et al., 2016). Poor-quality diets are high in refined grains, added sugars, salt, and fats, and low in whole grains, fruits, vegetables, legumes, fish, and nuts. They are often high in processed food products – typically packaged and often ready to consume – and light on whole foods and freshly prepared dishes (Anand et al., 2015; Yue et al., 2016). The major cause of CVD is as atherosclerosis, which is strongly influenced by dietary habits (Yue et al., 2016). The Global Burden of Disease study cited diet as a significant major contributor to the increase in other CVD risk factors such as hypertension, diabetes, and obesity (Anand et al., 2015). Findings from the Nurses' Health Studies I and II suggest that certain types of fats and carbohydrates are predominant in developing CVD (Yu et al., 2016). The American Heart Association Presidential Advisory strongly advises that replacing dietary saturated fats with unsaturated fats can reduce CVD (Australian Heart Association Presidential Advisory, 2017). Also, reducing saturated fat and replacing it with polyunsaturated vegetable oil decreases CVD by approximately 30% (Sacks et al., 2017). In a prospective observational study, reducing saturated fat and replacing it with polyunsaturated or monosaturated fat resulted in 25% and 15% reduction in CHD incidence, respectively (Sacks et al., 2017). Data from the Nurses' Health Studies also provide strong evidence that a diet which is rich in fruits, vegetables, whole grains, nuts, and seafood, and low in red and processed meat and sugar-sweetened beverages, improves cardiovascular health and lowers CVD risk (Yu et al., 2016).

Physical inactivity is a leading modifiable CVD risk factor, and a global public health issue of the twenty-first century (Fletcher et al., 2018). Physical activity is defined as the body movement produced by skeletal muscle contraction requiring energy expenditure above the basal level (Fletcher et al., 2018). WHO guidelines recommend at least 150 minutes of moderate-intensity aerobic physical activity, at least 75 minutes of vigorous-intensity aerobic physical activity, or an equivalent comparable combination of moderate- and vigorous-intensity aerobic activity during the week to reduce CVD risk (WHO, 2022). All types of physical activity, regardless of age, sex, or ethnicity, positively contribute to the prevention of CVD (Fletcher et al., 2018). Also, the intensity and duration of physical activity/exercise is directly associated with improved cardiovascular health (Fletcher et al., 2018). The risk of all-cause mortality increases by about 20% to 30% in people with limited physical activity compared to those with regular physical activity (Fletcher et al., 2018; WHO, 2022). In addition, regular physical activity, such as walking, swimming, and cycling, indirectly mitigate the risk of CVD by reducing the development of other CVD risk factors, such as type 2 diabetes mellitus (T2DM), hypertension, and obesity (Agarwal, 2012). However, one in 4 adults does not meet the global recommended levels of physical activity globally (WHO, 2022). Based on self-reported data from the 2020–2021 National Health Survey in Australia, almost 27% of adults, aged 18–64, did not complete at least 150 minutes of physical activity in the past week, and 30% did not perform physical activity over 5 or more days (Australian Institute of Health and Welfare, 2022b). Inactivity among women is common in Australia: in 2017–2018, only 2 in 5 women in this country were sufficiently active (Australian Institute of Health and Welfare, 2019d).

Risk of CVD in women

CVD is the leading cause of death in men and women globally. It is responsible for one in 3 women's death worldwide (Virani et al., 2020). In 2017–2018, more than half a million Australian women aged 18 and over had one or more heart or vascular disease, or stroke (Australian Institute of Health and Welfare, 2019a). The Australian Institute of Health and Welfare reported that the prevalence of CVD was significantly higher in postmenopausal women compared to men (55% vs 45%) (Australian Institute of Health and Welfare, 2019b). After adjusting for age, the prevalence rate was still higher in women (19,449 per 100,000 women vs 17,439 per 100,000 men) (Australian Institute of Health and Welfare, 2019b). Overall, many Australian men and women have at least one risk factor for developing CVD, and it is known that more than 90% of CVD events occur in individuals with at least one risk factor globally (Wilson & Douglas, 2015).

There are differences between men and women in aetiology and clinical presentation of CVD (Garcia et al., 2016; O'Neil et al., 2018). Biological differences are considered sex differences (Aggarwal et al., 2018; Garcia et al., 2016). Sex differences in the cardiovascular system relate to differences in gene expression from sex chromosomes which cause sex-unique gene expression and function. These disparities result in differences in the prevalence and presentation of cardiovascular conditions, such as those related to autonomic regulation, hypertension, and diabetes mellitus (Garcia et al., 2016). Menopause marks an important cardiovascular biological transition, with a significantly increased CVD risk in women aged 55 years and over and equals the risk of men aged 45 years and over (Aggarwal et al., 2018; Prabakaran et al., 2021). However, gender differences are related to the environment, lifestyle, nutrition, and societal attitudes between men and women (Aggarwal et al., 2018; Garcia et al., 2016). Despite recent improvements in sex and gender research, gender-based disparities in CVD still exist (Prabakaran et al., 2021). The risk of CVD in women is usually underestimated due to a misperception that women are more 'protected' against CVD than men due to oestrogen and HDL-C production (O'Neil et al., 2018). Anatomically, in women, the clinical onset of CVD is delayed about 10 years compared with men, while men often develop CVD at a younger age (Bots et al., 2017). Women, in contrast, are at higher risk of developing stroke, which usually happens at an older age for women (Bots et al., 2017). Also, women are more likely to have undiagnosed MIs, and receive less aggressive treatment than men (Möller-Leimkühler, 2022). Several studies have shown that women have a higher rate of mortality and poorer prognosis after an acute CVD event (Di Giosia et al., 2017; Gao et al., 2019; Möller-Leimkühler, 2022). Younger women have higher rates of death during hospitalisation for acute MI compared with men of the same age (< 50 years: 6.1% vs 2.9%) (Möller-Leimkühler, 2022). Also, the analysis of New South Wales hospital data from 2004 to 2014 showed that the death rate within the first year post-MI was 22% among women compared to 15% in men (Woodward, 2019). Moreover, the rate of recurrent MI within the first year post-MI was higher among women than men, 7.2% vs 6.8%, respectively (Woodward, 2019).

Despite shared risk factors and significant overlap in clinical symptoms of CVD between men and women, there are important gender differences in CVD risk factors (Möller-Leimkühler, 2022). For example, men are more likely to engage in moderate physical activity (Möller-Leimkühler, 2022; Sallam & Watson, 2013). Based on self-reported data from the 2017–2018 National Health Report, women were more likely than men to be insufficiently active (59% compared with 50%) (Australian Institute of Health and Welfare, 2022c). In contrast, women eat more fruits and vegetables, and tend to eat healthier than men (Varì et al., 2016).

Some studies have also demonstrated disparities in the impact of different CVD risk factors on each gender. For instance, age, hypertension, total cholesterol, and LDL-C have a greater impact on CVD development in men (Gao et al., 2019; Möller-Leimkühler, 2022), while obesity, diabetes mellitus, smoking, TG, and HDL-C impose substantially greater risk for development of CVD in women (Gao et al., 2019; Woodward, 2019). In the Framingham Heart Study, obesity increased the relative risk of CVD in women and men by 64% and 46%, respectively (Garcia et al., 2016). Likewise, the 2013 National Health and Nutrition Examination Survey results suggested that the impact of obesity on CVD development was higher in postmenopausal women (Garcia et al., 2016). This is due to fat redistribution around the abdominal area and a predisposition to metabolic syndrome after menopause (Garcia et al., 2016).

The prevalence of diabetes does not significantly differ by sex in most countries (Humphries et al., 2017). Globally, based on the International Diabetic Federation 2018 atlas, 221 million men and 204 million women were estimated to have T2DM in 2017 (Huebschmann et al., 2019). There is also strong evidence that T2DM increases the risk of major CVD events more remarkably in women than in men (Ballotari et al., 2017; Madonna et al., 2019). Women with diabetes mellitus are 44% more likely to develop CVD and have a 50% higher chance of fatal coronary artery disease (CAD) than their male counterparts (Gao et al., 2019; Humphries et al., 2017; Madonna et al., 2019). Further, the risk of fatal and nonfatal vascular events is double in women than in men with type 1 diabetes (Huxley et al., 2015).

Correspondingly, smoking is a significant risk factor for CVD in women compared to men (Thompson & Daugherty, 2017). Female smokers have a 25% higher risk of developing CVD than their male counterparts, and this increased risk is independent of the intensity of smoking or other CVD risk factors (Thompson & Daugherty, 2017). Also, another study reported that women who smoke had a 50% greater CHD risk than their male counterparts (Gao et al., 2019), and smoking was associated with a greater risk of a MI in women than in men (Gao et al., 2019).

In addition, a reduced level of HDL-C accounts for CHD in both young and older women and predicts a higher CHD mortality rate in women than men (Thompson & Daugherty, 2017). This finding has been supported by the Framingham Study (Gao et al., 2019). Finally, having a history of CVD imposes a greater risk for future CVD events in women than in men (Li et al., 2019). The results of a study on the survivors of first MI between 2004 and 2010 in the UK showed that the rates of recurrent MI were 5.6% vs 7.2% and 13.9% vs 16.2% in the first- and seventh-years post-MI, for men and women, respectively (Li et al., 2019).

Risk of CVD in women with a history of complications of pregnancy

The cardiovascular system in women is also affected by some female-specific risk factors, such as complications of pregnancy, including HDP, pregnancy loss, and gestational diabetes (GDM) (Gao et al., 2019). A normal pregnancy by itself poses a significant challenge to the cardiovascular system. It is considered a cardiovascular stress test for women's future health, which can help to identify those who are at higher risk of CVD in the following years (Gao et al., 2019; Hauspurg et al., 2018; Parikh et al., 2021). A growing body of literature links some of the complications arising during pregnancy with the development of CVD in later life (Gao et al., 2019). Generally, the vascular and metabolic changes triggered by pregnancy are short-term, but the consequences on the cardiovascular system may remain long-term (Gao et al., 2019). The gender-based differences in CVD symptoms, risk factors, the choice of medical treatment, and outcomes are increasingly being recognised (Möller-Leimkühler, 2022; Shah et al., 2016). These disparities must be considered in the prevention, diagnosis, and treatment of CVD (Shah et al., 2016). The first female-specific guideline for CVD prevention was published in 1999 by the AHA, and it has been updated regularly since then, with the most recent update being in 2020 (Cho et al., 2020; Iida, 2022). Increasingly, there are more female-specific guidelines, such as the guideline for management of hypertension and hypercholesterolemia in women (Cho et al., 2020). It is vital that women and healthcare providers are aware of sex and gender differences in CVD, particularly the risk factors associated with complications of pregnancies.

Complications of pregnancy include conditions or pathological processes that may happen during or after pregnancy and vary in intensity from minor complications to severe diseases necessitating medical interventions (Cunningham et al., 2014). Complications of pregnancy occur in 10–20% of all pregnancies (Cho et al., 2020). In 2013, they accounted for 293,000 deaths worldwide (Naghavi et al., 2015). The effect of adverse pregnancy outcomes is emerging as a significant predictor of future CVD in women and is associated with a 1.8–4.0-fold greater risk of future CVD (Cho et al., 2020). These complications include but are not limited to HDP, pregnancy loss (miscarriage and stillbirth), and gestational diabetes mellitus (GDM) (Gulati, 2017; Harreiter et al., 2014; Mahendru & Morris, 2013; Oliver-Williams et al., 2013).

The risk of CVD is even higher among women who have experienced a more severe form of the complications or in multiparous women who have experienced these complications in more than one pregnancy (Cho et al., 2020). Hence, pregnancy should be considered as a natural stress test that can help identify women who are at higher risk of CVD. Nevertheless, complications, such as elevated blood pressure or glucose intolerance, which are developed during pregnancy and cease after the postpartum period, are not considered seriously and the associated risks are not discussed with the women (Gulati, 2017). The incidence rates of these complications are sizeable both in Australia and worldwide (Daly et al., 2018; Hvidtjørn et al., 2016; Tooher et al., 2017), meaning the individual and social burden of these complications should not be discounted (Daly et al., 2018). The risk of CVD associated with complications of pregnancy and the risk of CVD are discussed in detail in the next chapter. This section provides a brief description of complications of pregnancy which are associated with increased CVD risk.

Pregnancy loss

Pregnancy loss, also referred to as miscarriage or spontaneous abortion, is associated with an increased risk of future CVD (Muehlschlegel et al., 2020). Stillbirth is defined as foetal death before a complete separation from pregnancy products and the mother. According to the Australian Institute of Health and Welfare, the threshold for defining foetal death or stillbirth is a foetal death prior to the birth of a baby of 20 or more completed weeks of gestation or of 400 grams or more birthweight (Australian Institute of Health and Welfare, 2022f). With a global rate of 13.9 stillbirths per 1000 total births, stillbirth constitutes a global health problem (Hug et al., 2022). In Australia, the rate of stillbirths has decreased from 3.3 per 1000 births in 2003 to 2.6 per 1000 births in 2020 (Australian Institute of Health and Welfare, 2022f). In 2018, the New South Wales prenatal mortality rate was 8.1 per 1000, with stillbirths accounting for 77.2% of this mortality (Centre for Epidemiology and Evidence, 2019).

Miscarriage or spontaneous abortion is defined as pregnancy loss before 20 weeks of pregnancy, a condition that is diagnosed and confirmed clinically (Dugas & Slane, 2022; Strumpf et al., 2021). Recurrent miscarriage was previously defined as 3 or more pregnancy losses; however, more recent guidelines changed the definition to 2 or more pregnancy losses (Marren, 2018). Induced abortion or elective abortion is the termination of a pregnancy before 20 weeks of gestation, or before the foetus is viable, at a woman’s request with or without the presence of any medical indication, and for reasons other than maternal health or foetal disease (Onwere et al., 2014). Miscarriage or spontaneous abortion is the most common complication in early pregnancy. The American College of Obstetricians and

Gynaecologists (ACOG) estimated that 26% of all pregnancies end in miscarriage (Dugas & Slane, 2022; Strumpf et al., 2021), and the incidence of pregnancy loss among clinically recognised pregnancies is 12–15% (Marren, 2018). Recurrent miscarriage with 3 or more losses happens among 1% of couples, and 5% of couples experience 2 or more losses (Marren, 2018). In Australia, it is anticipated that 147,000 Australian women lose a pregnancy each year (Edwards et al., 2016).

Hypertensive disorders of pregnancy (HDP)

According to the updated definition proposed by the American College of Obstetricians and Gynaecologists, also known as maternal hypertensive disorders, include the following conditions (American College of Obstetricians & Gynecologists [ACOG], 2013):

Chronic hypertension: Maternal blood pressure ≥ 140/90 detected after conception or before 20 weeks of pregnancy.

Gestational hypertension: New-onset elevation of maternal blood pressure ≥ 140/90, closer to term, in the absence of proteinuria.

Chronic hypertension with superimposed pre-eclampsia: Pre-eclampsia may obscure all other hypertensive disorders.

Pre-eclampsia: Maternal blood pressure ≥ 140/90 in 2 separate measurements, at least 4 hours apart, after 20 weeks of pregnancy, in those pregnant women whose blood pressure was previously normal. Alternatively, in the situation of maternal blood pressure ≥ 160/110, hypertension can be confirmed within shorter intervals (even minutes) to facilitate antihypertensive therapy soon after proteinuria. Alternately, if proteinuria is not present, new-onset hypertension can be confirmed along with the new onset of any of these symptoms: thrombocytopenia, renal insufficiency, impaired liver function, pulmonary oedema, and cerebral or visual symptoms (ACOG, 2013). Pre-eclampsia is categorised into early- and late-onset pre-eclampsia (Gomathy et al., 2018).

Early-onset pre-eclampsia is referred to pre-eclampsia that develops before 34 weeks of pregnancy, while late-onset pre-eclampsia develops at or after 34 weeks of pregnancy (Gomathy et al., 2018).

Eclampsia: Eclampsia is defined as grand mal seizures in women with pre-eclampsia without any neurological conditions that could be responsible for the seizures (August & Sibai, 2013).

Postpartum hypertension: Pre-eclampsia can develop anytime in the postpartum period, including pre-eclampsia with severe systemic organ involvement and seizures (ACOG, 2013).

In 2017, the American College of Cardiology and American Heart Association issued a clinical practice guideline on hypertension that reclassified the previous category of *prehypertension* into elevated BP (systolic BP 120–129 mmHg) and stage 1 hypertension (systolic BP 130–139 mmHg or diastolic BP 80–89 mmHg). The American College of Obstetricians and Gynaecologists guidelines do not incorporate the most recent hypertension definitions, and this is an area in which new evidence is essential (Ying et al., 2018).

Worldwide, the prevalence of HDP ranges between 5% and 10%. This condition is increasing with the rising prevalence of cardio metabolic disease in younger women (Hauspurg et al., 2019; Umesawa & Kobashi, 2017; Ying et al., 2018), with the prevalence of chronic hypertension 1–5%, gestational hypertension 6–7%, chronic hypertension with superimposed pre-eclampsia 0.2–1%, and pre-eclampsia 5–7% (ACOG, 2013; Ying et al., 2018).

The prevalence of HDP among women of reproductive age is high in Australia (Australian Health Ministers' Advisory Council, 2012). In New South Wales alone, the prevalence rate of all types of HDP was estimated to be 4.5% in 2018 (Centre for Epidemiology and Evidence, 2019).

Gestational diabetes

Gestational diabetes (GDM) is defined as any degree of glucose intolerance that is first detected during pregnancy, but this definition has severe limitations (American Diabetes Association, 2020). Depending on the severity of the condition, medication and/or diet modification are used to manage the complication (American Diabetes Association, 2020). GDM is one of the most prevalent endocrinopathies during pregnancy and affects 4–12% of all pregnancies depending on the type of diagnostic criteria as well as the prevalence of associated risk factors such as T2DM, BMI, advanced maternal age, and ethnicity (Ramezani Tehrani et al., 2021). It is the fastest-growing type of diabetes in Australia, and according to Diabetes Australia, the prevalence of GDM has increased from 7.0% in 2013 to 13.1% in 2017 (Diabetes Australia, 2020).

The overall rate of GDM in NSW is 13.7% (Centre for Epidemiology and Evidence, 2019), affecting 15% of all pregnancies in women aged 15–49 (Australian Institute of Health and Welfare, 2019c). The risk of GDM increases with maternal age, peaking in the age group of 45–49 years (Australian Institute of Health and Welfare, 2019c) The prevalence of GDM varies slightly in different regions of Australia; for example, in 2016–2017, the rate of GDM was 16% in New South Wales and 17% in both the Australian Capital Territory and the Northern Territory (Australian Institute of Health and Welfare, 2019c). Women with prior GDM are at a 1.4–2-fold increased risk of T2DM, a twofold increased risk of hypertension, a twofold increased risk of stroke, and a 2.8-fold increased risk of IHD (Cho et al., 2020).

A thorough review of the literature indicated a lack of current data on the recent trends of the impact of the complications in pregnancy on the development of CVD in the future among the affected women in Australia (Hare et al., 2020; Wertaschnigg et al., 2022). Another major shortcoming in the literature is the need for evidence showing the level of awareness related to the complications among the affected women and healthcare providers as well as the current risk management model. The recent rapid sociodemographic shift and population growth in Australia – with a specific reflection on the western suburbs and north Sydney as having the most cultural diversity in New South Wales – have negatively affected the reliability of the available data.

Gender differences in cardiovascular assessment and management

Timely identification of individuals at risk of CVD events can lead to development of better prevention schemes and clinical outcomes (Cho et al., 2020). WHO highlights that primary prevention of CVD through risk-factor reduction is the potential solution to decrease future CVD burden (WHO, 2018). Risk-factor reduction starts with risk-factor assessment, which requires a detailed medical history and physical examination to evaluate traditional and gender/sex-specific risk factors (Lloyd-Jones et al., 2019). Primary healthcare providers maintain a central role in the primary assessment and prevention of CVD. Screening for CVD risk has been widely implemented in many developed countries to systematically detect high-risk individuals who may need CVD risk reduction through pharmacological interventions or lifestyle modifications (Garcia et al., 2016).

For more than 2 decades, the paradigm in primary prevention of CVD has focused on the concept that the intensity of prevention efforts should match the absolute risk of developing an incident CVD event of individuals (Lloyd-Jones et al., 2019). Absolute CVD risk refers to the probability of an acute coronary event happening within a specified time frame, usually 5 or 10 years (Australian Institute of Health and Welfare, 2019b). It reflects an individual's overall risk of developing CVD, and its estimation provides the opportunity of identifying patients who are at enough risk and need quality treatment, with a higher probability of net individual and social benefit (Lloyd-Jones et al., 2019). Absolute risk estimation also allows for the assessment of potential profits from intensive lifestyle modification, and direct comparison of potential benefits or harms from preventive pharmacological prevention treatments to assist clinicians and patients to make informed decisions (Lloyd-Jones et al., 2019). A person's absolute risk can be estimated in a short time in clinical practice with widely available tools (Motamed et al., 2017).

Over the past decades, several robust and multivariable CVD risk assessment tools have been developed from large perspective cohort studies or randomised trials to estimate CVD risk in time intervals ranging from 4 to 12 years (Motamed et al., 2017). To make these tools more practical for healthcare providers, information from the patient's medical history and laboratory tests are utilised. These tools are available in the form of simplified charts or tables in paper or computer-based formats (Motamed et al., 2017). They differ in the type and number of variables used, definitions of endpoints and the population in which they were developed and validated (Baart et al., 2019). Some of these tools are more widely used worldwide, including the Framingham Risk Score, pooled cohort equations, the American College of Cardiology/AHA risk prediction tool, the Reynolds Risk Score, and the systematic coronary risk evaluation (SCORE) equations (Lloyd-Jones et al., 2019).

The common variables used in the estimation of absolute CVD risk include age, sex, race, total cholesterol, HDL-C levels, systolic blood pressure, current smoking, antihypertensive therapy, history of diabetes mellitus, C-reactive protein level, and parental history of MI before age 60 years (Hedlin et al., 2019; Motamed et al., 2017). However, debates remain on what is the most important for risk estimation, the most generalisable outcomes across populations, and the necessity for a remodelling or recalibration in populations other than the source cohort (Lloyd-Jones et al., 2019). Framingham 10-year

CHD risk score is used widely in different countries to make appropriate CHD preventive recommendations (Garg et al., 2017; Klisić et al., 2018). The original Framingham Risk Score was developed to evaluate CHD risk and then improved by the third Adult Treatment Panel in 2002 with a focus on hard CHD endpoints, death, and nonfatal MI. The 2008 Framingham General CVD Risk Score included additional cardiovascular endpoints of stroke, heart failure, and peripheral arterial disease (Garg et al., 2017).

The risk level is calculated using age, sex, total cholesterol, and HDL-C levels, smoking history, systolic blood pressure, and whether the patient has been treated for hypertension, diabetes, or smoking (Klisić et al., 2018). The updated version excluded diabetes, as T2DM was considered a CHD risk equivalent, possessing the same 10-year risk as patients with previous CHD (Klisić et al., 2018). Based on Framingham Risk Score estimation, individuals with a score above 20% are considered at high CHD risk within 10 years. High-risk groups also include individuals with established CVD as well as those with CHD equivalents such as diabetes and chronic renal disease. Individuals with a 10-year CHD risk of 10–20% are at intermediate risk, and those with less than 10% are considered as low risk (Saeed et al., 2017). The Reynolds Risk Score was initially developed for women without diabetes. This tool does not include current blood pressure medication use, but considers haemoglobin A1C in female patients with diabetes, family history, and high-sensitive C-reactive protein in CVD risk assessment of both men and women. This risk tool has been validated in both genders (Cook et al., 2012; Hedlin et al., 2019).

Overall, although these risk assessment tools provide an improved estimate of CVD risk among individuals, there are still some challenges in using them. One of these challenges is that they usually underestimate CVD risk in women (Isiadinso & Wenger, 2017), likely because female-specific risk factors are rarely included in these risk assessment models (Baart et al., 2019). CVD is largely preventable, and almost 75% of CHD cases in women can be prevented by adopting healthy lifestyle choices, such as smoking cessation (Díaz-Gutiérrez et al., 2018). Special attention is needed when considering preventive or treatment options for women as they have different manifestations of CVD, and women's responses to risk factors and treatments are different (Cho et al., 2020). Further, some risk factors are unique to women, such as complications of pregnancies (Cho et al., 2020). According to the American College of Cardiology/American Heart Association guideline for prevention of CVD in women, preventive measures should be designed based on the individual's risk score (Lloyd-Jones et al., 2019). However, this guideline still recommends that counselling on lifestyle interventions, including smoking cessation, physical activity, a heart-healthy diet, and weight maintenance, is important for all women, regardless of their risk level, even if only to reinforce established healthy behaviours (Lloyd-Jones et al., 2019).

Also, this guideline recommends that risk-factor interventions such as blood pressure or hyperlipidaemia control should apply to all risk groups as well as women with a high risk for CVD (Lloyd-Jones et al., 2019). Additionally, selected women at intermediate risk should receive aspirin and beta blockers unless contraindicated (Lloyd-Jones et al., 2019). Furthermore, this guideline emphasises that women with a high risk for CVD, especially those with overt CHD, should be screened and treated for depression, as this comorbidity confers a significantly increased risk for developing CVD and is a major barrier to the adoption of healthy lifestyle behaviours, and it is associated with a higher risk for first and recurrent MI (Lloyd-Jones et al., 2019). Depression is more prevalent in women than men (Lloyd-Jones et al., 2019; Mosca et al., 2011b).

The American College of Cardiology/AHA guideline emphasises that it is crucial to improve CVD risk assessment in women so that they receive quality preventive care. However, generally, CVD risk factors in women are under recognised, diagnosed, and treated (Di Giosia et al., 2017; Shah et al., 2016). Several studies demonstrated that women receive suboptimal CVD prevention care compared to men (Di Giosia et al., 2017; Shah et al., 2016). Similarly, women of all age groups in Australia are less likely to have risk factors assessed in primary healthcare (Lee et al., 2019). For instance, although body size can be calculated easily during consultation, height, weight, and specifically waist circumference are not measured in primary care in Australia (Lee et al., 2019). Moreover, the historical assumption that CVD is a condition that mainly affects men resulted in women with a history of CVD being less likely to be managed based on guidelines compared with their male counterparts (Lee et al., 2019). The underestimation of CVD in women leads to inadequate screening, diagnostic angiograms, and interventional procedures (Gao et al., 2019; Thompson & Daugherty, 2017).

Compared to men with similar CVD risk, women are less likely to receive preventive treatment, such as lipid-lowering therapy, aspirin (ASA), and therapeutic lifestyle changes (Garcia et al., 2016). Also, when medication is prescribed, treatment in women is less likely to be adequate to achieve optimal outcomes (Gao et al., 2019). For instance, women with high blood pressure are less likely to have their blood pressure at the target goal, or women with hyperlipidaemia, especially those with diabetes mellitus, are less likely to be treated with statins to lower LDL-C levels (Gao et al., 2019). Likewise, cardiac rehabilitation is used 55% less in women, partially because women are less likely to be referred to cardiac rehabilitation programs by their physicians (Garcia et al., 2016).

In addition, most trials of cardiac medications have focussed on males, with a notable absence of female subjects, leading to an inability to draw sex-specific conclusions about effectiveness of cardiac medications (Gao et al., 2019). Increasingly, however, there is recognition that the therapeutic approach to CVD should be sex-specific because of sex-related disparities in cardiovascular physiology and response to treatments (Gao et al., 2019). For example, it has been found that the effects of aspirin in preventing stroke and MI are different for men and women. In addition, women are more likely to experience bleeding as a side effect of anticoagulants, further highlighting the physiological differences between the sexes that remain under research (Gulati, 2017).

Healthcare system in Australia

The healthcare system in Australia includes a multifaceted variety of public and private providers, settings, and supporting mechanisms, providing a wide range of services, from public health and preventive services to primary healthcare, emergency health services, and hospital-based treatment in public and private hospitals. Australia's federal, state, territory, and local governments share responsibility for running the health system. While some aspects of the Australian healthcare system are the same nationwide, other aspects vary depending on the location, with variances between states, cities, and rural and remote areas. For example, access to various healthcare providers varies depending on location (Australian Government Department of Health and Aged Care, 2022).

General practitioners and emergency departments are the leading portals to other health services, including specialists. For most people with illnesses, primary healthcare, such as general practitioners and midwives, are their first point of access (Australian Government Department of Health and Aged Care, 2022). Medical specialists work in a chosen area of medicine, such as cardiology or obstetrics and gynaecology, and work in the private sector or private or public hospitals. Usually, individuals seeking specialist care need to be referred by their general practitioners (Australian Government Department of Health and Aged Care, 2022).

Significance of the study

Despite considerable progress in managing CVD in recent decades, it remains a significant health problem and the leading cause of death worldwide for both men and women (WHO, 2017). In 2016, CVD accounted for 31% of all global deaths, and projections from 2016 indicate that 23.3 million people will die from CVD by 2030 (WHO, 2017). In Australia, in 2017–2018, 4.8% of women aged 18 and over had one or more heart or vascular disease or stroke, with approximately 206,000 women having CHD (Australian Institute of Health and Welfare, 2019b). CVD was responsible for 12% of the total burden of disease and injury among Australian women in 2015, with CHD alone accounting for 5% of the burden (Australian Institute of Health and Welfare, 2019b) (Australian Institute of Health and Welfare, 2019b). Many Australian women have at least one of the well-known behavioural or biomedical CVD risk factors (Australian Institute of Health and Welfare, 2019b).

In 2017–2018, a significant proportion of Australian women had modifiable risk factors for CVD. Specifically, 11% of women smoked daily, 59% did not meet physical activity guidelines, 89% did not consume the recommended daily serves of vegetables, and 44% did not eat the recommended daily serves of fruit (Australian Institute of Health and Welfare, 2019b). In addition, 60% of women were overweight or obese, and 20% had uncontrolled high blood pressure (Australian Institute of Health and Welfare, 2019b). Women aged 55 years or older with at least 2 major risk factors are 3 times more likely to die from CVD by age 80 than men with zero or one CVD risk factor (Australian Bureau of Statistics, 2015; Australian Institute of Health and Welfare, 2019b). An estimation of CVD risk in women suggested that almost 14% of Australian women aged 45–74 had a high absolute risk of a CVD event over the next 5 years (Australian Institute of Health and Welfare, 2019b). Of concern, only 48% of high-risk women who had previous CVD received lipid-lowering medication, 63% received blood pressure–lowering medication, and 34% received both lipid-lowering and blood pressure–lowering medications (Australian Institute of Health and Welfare, 2019b).

Modifiable risk factors related to CVD are self-imposed conditions, meaning that CVD is mainly a preventable condition (Heart Disease and Stroke Prevention, 2016; Kelly & Fuster, 2010). Adopting healthy lifestyles such as avoiding smoking, controlling weight, having a healthy diet, and engaging in a physically active lifestyle can considerably decrease the risk of CVD by preventing the onset of some of the risk factors, such as obesity, T2DM, and hypertension (Lind et al., 2014). It is worth noting that pregnancy is accompanied by significant changes in women's hormonal settings that can affect the cardiovascular system (Kodogo et al., 2019).

These changes may increase the risk of developing CVD later in life. In particular, a history of pre-eclampsia, gestational diabetes, and preterm delivery has been associated with an increased risk of CVD, including hypertension, CHD, and stroke (Wu et al., 2019). Therefore, it is crucial to identify women who are at high risk of CVD early in life, especially those with a history of complications during pregnancy, and provide appropriate preventive interventions. These interventions should include lifestyle modifications such as adopting healthy diets, engaging in regular physical activity, and avoiding smoking, as well as medical interventions such as blood pressure–lowering and lipid-lowering medications if needed. By addressing these risk factors early in life, we can reduce the burden of CVD in women and improve their overall health and wellbeing.

In contrast, HDL-C increases rapidly within the second trimester but decreases notably during the third trimester (Wu et al., 2019). With every subsequent pregnancy, HDL-C levels are lower than previous levels (Mankuta et al., 2010; Wu et al., 2019). These physiological changes are uncomplicated for most women. However, for 30% of women who experience complications of pregnancy, these adverse pregnancy outcomes may serve to identify women at risk for CVD who would not have been detected using traditional risk assessment tools (Wu et al., 2019). Pre-pregnancy conditions such as obesity, genetic thrombophilia (Cho et al., 2019), unrecognised pre-pregnancy hypertension, or diabetes (Alladin & Harrison, 2012) are important indicators and could predispose women to some of the complications of pregnancy, such as HDP or GDM (Muto et al., 2016). Furthermore, there is compelling evidence that some of the complications of pregnancy, such as HDP, pregnancy loss (stillbirth and miscarriage), and GDM, contribute to the development of CVD in women in their future life (Harreiter et al., 2014; Mahendru & Morris, 2013; Oliver-Williams et al., 2013). CVD and some of the complications of pregnancy share common risk factors; thus, earlier efforts to prevent CVD risk in women may also prevent the onset of some of the complications of pregnancy (Wu et al., 2019).

There has been insufficient attention given to the CVD risks of women who experience complications during pregnancy (Lloyd-Jones, 2010; Tran et al., 2020). While follow-up care for these women can provide an opportunity for assessment, communication, and management of possible associated risks in the future, the current follow-up care for women with a history of complicated pregnancy is limited (Daly et al., 2018; Fabiyi et al., 2019). For instance, Daly et al. (2018) reported that less than 60% of women diagnosed with GDM in one of their pregnancies were screened for T2DM within the first year of the index pregnancy in primary care, and the proportion screened rapidly declined after this period, even though the National Institute for Health and Care Excellence guideline recommended annual screening for T2DM for all women with a history of GDM in one of their pregnancies (Daly et al., 2018). Moreover, few women received education and information about the long-term risks of CVD associated with their obstetric history (Fabiyi et al., 2019).

Behavioural change is a complex and multifaceted process, but research has shown that improving high-risk women's knowledge, awareness, and perception of CVD risk can facilitate behaviour change and reduce their risk (Boo et al., 2017). Therefore, it is crucial to increase women's awareness of CVD risk factors and encourage them to engage in appropriate actions to reduce their risk. A heart-healthy lifestyle should be promoted among women of all ages, and healthcare providers should provide advice and guidance. Healthcare providers' knowledge, beliefs, and attitudes can influence patients' health outcomes by shaping their decisions about treatment approaches (Qadi et al., 2019; Young et al., 2012). The primary objectives of this study are to evaluate the levels of knowledge of CVD risk among women with a history of pregnancy complications and healthcare providers, as well as to gain insight into their engagement in CVD risk-reducing interventions and programs.

Conclusion of the chapter

This chapter introduced the thesis including its aims and research questions and provided a background to the research. The background included an overview of CVD and its risk factors, the risk of CVD in women in general and in those with a history of complications of pregnancy, gender differences in cardiovascular assessment and management, and healthcare systems in Australia. Lastly, the significance of the study was discussed. The following chapter presents the theoretical framework of the study.

Chapter Two: Theoretical Framework

Introduction to the chapter

The previous chapter introduced the aims and research questions of the thesis and provided background information on CVD and its risk factors, the increased risk of CVD in women with a history of complications of pregnancy, gender differences in cardiovascular assessment and management, and the healthcare system in Australia. The chapter also discussed the significance of the study.

This chapter serves as the theoretical framework for the thesis. It builds upon the introduction in chapter one, which highlights the importance of reducing CVD risk in women with a history of complicated pregnancy. The chapter provides a comprehensive explanation of the key concepts and theories relevant to this study. These include health promotion, health education, healthcare providers' competency in promoting health, and preventing disease in individuals. Kanter's Theory of Structural Power in Organisations is discussed as a valuable tool to empower healthcare providers to effect change. This theory is used to explore the power dynamics within healthcare organisations and how these dynamics impact the ability of healthcare providers to promote health and prevent disease in their patients. In addition, the chapter provides an overview of existing health behaviour models and theories, including the Health Belief Model, the Theory of Planned Behaviour, and the Transtheoretical Model. These theories explain the role of knowledge and risk perception in changing unhealthy behaviours and promoting healthy behaviours. Overall, this chapter sets the stage for the thesis by establishing the theoretical foundation necessary to understand the role of healthcare providers in reducing CVD risk in women with a history of complicated pregnancy. It demonstrates the importance of empowering healthcare providers to promote health and prevent disease in their patients and provides a framework for understanding how this can be achieved.

Health promotion

Health promotion includes a ‘combination of educational, organisational, economic and political actions’ (Howat et al., 2003) to empower individuals and communities to increase control over their health and improve it. Health promotion includes the elements of health protection, health education, and disease prevention (Kirsten, 2001; Sharma & Branscum, 2020). Health protection often deals with public policies aimed at preventing diseases at the population level (Sharma & Branscum, 2020; WHO, 2012). For instance, nutrition facts panels aid consumers in the evaluation of food and nutrient information, so people with special conditions such as high blood-cholesterol levels or diabetes can easily collect this information from the food labels and make healthy food choices (Guthrie et al., 2015; Kozup & Hogarth, 2008).

Disease prevention is defined as activities and methods to reduce the possibility that a disease or disorder will affect a person, interrupting or slowing the disease’s progress or reducing disability (Cavusoglu & Demirbag-Kaplan, 2017; WHO, 2014). Levels of prevention include primary prevention, which aims to lessen the possibility of a disease or disorder occurring; secondary prevention, which focuses on disrupting, preventing or reducing the progress of a disease at an early stage; and tertiary prevention, which stops the progression of damage following a disease (Cavusoglu & Demirbag-Kaplan, 2017; Willcox, 2015; WHO, 2014). The primary purpose of any health system is to prevent disease and reduce ill health to keep people as healthy as possible for as long as possible. Decreasing the adverse effects of an illness, disability, and injury increases the number of people who can work and improves the quality of life of individuals (Fry & Zask, 2017; Gruszin et al., 2012). This approach to disease prevention highlights the importance of lifestyle choices and personal behaviour in defining a person’s health condition (Willcox, 2015; WHO, 2012). In 1986, WHO provided a framework for an effective health promotion practice in its Ottawa

Charter for Health Promotion, the most well-known health promotion initiative (Fry & Zask, 2017; Gilbert et al., 2010). The 5 main strategies described by the Ottawa Charter include: building healthy public policy, creating supportive environments, strengthening community actions, developing personal skills, and reorienting health services (Fry & Zask, 2017; Gilbert et al., 2010). In clinical settings, health promotion focuses on targeted individuals (Australian Institute of Health and Welfare, 2012; Willcox, 2015).

Health education and the role of healthcare providers in health education and health promotion

Health education is an integral part of health promotion. It refers to planned and deliberately designed teaching opportunities that provide health facts and develop life skills for individuals and the community (Pueyo-Garrigues et al., 2019; WHO, 2012). Health education aims to inform individuals about the nature of health and the cause of illness and elucidate the risk associated with lifestyle-related behaviours. It strives to motivate individuals to adapt behaviour change by directly influencing their values, beliefs, and attitude system, where it is believed that the person is at risk or has already been affected by illness/disease or disability (Sharma & Branscum, 2020; Van Achterberg et al., 2011). The central purpose of health education is to increase a person's skills and knowledge and health literacy about health and healthy behaviours (Sharma & Branscum, 2020; Van Achterberg et al., 2011).

Health education and health promotion are integral to the role of healthcare professionals. Primary healthcare providers, particularly general practitioners, have a significant role in achieving the goals of health promotion and disease-prevention programs (Achhra, 2009; Porter et al., 2014), and they are considered the main sources of health information for patients and the community (Achhra, 2009; Porter et al., 2014). Health promotion is also a key component of clinicians including those of nursing and midwifery practice. Nurses and midwives are expected to actively engage in promoting the health of individuals, families, communities, and populations (Raingruber, 2014). The US National Commission for Health Education Credentialing has identified 7 major responsibilities for health educators, including evaluating individual and public needs for health education, developing operative health education programs, applying for health education programs, evaluating the effectiveness of health education programs, cooperating with health and health education recourses and needs, coordinating the provision of health education services, and acting as resource people in health education (McKenzie et al., 2016; WHO, 2012).

Individuals need to be supported to maintain or promote their health status (Willcox, 2015). Healthcare providers can be effectively involved in health promotion initiatives by adopting an all-inclusive approach that aims to empower and educate individuals and communities to take better control over their health (Kumar & Preetha, 2012; Willcox, 2015). The Ottawa Charter has identified empowering individuals and relevant organisations as a critical factor in creating sustainable health systems, and empowerment starts with individuals (Kayser et al., 2019). Therefore, educating women at higher risk for developing CVD is essential in engaging them in risk-reducing programs to reduce their future CVD risk. The primary purpose of health education and health promotion strategies is to promote healthy behaviours that may reduce or prevent morbidity and mortality (Lin et al., 2004; Raingruber, 2014). For example, a healthy diet helps prevent the development of many diseases such as CHD and diabetes (Pallazola et al., 2019), or promoting physical activity helps to prevent or reduce the incidence of diseases such as CVD and diabetes (Tian & Meng, 2019). These behaviours result in improved cardiovascular health and reduced mortality and morbidity from CVD.

Healthcare providers' perceived competency in health education and health promotion

Promoting healthy behaviours has been shown to effectively reduce or prevent morbidity and mortality among populations (Lin et al., 2004; Willcox, 2015). Healthcare providers can empower women with a history of pregnancy complications to take control of their health by becoming engaged in lifestyle-modification and risk-reduction programs to prevent the development of CVD later. However, this requires that healthcare providers themselves are sufficiently empowered and knowledgeable about CVD risk and risk-reducing programs to support these women effectively.

Research reveals that healthcare providers are not routinely involved in providing appropriate information and support with the aim of changing individuals' unhealthy behaviours (Laverack, 2017) due to barriers such as lack of time, reimbursement, support services, and adequate training (Laverack, 2017). Generally, healthcare providers including general practitioners feel more capable and confident in diagnosing and treating diseases than in dealing with health promotion and health-prevention issues (Porter et al., 2014; Van Achterberg et al., 2010). Thus, there remains a huge scope for improvement in practice for healthcare providers to extend their health promotion skills and activities by focusing on the various aspects of the Ottawa Charter framework (Achhra, 2009; Porter et al., 2014).

The healthcare sector is a self-motivated environment that must continuously adapt to evolving knowledge and government policies (Fry & Zask, 2017; Gilbert et al., 2010) to enable healthcare providers to access evidence-based, effective health promotion strategies and tools. For example, choosing appropriate health promotion materials is essential to the development of an individual's health promotion plans (Australian Health Ministers' Advisory Council, 2012; Fry & Zask, 2017), and health education and health promotion materials should be chosen depending on the target groups' specific risks and needs (Australian Institute of Health and Welfare, 2012; Willcox, 2015). Hence, healthcare systems can use frameworks and theories, such as Kanter's Theory of Structural Power in Organisations, to empower healthcare providers to be competent in providing quality care.

Kanter's Theory of Structural Power in Organisations

Kanter et al. (1993), in their theory of Structural Power in Organisations, defined power as the ability to use resources to accomplish expected outcomes. The theory considers formal and informal empowering strategies. Formal power results from specific job characteristics, such as flexibility, adaptability, and creativity, associated with discretionary decision-making, visibility, and centrality to organisational purpose and goals. Informal power results from social connections, and the development of communication and information networks with supporters, peers, and cross-functional groups (Pennbrant et al., 2014). Kanter et al. (1993) suggested that empowering the workforce using formal and informal power could facilitate healthcare providers' access to information, opportunities, and support, which could help them improve the quality of their practice (Pennbrant et al., 2014). A high level of formal and informal empowering structures in an organisation helps healthcare professionals to perform their tasks in meaningful and effective ways (Kanter, 1993; Pennbrant et al., 2014). Kanter's theory of structural power in organisations was examined in a non-experimental cross-sectional survey conducted by Duff (2019). Researchers in this study investigated a proposed model that elucidates the connections between educational structural empowerment, psychological empowerment, nurse practitioner role competence, and patient safety competence. The study adopted a convenience sample comprising Nurse Practitioners who were educated in Canada. This group consisted of individuals who had completed a Nurse Practitioner program within the last two years. The study model sought to evaluate how educational structural empowerment impacts both nurse practitioner role competence and patient safety competence, with psychological empowerment playing a partial mediating role.

The outcomes of the study indicated that the learning environment considerably influences how newly graduated nurse practitioners perceive psychological empowerment, shedding light on their competence development at work. These findings provide support for Kanter's theoretical framework regarding competence development in the workforce, offering insights into how recently graduated nurse practitioners in Canada perceive their roles and competencies related to patient safety (Duff, 2019).

Health behaviour theories and models

Changing people's risk behaviour is challenging, and many strategies that aim to promote individuals' health by changing their unhealthy behaviours fail, especially in the long term (Sharma & Branscum, 2020; WHO, 2012). Effective interventions often use health behaviour theories to help clarify the processes for changing health behaviours and influences of complex factors. These theories are used as a compass to help health-policy planners detect the most appropriate target audience, identify the most appropriate methods for development and change, and appropriately define expected outcomes (Sharma & Branscum, 2020; WHO, 2012). Most programs aim to help individuals improve their health, prevent disease, or manage their chronic health conditions, such as high blood pressure (Sharma & Branscum, 2020).

Overall, 3 common themes have been identified in the published literature concerning the nature and strength of intervening variables on human behaviour; these themes include environmental supports and contexts, individual capacity, and interpersonal relationships and supports (Sharma & Branscum, 2020; WHO, 2012):

1. *Environmental supports and contexts*

Health education consists of programs that target or teach individuals and smaller groups, such as families. When health education targets whole communities or larger groups, it is considered to be health promotion. Thus, the environmental context falls mainly within the realm of health promotion (Sharma & Branscum, 2020; WHO, 2012). Two community-level health education theories include Communication Theory, which aims to explain how different types of communication affect health behaviour, and Diffusion of Innovations Theory, which strives to understand how new ideas and social practices spread within a community (Sharma & Branscum, 2020; WHO, 2012). These theories are helpful in health education, as they can assist healthcare professionals in finding a suitable communication method to better communicate the health risks, inform people about the importance of healthy lifestyles, and influence behaviour changes (Sharma & Branscum, 2020; WHO, 2012). Health systems can apply these theories to educate the public about cardiovascular diseases, which are the leading cause of death worldwide.

2. *Individual capacity*

The core concepts that are related to behaviour change at the individual capacity level include awareness and knowledge, beliefs, opinions and attitudes, self-efficacy, intentions, and personal power (Sharma & Branscum, 2020; WHO, 2012). Theories or models that address the individual capacity level are as follows:

a. *The Activated Health Education model*

This model consists of 3 phases (Sharma & Branscum, 2020; WHO, 2012):

i. the experiential phase, in which people could assess their health through activities/experiences (Dennison & Golaszewski, 2002)
ii. the awareness phase, which gives people information explaining the reasons for doing the first phase (the experiential phase). This phase provides

information about their risk and how they can change their behaviour (Dennison & Golaszewski, 2002).

iii. the responsibility phase, in which individuals are involved in the process of changing their behaviour, facilitating their health values, and developing an individualised plan for behaviour change (Dennison & Golaszewski, 2002). Participants will develop their own plans of action through learning self-management strategies, such as self-monitoring, setting measurable goals, and utilising social support systems (Sharma & Branscum, 2020; WHO, 2012).

b. The Rational model or the Knowledge, Attitudes, and Practices model (KAP)

This model is based on the principal idea that advocates better results followed by better education (Murray-Johnson et al., 2004). The KAP model can avail information on what is known, what is thought, and what is done about general or specific topics of a specific population. The information collected by the KAP can be used to identify knowledge gaps, cultural beliefs, and behavioural patterns, which may detect needs, problems, and barriers to support plans, and implement interventions. It also can extend the understanding of commonly known information, attitudes, and factors that affect behaviour, as well as generate baseline levels and measure changes which result from interventions. Lastly, it can be used to measure and classify communication procedures and sources vital for program implementation and effectiveness and assists with identifying the concerns of the program and developing decisions (Pillay, 2005).

c. The Extended Parallel Process Model (EPPM)

This model argues that when individuals are made aware of a health risk, they consider it in 2 steps (Murray-Johnson et al., 2004). During the first step, they decide whether this risk applies to them and if it is severe. When individuals acknowledge that the risk applies to them, they then decide whether or not they should do something about it, and whether the recommended action is something they can perform (Murray-Johnson et al., 2004). According to the EPPM, an individual will engage in 2 types of efficacies: response efficacy and self-efficacy. Response efficacy relates to the individual's beliefs regarding the effectiveness of recommended responses to threats, and self-efficacy relates to the individual's beliefs in their ability to perform the recommended actions (Gore & Bracken, 2005). The combination of these 2 appraisals will result in the individual accepting the recommendation, rejecting it, or not responding.

The EPPM also considers the element of fear and the degree to which this is elicited. If the fear level is low and the threat is perceived as insignificant or trivial, the individual will not likely proceed to efficacy evaluation, leading to no response. If the fear level is high, the individual is likely to respond with an efficacy evaluation, leading to acceptance or rejection. Acceptance occurs when both self-efficacy and fear of the perceived threat are high. When self-efficacy is low and fear is high, the EPPM suggests individuals follow a course of fear control. They will allow their emotions to dictate their actions, commonly leading to the use of maladaptive coping mechanisms such as denial, resistance, and/or avoidance. The successful use of fear appeal should result in an individual appropriately evaluating the threat and then engaging in recommended behaviour to control the danger instead of being guided by emotions. The EPPM also identifies the critical point when an individual considers the perceived efficacy of the recommended response. According to the EPPM, if an individual loses faith in the recommended response or self-efficacy, they will give up on any attempt to control the danger and focus on controlling their fear (Gore & Bracken, 2005).

d. The Transtheoretical Model of Change (TTM)

This model is also known as the Transtheoretical Model, and it proposes that individuals go through a series of stages when making behaviour changes. The stages are pre-contemplation, contemplation, preparation, action, maintenance, and termination. In each stage, individuals require different types of information to complete the stage successfully.

The pre-contemplation stage is characterised by lack of awareness or denial of a problem. The contemplation stage is where individuals begin to recognise the problem and start to consider the possibility of change. The preparation stage is where individuals intend to take action and start to plan how to achieve their goals. The action stage is where individuals start to take specific steps towards behaviour change. The maintenance stage is where individuals work to maintain their new behaviours and prevent relapse. Lastly, the termination stage is where individuals have completely integrated the new behaviour into their lifestyle, and it has become a part of their routine.

The TTM can be a useful framework for developing and implementing behaviour change interventions, as it recognises the importance of different stages in the process and tailors interventions to meet the needs of individuals at each stage (Rimer & Glanz, 2005).

e. *The Health Belief Model*

This is one of the earliest models, containing several concepts attempting to explain how and why people decide to change their health behaviour. These concepts include self-efficacy, susceptibility, seriousness, benefits and barriers to a behaviour, and cues to action (Champion & Skinner, 2008). More simply, if individuals consider themselves at risk of developing an adverse condition and believe that they can reduce or mitigate their risk, they are more likely to engage in proactive health behaviours, provided that the expected benefits outweigh the disadvantage (Champion & Skinner, 2008). A recent systematic review by Limbu et al. (2022) employed the Health Belief Model as the theoretical framework to investigate the constructs related to COVID-19 vaccine hesitancy. The findings of this study revealed a significant predictive relationship between the concepts of the Health Belief Model and COVID-19 vaccine hesitancy. These findings underscore the value of utilising the Health Belief Model in predicting and comprehending the factors that either facilitate or hinder COVID-19 vaccine acceptance (Limbu et al., 2022). Consequently, interventions and educational initiatives based on the Health Belief Model have the potential to effectively promote health behaviours.

f. The Theory of Planned Behaviour

This theory focuses on explaining and predicting behavioural intentions by examining behavioural, normative and control beliefs, attitudes, subjective norms, and perceptions of behavioural control (Ajzen, 2005). However, attempting to predict behavioural intentions in order to predict behaviour is greatly influenced by an individual's perceived control over their behaviour. The less control one perceives over their behaviour, the lower the chance of behaviour change (Ajzen, 2011).

A quantitative study, guided by the Theory of Planned Behaviour, investigated the impact of health education, media campaigns, and peer counsellor training on employees' well-being (Wu, 2022). This research focused on employees within the Chinese tobacco industry and their smoking behaviours. The study revealed that tobacco control played a moderating role in the relationship between employee health and the interventions of health education, media campaigns, and peer counsellor training. Significantly, these interventions led to an enhancement of employees' overall health. Furthermore, employees' perceived ability to control their smoking behaviours had a positive influence on their health and well-being (Wu, 2022). This theory can be applied to improve the health behaviours of women at risk of developing CVD by enhancing their perceived control over risk-related behaviours.

3. Interpersonal relationships and supports

Theories that focus on interpersonal relationships and supports are based on the impression that individuals can self-regulate their environments and actions and be acted upon by their environments. In other words, they create their surroundings/environments and are influenced by them (Sharma & Branscum, 2020). While several social learning theories focus on interpersonal relationships and supports, the most robust and widely used theory in health research is the social cognitive theory, which is explained in the following section (Luszczynska & Schwarzer, 2015; Sharma & Branscum, 2020).

Social cognitive theory

The social cognitive theory presents a collective set of factors to consider for effective health promotion and disease prevention programs (Luszczynska & Schwarzer, 2015). These factors consist of a person's knowledge of health risks and positive results of various health behaviours. Perceived self-efficacy refers to a person's ability to control their health routines and perceive consequence expectancies about the costs and benefits of a particular behaviour change. According to social cognitive theory, knowledge is essential for a change as the change is not possible if there is a lack of knowledge of how lifestyle habits affect health (Bandura, 2004). Nevertheless, other factors, including perceived self-efficacy, goals, and outcome expectancies, are also important factors affecting the ability of people to remove barriers that prevent them from embracing, implementing, and sustaining new lifestyle habits (Luszczynska & Schwarzer, 2015).

By implementing social cognitive theory and other health-behaviour theories (Luszczynska & Schwarzer, 2015; Rimer & Glanz, 2005), individuals will be more likely to change behaviour even if some barriers exist (Luszczynska & Schwarzer, 2015; WHO, 2012). In social cognitive theory and action, self-efficacy is considered the foundation for human motivation (Luszczynska & Schwarzer, 2015; WHO, 2012). If individuals do not believe they can reach the desired outcomes through their actions, there will be a lack of motivation to act (Luszczynska & Schwarzer, 2015). The social cognitive theory considers that people's motivation is increased when they receive support from professionals that is inclusive of their personal goals and facilitates the realisation that a particular behaviour is in their best interest (Luszczynska & Schwarzer, 2015). Strategies to increase a person's self-efficacy include: individuals setting goals that they can easily reach, behavioural contracting wherein individuals make a deal with themselves with defined goals and rewards, as well as monitoring and reinforcement (Luszczynska & Schwarzer, 2015; WHO, 2012).

In relation to this study, it is important that healthcare professionals provide appropriate information, motivation, and support to assist women with complications of pregnancy in reducing their CVD risk. Thus, it is important to be aware of and have control over the factors that contribute to a better health state, including knowledge and awareness. Knowledge is required to develop competencies that help foster self-confidence in achieving goals and self-regulatory competencies for influencing one's motivation and actions (Rimer & Glanz, 2005). Understanding the factors influencing life (either planned or unexpected) serves as a guide to support values (Luszczynska & Schwarzer, 2015).

Based on cognitive processes, as knowledge and thinking abilities provide the tools needed for cognitive problem-solving, people first test the possible solutions to problems through their thinking (Luszczynska & Schwarzer, 2015). Before taking any action, possible solutions are rejected or retained based on perceived likely outcomes (Luszczynska & Schwarzer, 2015). However, wrong judgements might be made when reasoning is based on inadequate or incorrect information (Luszczynska & Schwarzer, 2015). In social cognitive theory, this process is referred to as outcome expectancies (Luszczynska & Schwarzer, 2015).

Outcome expectancies are subjective and refer to what a person expects their action to produce (Luszczynska & Schwarzer, 2015). Information accompanied by an extension of practical risk-reduction approaches is likely to create desirable results; people learn and develop effective ways of behaving under realistic solutions (Luszczynska & Schwarzer, 2015). Furthermore, based on social cognitive theory, people behave in the same framework made and controlled by personal factors (Luszczynska & Schwarzer, 2015). Behaviour is believed to be constructed by an individual's expectations, beliefs, self-perceptions, goals, and interactions (Luszczynska & Schwarzer, 2015). Hence, what people think, believe, and feel can affect their behaviours (Luszczynska & Schwarzer, 2015).

Relationships between personal factors and environmental impacts are believed to develop through an individual's expectations, emotional changes, and cognitive abilities (Luszczynska & Schwarzer, 2015). Also, these relationships are changed by social interactions, which act to link information and stimulate emotional reactions through modelling, teaching, and social persuasion. Moreover, physical characteristics, such as age, BMI, race, and sex, tend to impact the individual's response to their social environment. Consequently, they activate various social reactions based on their social roles and/or positions (Luszczynska & Schwarzer, 2015).

Utilising social cognitive theory to reduce the risk of CVD in women involves understanding and applying its key concepts to promote behavioural changes that promote a healthier lifestyle. This can be approached through various strategies, such as implementing educational programs that showcase credible and relatable female role models who have successfully adopted heart-healthy lifestyles (Ross Arena et al., 2015). Another approach to promoting a healthier lifestyle for women is enhancing their self-efficacy. This can be accomplished by offering training programs and workshops that equip women with the knowledge and skills needed to manage and enhance their heart health (Ross Arena et al., 2015). Furthermore, empowering women to participate in the decision-making process concerning their health is another critical factor (Anderson et al., 2016; Osokpo & Riegel, 2021). Encouraging them to reflect on how their thoughts, beliefs, and actions can impact their heart health is essential in this regard (Anderson et al., 2016; Osokpo & Riegel, 2021).

Key personal factors in the health behaviour models

An overview of health behaviour models and theories suggests that health knowledge and risk perception are essential factors in promoting healthy behaviours. These concepts will be further explored in the next section.

Health knowledge

Health knowledge refers to the knowledge and understanding people acquire through experience or education about health-related issues (Chin et al., 2011; Gellert & Tille, 2015). There are interrelationships between education, health literacy, health behaviour change and health status (WHO, 2012). An individual's lifestyle is influenced by their level of education and social skills, as well as socioeconomic, environmental, and personal experiences. Individuals with high health knowledge/health literacy are more likely to effect positive lifestyle changes (Gellert & Tille, 2015). According to WHO, health literacy refers to how well a person can gather knowledge and understand information about health, how motivated and capable they are in accessing health information, and how well one can use such information to improve or maintain their health status (Sharma & Branscum, 2020; WHO, 2012).

Numerous studies have reported the positive impact of health literacy on health behaviour change (Berkman et al., 2004; Clement et al., 2009; Gellert & Tille, 2015). A survey conducted in the UK showed higher levels of health literacy were associated with health behaviours – such as eating at least 5 portions of fruits and vegetables a day or being a non-smoker – independent of education, gender, ethnicity, and income (Suka et al., 2015). By contrast, people with low health literacy show lower levels of engagement in health-promoting behaviours and are more likely to smoke, especially during adolescence and young adulthood (Berkman et al., 2004; Stewart et al., 2013).

Thus, increasing women's knowledge and awareness of CVD risk associated with complications of pregnancy is an essential step towards encouraging them to engage in CVD risk-reducing behaviours. Although health education is an essential and fundamental part of health promotion, health professionals should consider that providing knowledge, materials, and professional support alone is not always sufficient to lead to behavioural change (Pueyo-Garrigues et al., 2019; Van Achterberg et al., 2011). Some patients may have adequate knowledge about their risky behaviours and may have made frequent attempts to change them with no success. In these cases, healthcare providers must develop a comprehensive understanding of the factors that affect people's behaviours and their decision to change them (Pueyo-Garrigues et al., 2019; Van Achterberg et al., 2011).

Risk perception

It is also important that individuals (in this study, women with complications of pregnancy) understand their personal risk and recognise the extent to which they are vulnerable to or at risk of a health threat. Although knowledge is an essential component of behaviour change, it is not adequate by itself to bring about behaviour change (Gellert & Tille, 2015; Spehr & Curnow, 2011). Thus, healthcare providers should avoid the assumption that providing knowledge and educational materials will be enough for patients to accomplish changes and they need to be more creative in the practical applications of behaviour change interventions (Fernandez et al., 2019; Van Achterberg et al., 2011). Healthcare providers who plan to assist patients in changing their health behaviours can be more effective if they target patients' awareness of their personal risk (Fernandez et al., 2019; Van Achterberg et al., 2011). This can be achieved through risk communication tool and self-monitoring of behaviour, as well as discussing the intention with goal setting, and ways to increase social support or increase self-efficacy through planning coping responses (Fernandez et al., 2019; Van Achterberg et al., 2011).

The perception of personal risk drives behaviour changes considerably more than having general knowledge of a hazard or estimations of risks (Spehr & Curnow, 2011). Therefore, healthcare professionals should be more vigilant in their practice and provide the correct information at the right time and in a way that helps people acquire a reasonable perception of risk (Shahmoradi et al., 2017). Thus, to reduce the burden of CVD among women, particularly for women at high risk, such as those with a history of complicated pregnancy, it is important that these women are aware of the risk and perceive themselves at risk. This insight can help health researchers and providers develop strategies that effectively engage high-risk women in CVD risk-reduction behaviours (Collins et al., 2004). Misperception of personal CVD risk has been consistently reported in both developed and developing countries (Azahar et al., 2017; Gholizadeh et al., 2010). Helping women to identify how to combat CVD risks can increase their motivation to take positive action with risk-reducing behaviours (Azahar et al., 2017; Gholizadeh et al., 2010).

Understanding the challenges and barriers that women encounter in maintaining CVD health, as viewed through the lens of health behaviour models, is crucial for developing effective strategies to address these issues. According to the health belief model, women may underestimate their vulnerability to CVD or its severity due to misconceptions that it primarily affects men or older individuals. Also, some perceived barriers such as time constraints, financial concerns, or lack of social support may outweigh the perceived benefits of engaging in heart-healthy lifestyles for some women. Similarly, drawing from the Social

Cognitive Theory, low self-efficacy may hinder women from engaging in cardiovascular health behaviours due to their lack of confidence in their ability to initiate and maintain lifestyle changes. In addition, based on the Theory of Planned Behavior, social and cultural norms, as well as attitudes towards cardiovascular health behaviours such as exercise, a healthy diet, and preventive screenings, can influence women's intentions to embrace a healthier lifestyle. Socioeconomic disparities, including income, education, and employment, may also restrict access to healthcare, healthier diets, and opportunities for physical activity, thereby impacting cardiovascular health. Finally, following the Health Literacy Model, limited health literacy can prevent women from understanding and adhering to medical guidelines or effectively managing their cardiovascular health.

Conclusion of the chapter

This chapter presented the theoretical foundation underpinning of this thesis and explained the key concepts, including health promotion and health education. Healthcare providers' competency to promote health and prevent disease in individuals was discussed, and Kanter's Theory of Structural Power in Organisations as a valuable theory to empower healthcare providers in their health promotion and disease prevention role was presented. Furthermore, an overview of the main health behaviour models and theories was provided, and the role of knowledge and risk perception in changing unhealthy behaviours was discussed. Key elements related to health behaviours such as perceived susceptibility and severity, perceived barriers, health literacy levels, and interpersonal and community influences in cardiovascular health among women were identified. Despite extensive efforts to enhance nationwide awareness, only 45% of women and less than half of all healthcare providers recognise CVD as the leading cause of death in women or as the primary concern for women's health (Brown & Smith et al., 2020). Over the past decade, increasing evidence has emerged indicating that women who have experienced specific complications during pregnancy face an elevated risk of developing CVD later in life. Therefore, improving the level of knowledge and awareness of women and healthcare providers in this regard is essential to prevent CVD morbidity and mortality among this hight risk population group (Hauspurg et al., 2018). The next chapter will provide a comprehensive review of the literature on CVD risks among women who have experienced complications during pregnancy.

Chapter Three: Literature Review

Introduction to the chapter

Chapter Two provided a theoretical foundation for the study, elucidating both individual and systemic factors that impact behaviour change. It discussed how this knowledge can be applied to engage high-risk groups, such as women with a history of pregnancy complications, in behaviours aimed at reducing cardiovascular risks. While there has been a significant reduction in the risk of death from CVD for both men and women since 2000, the rate of decline has been notably slower in women. Recent data highlights the persistence of this gender disparity, with the death rate per 100,000 population for women reaching 209 per 100,000 in 2017, in contrast to 129.6 per 100,000 for men during the same year (Brown & Smith, 2020). This gender disparity in the development and outcomes of CVD requires further exploration. Over the last decade, a growing body of evidence has emerged, indicating that women who have experienced complications of pregnancy, such as pregnancy loss, HDP, and GDM, are at an elevated risk for the subsequent development of CVD (Cusimano et al., 2014; Täufer Cederlöf et al., 2022). However, there is a limited number of review studies that have aimed to synthesise and reconcile the findings from these studies in order to provide a clearer path forward and promote actionable steps. This chapter offers a comprehensive review of the current literature regarding the connections between pregnancy complications and the risk of CVD in women. The review is organised into three primary sections. Section 3.1 examines the CVD risk in women with a history of miscarriage. Section 3.2 outlines the CVD risk associated with hypertensive disorders of pregnancy, and Section 3.3 concentrates on the CVD risk in women with a history of gestational diabetes mellitus. The literature reviews have been published in peer-reviewed journals.

The first literature review article, which provided a comprehensive review of the association between a history of pregnancy loss, including miscarriage and stillbirth, and future CVD among affected women, was published in Health Care for Women International. This journal was selected due to its relevance and rigorous peer-review process. Health Care for Women International is an international journal that encompasses a wide spectrum of healthcare and related topics concerning women. It offers researchers the opportunity to disseminate their work to a diverse readership. As of 2021, the journal had an impact factor of 1.484, according to the International Scientific Indexing. Over the past five years, the impact factor has averaged 1.633.

Section 3.1 Association between a history of miscarriage or stillbirth and future risk of CVD

Abstract

CVD remains a significant cause of morbidity and mortality in women worldwide. In addition to well-known risk factors, certain adverse pregnancy outcomes have been linked to an increased risk of CVD in women. This study aims to review the literature on the risk of CVD in women with a history of pregnancy loss, specifically miscarriage and/or stillbirth.

Electronic databases, including MEDLINE and CINAHL, were searched for English-language articles published from January 2000 to October 2022. Following the application of study inclusion and exclusion criteria, 12 studies were selected for review. The results of the review indicate that women with a history of miscarriage and/or stillbirth are more likely to develop CHD and stroke later in life compared to women without these conditions. The risk is particularly elevated in women with multiple miscarriages or stillbirths. These findings suggest that miscarriage and stillbirth should be considered a risk factor for developing CHD and stroke in women. Healthcare professionals should be aware of the risk associated with

miscarriage and stillbirth and use maternal history to identify, refer, closely monitor, and engage these high-risk women in healthy lifestyle and risk-factor modification programs. In conclusion, this study highlights the importance of considering a history of pregnancy loss as a potential risk factor for CVD in women. By identifying and managing this risk factor, healthcare professionals can potentially reduce the burden of CVD in women with a history of pregnancy loss.

Problem identification

CVD is a leading cause of premature mortality in women (Wagner et al., 2015). CVD generally refers to any disease that affects the cardiovascular system and includes, but is not limited to, CHD and cerebrovascular disease (stroke). CHD, IHD, and coronary artery disease (CAD) refer to the narrowing or blockage of coronary arteries, usually caused by atherosclerosis (Mosca et al., 2011a; WHO, 2021a). Common risk factors for CVD include hypertension, hypercholesterolemia, obesity, smoking, diabetes, physical inactivity, age, and family history (Australian Institute of Health and Welfare, 2021). Although men and women share many CVD risk factors and exhibit overlap in clinical presentations, there exist important gender-specific differences. Some risk factors are exclusive to women or affect women disproportionately (Gao et al., 2019). Diabetes, for example, is a greater risk factor for developing CVD in women than men, and factors related to childbirth and menopause are unique to women (Gao et al., 2019). The incidence of CVD is similar in men and postmenopausal women (Aggarwal et al., 2018; Mosca et al., 2011a).

There is emerging evidence linking adverse pregnancy outcomes to increased risk of CHD in women. The underlying mechanism of this association is unknown; however, several hypotheses have been proposed. One explanation is that duration of pregnancy in which women are exposed to high level of pregnancy estrogens is important for cardiovascular health (Facca et al., 2018; Kharazmi et al., 2010). In another word, the longer women are exposed to higher levels of estrogens, the better it is for their cardiovascular health. Then, if women have a shorter pregnancy due to pregnancy loss, then they aren't exposed to estrogens for long enough and so they become predisposed to CHD (Mahendru & Morris, 2013). It is also possible the metabolic, hormonal, and haemostatic changes related to adverse pregnancy outcomes contribute to development of CHD in women (Facca et al., 2018; Kharazmi et al., 2011), or the resulting vascular pathology may contribute to poor placenta implantation, causing pregnancy loss and, in later life, CHD (Ranthe et al., 2013).

The AHA recognises adverse pregnancy outcomes such as pre-eclampsia and gestation hypertension as early indicators of CVD risk in women, and advises that the current risk prediction tools, such as the Framingham Risk Score, are likely to underestimate the risk of CHD in women. However, miscarriage and stillbirth have not been explicitly stated as adverse pregnancy outcomes in the AHA 's guideline for prevention of heart disease in women. The aim of conducting this review is to consolidate the evidence linking history of miscarriage and/or stillbirth to future CVD risk in women.

Miscarriage or spontaneous abortion is the most common complication in early pregnancy and is defined as pregnancy loss before 20 weeks of pregnancy (Tulandi & Al-Fozan, 2016). Miscarriage occurs in about 10–15% of all pregnancies (Sugiura-Ogasawara, 2015), and the main known risk factors include advanced maternal age, history of spontaneous pregnancy loss, and smoking (Tulandi & Al-Fozan, 2016). Recurrent miscarriage refers to the loss of 2 or more pregnancies (Sugiura-Ogasawara, 2015), and it occurs in 0.5–3% of all fertile women (Tulandi & Al-Fozan, 2016). The cause of recurrent miscarriage is multifactorial, yet, in about half of the cases, the underlying reason remains unexplained (Mahendru & Morris, 2013). Chromosomal defects are the main cause of an early miscarriage; however, in early or late recurrent miscarriages usually one or more maternal risk factors are involved. Many of these risk factors overlap with the CVD risk factors; for example, endothelial dysfunction and hypertension (Mahendru & Morris, 2013). Stillbirth is defined as death before complete separation from pregnancy products and mother, regardless of the duration of pregnancy. The threshold for defining stillbirth/fatal death is gestational age 22 weeks and above, birth weight 500 grams and above, or crown–heel length 25 cm and above. Stillbirth accounts for over three quarters (76%) of all perinatal deaths in Australia (Australian Institute of Health and Welfare, 2022f).

Methods

This review utilised an integrative review approach, allowing for the inclusion of various types of studies. The integrative review is a systematic and comprehensive research methodology employed to analyse and synthesise existing literature on a specific research topic (Whittemore & Knafl, 2005). Following the stages recommended by Whittemore & Knafl (2005), this review commenced with problem identification, literature search, data evaluation, data analysis, and the presentation of the findings.

Literature search

An extensive search of literature published from January 2000 to October 2022 was carried out using electronic databases including MEDLINE and CINAHL to access the evidence linking miscarriage and stillbirth with future risk of CVD. MEDLINE and CINAHL were selected, as they are well-known for their comprehensive coverage of healthcare and nursing literature and were the most relevant to the field of current research. Non-English literature and review studies were excluded, as well as conference abstracts, letters to the editor, and editorial articles. However, the reference lists of the included studies and previously excluded review studies were searched for additional potential studies. The keywords used for the exposure included: ‘pregnancy loss*’, ‘abortion*’, ‘miscarriage*’, ‘fatal death*’, ‘stillbirth*’, ‘still birth*’, ‘stillborn’ and for the outcome included: ‘cardiovascular disease*’, ‘coronary artery disease’, ‘myocardial infarction’, ‘coronary heart disease*’, and ‘ischemic heart disease*’. Only primary studies that investigated the link between miscarriage or stillbirth and risk of CVD in later life were included.

Study selection

Initially, 55 publications were retrieved from the search. After limiting the results to English-language articles and the defined time period, 43 articles remained for screening.
The articles were imported into an EndNote library, where review articles and duplicates were subsequently eliminated. This process resulted in 29 papers that were deemed suitable for further analysis. During the title- and abstract-screening process, 12 additional articles were excluded. The full texts of the remaining 17 studies were reviewed for relevancy, resulting in the exclusion of 5 papers. In the end, 12 studies were included in the review (Figure 3.1). Of the 12 reviewed studies, 7 were conducted in Europe, including 2 in Scotland and one each in Finland, Germany, the Netherlands, The United Kingdom (not inclusive of Scotland), and Denmark. Three studies were conducted in the United States, one in Israel, and one in China. Table 3.2 provides a summary of the characteristics of each study, including location, study design, and sample size.

Quality assessment

The total of 12 articles were evaluated for quality using the Critical Appraisal Skills Programme tool (Critical Appraisal Skills Programme, 2016). The supervisory team oversaw the entire process, which encompassed the database search, article selection, quality assessment of the articles, data extraction, interpretation of the results, and the presentation of the findings. They conducted random audits of articles to ensure the accuracy of the quality assessment and data extraction. None of the studies were rated as being of poor quality, and all 12 studies were included in the review (Table 3.1).

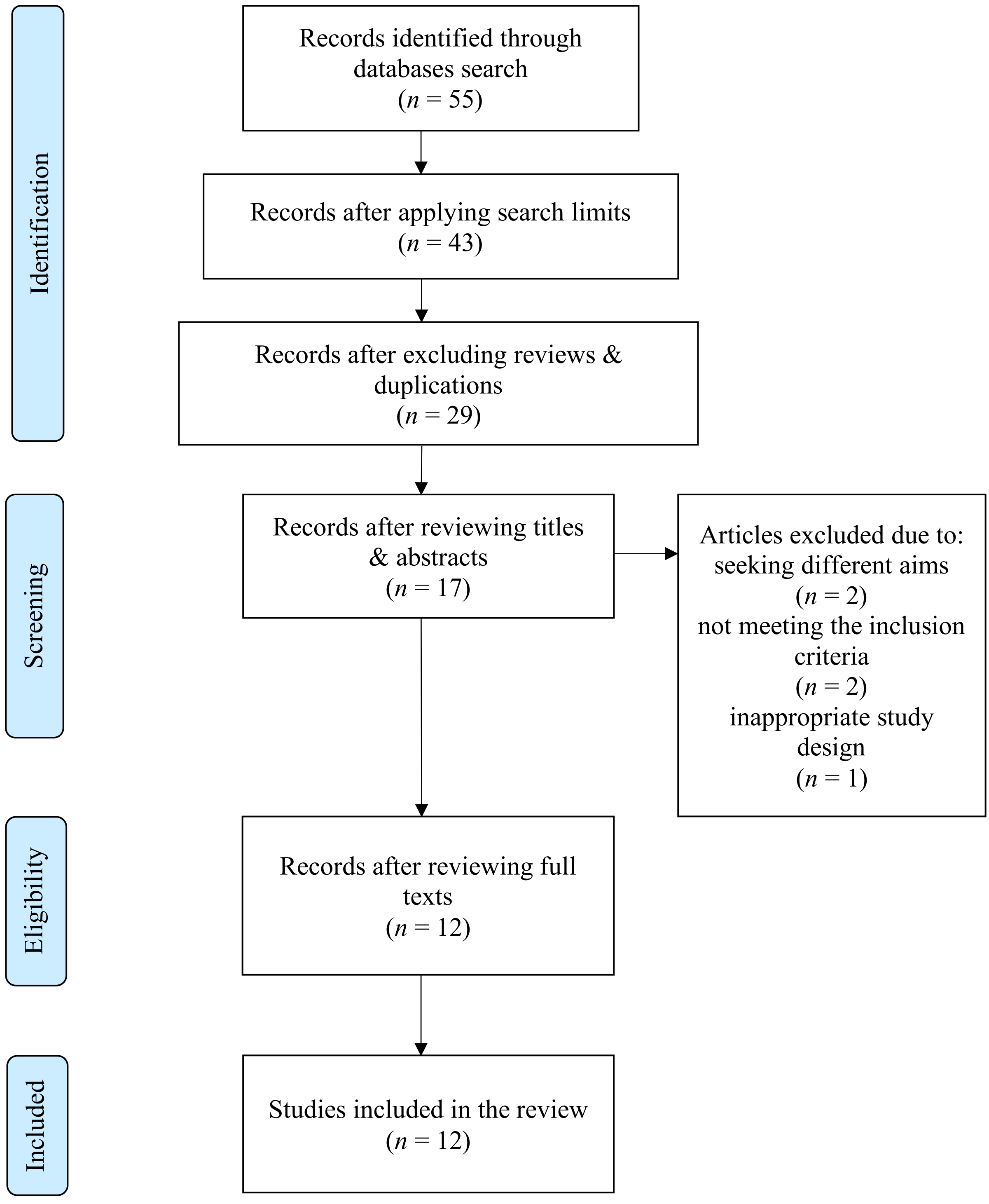

Figure 3.1 *PRISMA flow diagram of the literature search (pregnancy loss)*

Findings

The review findings are presented in 2 main categories: risk of CVD in women with history of miscarriage and risk of CVD in women with history of stillbirth.

Risk of CVD in women with history of miscarriage

The studies that examined the relationship between a history of miscarriage and CVD consistently suggest that miscarriage, particularly recurrent miscarriage, is associated with an increased risk of CHD, MI, and stroke. For example, in a retrospective population-based study in Scotland, researchers investigated 129,290 women who had their first live child between 1981 and 1985 to examine the risk of CHD in women with a history of early miscarriage (Smith et al., 2003). They found that women with a history of early miscarriage before their first live delivery were more likely to have CHD events in later life. The risk increased with the number of early miscarriages. Women with 1–2 early miscarriages were at increased risk of CHD (adjusted hazard ratio [HR] 1.48; 95% CI 1.09 to 2.02; $p = 0.01$). The HR increased to 2.35 in women with 3 or more early miscarriages (95% CI 0.87 to 6.36; $p = 0.09$). The increased risk was found to be independent of maternal age at the time of the first birth, height, socioeconomic deprivation, history of essential hypertension, and adverse events during the first pregnancy. However, the effects of other important confounders, such as smoking or diabetes, were not controlled in this study. The researchers did not find an association between termination of pregnancy and future risk of CHD (Smith et al., 2003).

Similarly, in a prospective cross-sectional study, researchers examined 3,937 Finnish women aged 30–99 years and found that women with a history of miscarriage had a slightly increased risk of MI in later life, although the association was not statistically significant (fully adjusted OR 1.3; 95% CI 0.6 to 2.4). However, subgroup analysis revealed a significantly greater risk of MI in women aged 50–74 years (age-adjusted OR 2.0; 95% CI 0.9 to 4.0). The risk was particularly high in women with recurrent miscarriages, with a 40%

increase in risk for every episode of miscarriage (age-adjusted OR per miscarriage 1.4; 95% CI 1.1 to 1.8). The study controlled for potential confounders, including age, BMI, waist–hip ratio, fasting blood glucose, blood pressure, smoking, physical activity, and education (Kharazmi et al., 2010).

Kharazmi et al. (2011) conducted another large population-based cohort study in Germany to investigate the association between miscarriage and future risk of MI. The study included 11,518 women aged between 30 and 66 years who had ever been pregnant and never had a history of MI or stroke and were followed up through regular questionnaires every 2–3 years for an average of 10.8 years. Of the participants, 25% experienced at least one miscarriage, 18% had at least one abortion, and 2% had at least one stillbirth. During the follow-up period, 82 cases of MI and 112 cases of stroke were recorded for the cohort. The study found that women who experienced miscarriage were more likely to currently or previously smoke and had slightly higher waist–hip ratios. Women with recurrent miscarriage were more likely to have higher BMI and waist–hip ratios than other women. Consistent with the Finnish study, the authors found that each miscarriage was associated with over a 40% increase in the risk of MI (age-adjusted HR 1.42; 95% CI 1.14 to 1.78). The risk of MI was about 9 times higher in women with recurrent miscarriage (> 3) (age-adjusted HR 8.90; 95% CI 3.18 to 24.90). When the analysis was limited to women aged 49 and older with a history of more than 3 miscarriages, the association between recurrent miscarriage and later MI remained significant (age-adjusted HR 9.07; 95% CI 3.2 to 25.4). The study concluded that women with a history of miscarriage or recurrent miscarriage were at significantly greater risk of MI, and the risk remained significant after adjustment for other potential confounders (fully adjusted HR 5.06; 95% CI 1.29 to 20.29). The researchers did not find a significant association between abortion and later MI or between any type of pregnancy loss and stroke (Kharazmi et al., 2011).

Similarly, a study was conducted in Denmark to investigate the association between miscarriage and the future risk of MI and other cardiovascular conditions. The researchers identified 1,031,279 females aged 12 years or older who had at least one pregnancy resulting in a live singleton birth, miscarriage, or stillbirth, registered in the Medical Birth Register between 1977 and 2008 (Ranthe et al., 2013). Women whose first registered pregnancy outcome was a live birth were considered unexposed until they experienced a pregnancy loss, whereas women whose first registered pregnancy outcome was a miscarriage or stillbirth were considered exposed from the start of follow-up. The participants were followed from the end of pregnancy for incident MI and other cardiovascular events for a total of at least 15,928,934 person-years.

The study found that compared to women with no miscarriages, women with one or more miscarriages had a higher rate of MI, with incidence rate ratios of 1.13 (95% CI 1.03 to 1.24). The association was dependent on the number of miscarriages, with each additional miscarriage increasing the rates of MI by 9% (3% to 16%). The association was also stronger in younger women (< 35 years). The researchers concluded that miscarriage is associated with an increased risk of MI and other cardiovascular conditions that have atherosclerotic changes in the vascular bed as a common feature. Therefore, pregnancy loss could be considered as a possible risk factor for atherosclerotic disease in women (Ranthe et al., 2013).

In another study, researchers applied a retrospective approach to examine the relationship between miscarriage and later CVD events in 77,701 postmenopausal women, with a mean follow-up of 7.7 years (Parker et al., 2014). Out of the participants, 30.3% had a history of miscarriage, 2.2% stillbirth, and 2.2% both. The researchers found that women with a history of one miscarriage had a greater risk for CHD compared with women without this history, with the multivariable-adjusted OR of 1.19 (95% CI 1.08 to 1.32). However, the risk was not significantly different from women who had 2 or more miscarriages, with the reported OR of 1.18 (95% CI 1.04 to 1.34). This study found no association between miscarriage and future ischemic stroke. In this study, the researchers accounted for the effects of most potential confounders. The researchers hypothesised that metabolic, hormonal, and haemostatic changes associated with pregnancy loss were likely to contribute to the increased risk of CHD in the affected women (Parker et al., 2014).

The results of the above study were supported by a Scottish cohort study with longer follow-ups (Wagner et al., 2015). Researchers in this study recruited 60,105 women and followed them up for 17 years. Of the participants, 15.67% experienced non-consecutive miscarriages, 1.56% had 2 consecutive miscarriages, 0.28% had 3 or more consecutive miscarriages, and 82.49% had no miscarriage. The researchers excluded women with pre-existing morbidity, such as type 1 diabetes mellitus, hypertension, and kidney disease. The effects of other important confounders were controlled for. They found that women who had 2 consecutive miscarriages had 1.75 times higher risk for developing CHD compared to women with no history of miscarriage (95% CI 1.22 to 2.52). The risk of CHD tripled (HR 3.18; 95% CI 1.49 to 6.80), in women with 3 or more consecutive miscarriages compared with women with no history of miscarriage. Similar findings were observed when the data were analysed irrespective of whether the miscarriage occurred consecutively or not. Therefore, the researchers concluded that there was a significantly positive association between the number of miscarriages and the risk of CHD, irrespective of whether consecutive or not (Wagner et al., 2015).

In another study, researchers followed up 93,676 postmenopausal women (Parikh et al., 2016). They excluded women with missing reproductive and CHD risk-factor information, those with no follow-up information, and women with predominant or unknown history, leaving 72,982 women for further investigation. Using an age-adjusted Cox proportional hazards analysis, the researchers revealed that compared with women without a history of miscarriage, the risk of CHD was greater in women with a single miscarriage (HR 1.13; 95% CI 1.05 to 1.22), in women with 2 to 4 miscarriages (HR 1.28; 95% CI 1.16 to 1.41), and in women with more than 5 miscarriages (HR 1.55; 95% CI 1.15 to 2.09). The associated risk remained significant even after adjusting for established CHD risk factors. It should be noted that this study considered postmenopausal CHD events only (Parikh et al., 2016).

In a hospital case–control study, researchers investigated the association between pregnancy loss and the risk of ischemic stroke or MI in women aged 18–50 years (Maino et al., 2016). Researchers approached all women who presented with a first event of MI (n = 218) or ischemic stroke (n = 165) to one of the 16 participating hospitals in the Netherlands between 1990 and 1995 and were eligible for study participation. For the control group, they approached women (n = 743) by random digit dialling who were matched with cases according to age (in 5-year categories), area of residence, and year of the event. Women with a history of CHD, cerebrovascular event, or peripheral vascular disease were excluded from the control cohort. The researchers also considered common CVD risk factors and family history of CVD in the analysis.

The study found that women with multiple (≥ 3) miscarriages had twice the risk of MI or ischemic stroke (OR 2.37; 95% CI 0.99 to 5.70) compared to women without a history of miscarriage. Both relative risks were higher for ischemic stroke (OR 3.51; 95% CI 1.08 to 11.35, and OR 2.06; 95% CI 0.81 to 5.23, respectively) than for MI (OR 2.04; 95% CI 0.71 to 5.86, and OR 1.04; 95% CI 0.39 to 2.79). The researchers concluded that multiple pregnancy loss is associated with an increased risk of arterial thrombosis at a young age. This increase in risk was more pronounced for ischemic stroke than for MI, especially when common cardiovascular risk factors and cardiovascular family history were considered (Maino et al., 2016).

A nationwide China Kadoorie Biobank study examined the associations between pregnancy outcomes (miscarriage, induced abortion, and stillbirth) and CVD incidence in Chinese women (Peters et al., 2017). The study included 302,669 women aged 30 to 79 years from 10 diverse locations in China and followed them up for 7 years. The study found that a history of miscarriage was associated with a higher risk of CHD (adjusted HR 1.07; 95% CI 1.02 to 1.13) and stroke (adjusted HR 1.04; 95% CI 1.00 to 1.09), particularly with recurrent miscarriage. HR for CHD and stroke for each additional miscarriage were 1.07 (95% CI 1.01 to 1.14) and 1.04 (95% CI 0.98 to 1.10), respectively. The study also found that a history of induced abortion was associated with a higher risk of CHD (HR 1.11; 95% CI 1.06 to 1.15) and stroke (HR 1.04; 95% CI 1.01 to 1.07), particularly with recurrent induced abortion. HR for CHD and stroke per each additional induced abortion were 1.02 (95% CI 1.00 to 1.05) and 1.03 (95% CI 1.00 to 1.05), respectively. The study concluded that a history of miscarriage, recurrent miscarriage, and induced abortion are associated with a higher risk of CVD outcomes among Chinese women (Peters et al., 2017).

The analysis of data from the UK Biobank, which included 267,440 women aged 40 to 69 years with a follow-up of 7 years, found that a history of miscarriage was associated with a higher risk of CHD, but not of CVD or stroke. After adjusting for multiple confounders, the HRs for women with a history of miscarriage versus women without this history were 1.07 (0.98 to 1.17) for CVD, 1.14 (1.01 to 1.29) for CHD, and 0.98 (0.86 to 1.12) for stroke. The adjusted HRs associated with each additional miscarriage were 1.04 (1.00 to 1.09) for CVD, 1.06 (1.00 to 1.13) for CHD, and 1.01 (0.95 to 1.09) for stroke. The study also reported that the associations between CVD and CHD and a history of miscarriage were stronger among women with a higher socioeconomic status ($p = 0.03$) after adjusting for most confounders (Peters & Woodward, 2018).

In a recent prospective longitudinal study conducted in the US, Tsulukidze et al. (2022) investigated the effects of pregnancy loss, including natural loss and induced abortion, on the risk of subsequent CVD of any type. The study used medical records between 1999 and 2014 from the US Centers for Medicare & Medicaid Services (CMS) and recruited 11,577,980 young women born in 1983 or later who had at least one pregnancy outcome before 2013. Pregnancy outcomes were categorised into live birth or pregnancy loss, including both natural losses and induced abortions. The study groups were divided into women whose first pregnancy ended in a loss and women whose first pregnancy ended in a live birth and had no subsequent known pregnancy losses.

The study reported that a history of pregnancy loss was associated with a 38% higher risk of a CVD diagnosis in the observed period (OR 1.38; 95% CI 1.37 to 1.40). After adjusting for history of diabetes, hyperlipidaemia, age, year of first pregnancy, race, state of residence, months of eligibility, number of pregnancies, births, and number of losses before and after the first live birth, they found that exposure to any pregnancy loss was associated with an 18% increased risk of CVD (adjusted OR 1.18; 95% CI 1.15 to 1.21). The study also revealed an important temporal relationship between CVD and pregnancy loss. Immediate and short-term increased CVD risk was more characteristic of women whose first pregnancy ended in a live birth, while a delayed and more prolonged increased risk of CVD was associated with a first pregnancy loss. Furthermore, the study reported that racial differences were most notable regarding Hispanic people, who had lower CVD rates following a first pregnancy than all other racial groups.

Risk of CVD in women with history of stillbirth

Research examining the associations between stillbirth and the risk of future CVD consistently reports significant positive associations between these 2 variables. In a population-based cohort study, Calderon-Margalit et al. (2007) investigated the relationship between stillbirth and the risk of future CVD. The study focused on women who had at least 2 deliveries between 1964 and 1976, with median follow-ups of 36.5 years, and gathered data through linkage with the Israeli population registry. The study found that women with a history of stillbirth had a significantly higher rate of all-cause death compared to those who had only live births, with an adjusted HR of 2.08 (95% CI 1.65 to 2.61). The adjusted HR of death from CHD was 2.00 (95% CI 1.02 to 3.93), all circulatory HR 1.70 (95% CI 1.02 to 2.84), and renal disease HR 4.70 (95% CI 1.47 to 15.0).

The researchers accounted for potential confounders such as age, ethnicity, and maternal medical conditions including heart disease, diabetes mellitus, GDM, pre-eclampsia, and placental abruption at any pregnancy. The association between stillbirth and later death did not change when the analyses were adjusted for history of GDM. The study suggested that stillbirth should be considered as an early indicator of premature death in fertile women. The study concluded that the relationship between stillbirth and later death is not causal, but rather that maternal metabolic disorders underlie both stillbirth and later CVD death. Women of North African origin were at particularly higher all-cause mortality risk with an adjusted HR of 2.47 (95% CI 1.69 to 3.63).

Similarly, Kharazmi et al. (2011) found that the age-adjusted HR of MI increased by 2.65 in women with a history of stillbirth (95% CI 1.37 to 5.12). Women with stillbirth were more likely to be older, less educated, physically less active, diabetic, and have hyperlipidaemia and hypertension compared to women without the condition. The association between stillbirth and later MI remained significant after adjusting for potential confounders (HR 2.32, 95% CI 1.2 to 4.9) (Kharazmi et al., 2011). Also, Ranthe et al. (2013) reported that women with stillbirth had a higher rate of MI (incidence rate ratio [IRR] 2.69; 95% CI 2.06 to 3.50) compared to women with no stillbirth (Ranthe et al., 2013). Consistent with these findings, Parker et al. (2014) reported that women with one or more stillbirths had a greater multivariable-adjusted odds ratio of CHD (OR 1.27; 95% CI 1.07 to 1.51) compared to women without a history of stillbirth. Because the interactions between stillbirth and diabetes, hypertension, lipid levels, and ethnicity were not significant, these variables were not included in the final multivariable model. Similar to Kharazmi et al.'s study (2011), women with a history of stillbirth were more likely to be older in this study (Parker et al., 2014).

Another study conducted by Parikh et al. (2016) found that women with a history of one stillbirth had an increased risk of CHD with an age-adjusted Cox proportional hazard of 1.24 (95% CI 1.07 to 1.44) compared to women without a history of stillbirth. After adjusting for established CHD risk factors and other reproductive and pregnancy risk factors, the study concluded that stillbirth was an independent risk factor for CHD in later life (Parikh et al., 2016).

In contrast, Peters et al. (2017) reported a higher risk of stroke (HR 1.06; 95% CI 1.00 to 1.12) among women with a history of stillbirth, but no apparent association between stillbirth and CHD (HR 1.00; 95% CI 0.94 to 1.07). The study also did not find a clear dose-response association between the number of stillbirths and stroke (Peters et al., 2017). These results were supported by a more recent study by Peters and Woodward (2018) in the UK, which found that a history of stillbirth was associated with a higher risk of CVD and stroke, but not of CHD; adjusted HRs 1.22 (95% CI 1.01 to 1.46) for CVD, 0.98 (95% CI 0.74 to 1.28) for CHD, and 1.44 (95% CI 1.12 to 1.85) for stroke.

Discussion

The results of this review suggest that women with a history of miscarriage compared to women without miscarriage are at increased risk for developing CHD in later life. The risk is particularly greater in women with recurrent miscarriages (Parikh et al., 2016; Parker et al., 2014; Peters et al., 2017; Wagner et al., 2015), irrespective of being consecutive or not (Wagner et al., 2015). Early miscarriage and the number of miscarriages have been found to strengthen the associations between miscarriage and future CHD (Smith et al., 2003; Wagner et al., 2015). While Smith et al. (2003) and Kharazmi et al. (2011) did not find any evidence of association between induced abortion and risk of CHD, a recent study by Peters et al. (2017) reported increased risk of CHD in women who had a history of induced abortion compared to those without induced abortion. Also, another recent study reported that overall women who had history of pregnancy loss (both spontaneous abortion and induced abortion) had a higher risk of CVD compared to women without such a history (Tsulukidze et al., 2022).

Women with a history of stillbirth may be at higher risk of developing CHD and experiencing premature death, independent of traditional CHD risk factors. The risk of CHD may be particularly elevated in women with a history of recurrent stillbirths (Kharazmi et al., 2011; Kharazmi et al., 2010; Parikh et al., 2016; Parker et al., 2014). The association between miscarriage and future CVD risk is less clear, with some studies reporting a positive association while others did not find a significant link. Similarly, the evidence on the association between pregnancy loss and future stroke risk is mixed. Further research is needed to fully understand the mechanisms underlying these associations and to develop effective strategies for preventing CVD in women with a history of pregnancy loss (Peters & Woodward, 2018; Peters et al., 2017).

This review highlights the need for healthcare providers to consider a history of recurrent miscarriage as a potential risk factor for future CHD (Kyriacou et al., 2022). However, further research is required to determine the full extent of cardiovascular complications associated with pregnancy loss. It is also unclear whether women with a history of both miscarriage and stillbirth are at a higher risk of developing CHD than those with a history of only one type of pregnancy loss (Smith et al., 2003; Wagner et al., 2015). Future studies should also examine potential racial differences in the association between pregnancy loss and CHD. Calderon-Margalit et al. (2007) found that the association between stillbirth and all-cause mortality was more significant in African women, while Tsulukidze et al. (2022) reported that Hispanic women had lower CVD rates among those with a history of pregnancy loss than women of other racial groups. Therefore, it is essential to consider race and ethnicity when evaluating the relationship between pregnancy loss and CHD.

Additionally, some studies suggest that genetic or epigenetic factors may contribute to the association between pregnancy loss and CHD (Mahendru & Morris, 2013). Smith et al. (2011) investigated the association between pregnancy loss before the first live birth and family history of CVD in a large cohort of women. They found that women with a history of 2 or more miscarriages before the first live birth had a 25% higher risk of having a family history of CHD, and the association was even greater (56%) in women with 3 or more miscarriages. However, the study did not find a significant association between elective abortion before the first live birth and family history of CVD. These findings suggest that there may be shared genetic susceptibility and pathophysiological pathways between spontaneous miscarriage and CHD (Oliver-Williams et al.,2022).

Despite the lack of a clear understanding of the underlying mechanisms, the evidence suggests that a history of pregnancy loss increases the risk of developing CHD. Miscarriage and stillbirth may influence the risk of CHD in combination with other risk factors as well as independently. Nevertheless, future prospective cohort studies are necessary to establish a causal relationship between pregnancy loss and the development of CHD.

Healthcare providers should take into account the association between pregnancy loss and CHD, and properly evaluate and monitor women with a history of miscarriage and/or stillbirth for future CHD risk. These reproductive risk factors are easily identifiable through a medical history and could serve as a simple, non-invasive, and cost-effective risk stratification tool (Horn et al., 2019; Wang et al., 2022). These risk factors could also indicate the need for early risk modification, as they often precede the onset of established CHD risk factors in younger women (Horn et al., 2019; Wang et al., 2022). The inclusion of pregnancy loss history, either alone or in combination with other established risk factors, in current CHD risk prediction tools for women should be further studied to determine its usefulness. Improved CHD risk prediction tools could help identify high-risk women who could benefit from timely supportive interventions (Lloyd-Jones et al., 2019) .

This review is primarily based on the findings of large population-based cohort or cross-sectional studies, which have their own limitations. One potential limitation is recall bias or missing data, which can affect the accuracy of the reported associations. Another limitation is that the included studies may be controlled for the effects of some but not all potential confounders, which could influence the observed associations.

Moreover, the results of the reviewed studies are mainly based on research conducted in European and American populations. Therefore, caution should be taken when generalising these findings to other populations. As the study by Calderon-Margalit et al. (2007) highlighted, ethnicity can be a significant factor in the association between pregnancy loss and CHD, and further research is needed to investigate the potential mediating effect of race and ethnicity in the association between pregnancy loss and CHD in other populations.

Conclusion

Complications during pregnancy, such as miscarriage or stillbirth, may serve as early clinical indicators of future development of CVD. Therefore, identifying high-risk women early on offers a crucial opportunity for timely intervention to prevent or mitigate CVD-related complications

Table 3.1 *Quality assessment of the included studies (Pregnancy loss)*

Author(s), year, country	Did the study address a clearly focused issue?	Was the cohort recruited in an acceptable way?	Was the exposure accurately measured to minimise bias?	Was the outcome accurately measured to minimise bias?	Have the authors identified all important confounding factors?	Was the follow-up of the subjects complete/ long enough?	What are the results of this study?	How precise are the results?	Can the result be applied to the local population?	Do the results of this study fit with the other available evidence?	What are the implications of this study for practice?
Calderon-Margalit et al. (2007) Israel	Yes	Yes	Yes	Yes	Yes	Yes	Increased long-term mortality from CHD in women with history of stillbirth	95% CI	Yes	Yes	Women that experience stillbirths make up a population that who will require carful follow-up and screening for CVD. Understanding this potential risk factor could have ramifications for the primary healthcare for women in the obstetrics and gynaecology clinics.
Kharazmi et al. (2010) Finland	Yes	Yes	Yes	Yes	Yes	Yes	No significant increase in the risk of MI in women with history of miscarriage for the whole cohort, but significant increased risk of MI in women aged 50–74 years	95% CI	Yes	Yes	Longitudinal research is essential to validate the conclusions of the study, suggesting that women who experience recurrent miscarriages might face an elevated risk of developing cardiovascular disease in the future.
Kharazmi et al. (2011) Germany	Yes	Yes	Yes	Yes	Yes	Yes	Increased risk of future MI in women with history of miscarriage, particularly recurrent miscarriages. Increased risk of MI in women with history of stillbirth..	95% CI	Yes	Yes	Recurrent miscarriage and stillbirth emerge as robust sex-specific prediction for MI, underscoring their significance as essential markers for tracking cardiovascular risk factors and preventive actions. Further investigations is recommended to undercover the shared underlying risk factors associated with pregnancy loss that simultaneously elevated the susceptibility to CVDs.
Maino et al. (2016) The Netherlands	Yes	Yes	Yes	Yes	Yes	Yes	Multiple pregnancy loss and stillbirth is associated with an increased risk of arterial thrombosis at young age. This increase in risk was more pronounced for ischemic stroke than for MI, especially when common CVD risk factors and cardiovascular family history were considered.	95% CI	Yes	Yes	The study revealed that experiencing multiple pregnancy losses and stillbirths is likely linked to increased risk of arterial thrombosis at a younger age. This increased risk is particularly prominent in the case of stroke compared to MI. It appears that the presence of antiphospholipid antibodies is unlikely to be linked to the mediator of this connection.

Author(s), year, country	Did the study address a clearly focused issue?	Was the cohort recruited in an acceptable way?	Was the exposure accurately measured to minimise bias?	Was the outcome accurately measured to minimise bias?	Have the authors identified all important confounding factors?	Was the follow-up of the subjects complete/ long enough?	What are the results of this study?	How precise are the results?	Can the result be applied to the local population?	Do the results of this study fit with the other available evidence?	What are the implications of this study for practice?
Parikh et.al. (2016) US	Yes	Unclear	Yes	Yes	Yes	Yes	Increased risk of CHD in women with younger first birth, history of stillbirth, miscarriage	95% CI	Yes	Yes	The findings underscore the importance of conducting future research that explores the connections between reproductive factors and CHD in women before menopause. Also, it's crucial to include other complications of pregnancy such as HDP and GDM.
Parker et al. (2014) US	Yes	Yes	Yes	Yes	Yes	Yes	Increased risk of CHD in women with history of stillbirth and miscarriage. No increase in ischemic stroke.	95% CI	Yes	Yes	Women who have experienced a miscarriage or a stillbirth might face an elevated risk of CVD. Therefore, they should be regarded as potential candidates for more vigilant monitoring and early intervention by their primary healthcare providers.
Peters et al. (2017) China	Yes	Yes	Yes	Yes	Yes	Yes	Increased risk of circulatory disease, CHD, and stroke in women with history of pregnancy loss (miscarriage, induced abortion, and stillbirth)	95% CI	Yes	Yes	More studies are needed to clarify the physiological, behavioural, and socioeconomic elements involved. More frequent screening and timely intervention might help to delay or prevent the onset of CVD in women who have had numerous pregnancies or recurrent pregnancy loss.
Peters et al. (2018) UK	Yes	Yes	Yes	Yes	Yes	Yes	Participants provided electronic informed consent and completed questionnaires on their lifestyle, environment, and medical history, had physical and functional measures performed, and had samples of blood, urine and saliva collected.	95% CI	Yes	Yes	The study revealed associations between various reproductive factors and the risk od=f CVD in later life. Further research is necessary to validate these current findings and shed light on the underlying biological, behavioural, and social mechanisms involved.
Ranthe et al. (2013) Denmark	Yes	Yes	Yes	Yes	Yes	Yes	Increased incidence of MI, cerebral infarction, and renovascular hypertension in women with stillbirth and miscarriage	95% CI	Yes	Yes	The connection between pregnancy loss and future CVD is in line with the idea of either a common underlying cause or possibility that a pregnancy loss triggers pathological process that result in atherosclerosis. This indicate the needs for further investigations.

Author(s), year, country	Did the study address a clearly focused issue?	Was the cohort recruited in an acceptable way?	Was the exposure accurately measured to minimise bias?	Was the outcome accurately measured to minimise bias?	Have the authors identified all important confounding factors?	Was the follow-up of the subjects complete/ long enough?	What are the results of this study?	How precise are the results?	Can the result be applied to the local population?	Do the results of this study fit with the other available evidence?	What are the implications of this study for practice?
Smith et al. (2003) Scotland	Yes	Yes	Yes	Yes	Unclear	Yes	Increased risk of future CHD in women with history of early miscarriage	95% CI	Yes	Yes	The study hypothesised that concealed cardiovascular dysfunction may result in pregnancy complications during woman 'reproductive years and manifest as overt CVD later in life. As a result, a woman's reproductive history could potentially serve as a predictor of future cardiovascular risk.
Tsulukidze et al. (2022) US	Yes	Yes	Yes	Yes	Yes	Yes	Increased risk of CVD in women with history of pregnancy loss	95% CI	Yes	Yes	The exact pathophysiological mechanisms underpinning the connection between pregnancy loss and the onset od CVD remain unclear. Further research is needed to explore whether proposed hypothesis, such as shared metabolic and hormone changes contributing to both adverse pregnancy outcomes and the development of CVD, vascular issues leading to inadequate placental implantation and subsequent pregnancy loss and CHD in later life, the loss of a protective effect of high estrogen levels on cardiovascular health due to shorter pregnancy duration, and specific genetic or epigenetic traits that make women more susceptible to both pregnancy loss and CHD, will prove to be accurate.
Wagner et al. (2015) Scotland	Yes	Yes	Yes	Yes	Yes	Yes	Increased risk of CHD in women with history of recurrent miscarriage irrespective of whether consecutive or not	95% CI	Yes	Yes	The study suggests that women who have experienced two or more miscarriage, whether consecutive or not, should be informed about an elevated risk of cardiovascular issues and advised o0n suitable measures for modifying risk factor. Further research is required to establish whether women with such a history would derive advantages from these screening and preventive measures.

Table 3.2 *Characteristics of the included studies (pregnancy loss)*

Author(s), year, country	Design	Setting/sample/sample size	Brief description of participants	Independent variables	Study tools	Main findings	Study limitations & strengths
Calderon-Margalit et al. (2007) Israel	Population-based cohort study	Linkage between data from all births to West Jerusalem residents and Israeli population registry *n* = 25,118	Mothers who delivered at least twice from 1964 to 1976. Exposed group: women with at least one stillbirth: *n* = 595 Control group: women with only live births: *n* = 24,523	Stillbirth	Birth data collected from birth notifications and maternity ward, structured questionnaires, and data from Israeli population registry	Increased long-term mortality from CHD in women with history of stillbirth	The data about stillbirth were collected only during study not during the entire of women's reproductive age.
Kharazmi et al. (2010) Finland	Cross-sectional study	Nationally representative sample of Finnish women with at least one pregnancy (the Health 2000 Survey) *n* = 3937	Women aged 30–99 years who have ever been pregnant	Miscarriage, recurrent miscarriage	Interview using questionnaire and comprehensive health examination	No significant increase in the risk of MI in women with history of miscarriage for the whole cohort, but significant increased risk of MI in women aged 50–74 years	Random sampling used. The sample was taken at one point in time and so it was not clear if exposure happened before, after or during the beginning of the outcome.
Kharazmi et al. (2011) Germany	Prospective population-based cohort study	The Cancer and Nutrition (EPIC) cohort in Heidelberg, Germany *n* = 11,518	Women within age range of 35–66 having at least one pregnancy	Stillbirth, one miscarriage, recurrent miscarriage, abortion	Baseline medical history and blood sample, then follow-up questionnaires every 2–3 years up to 10.8 years	Increased risk of future MI in women with history of miscarriage, particularly recurrent miscarriages. Increased risk of MI in women with history of stillbirth.	The reproductive history information was collected at baseline only. The follow-up period of 10.8 years might not be long enough for occurrence of the outcomes. Potential confounders like smoking were not considered.
Maino et al. (2016) The Netherlands	Hospital case–control	Participating hospitals in The Risk of Arterial Thrombosis in Relation to Oral Contraceptives, in The Netherlands *n* = 1,126	Women presented to participating hospitals with MI: *n* = 218 ischemic stroke: *n* = 165 matched controls: *n* = 743	Recurrent miscarriage, stillbirth	Questionnaires	Multiple pregnancy loss and stillbirth is associated with an increased risk of arterial thrombosis at young age. This increase in risk was more pronounced for ischemic stroke than for MI, especially when common CVD risk factors and cardiovascular family history were considered.	Considered confounders. Limited number of cases. Relatively younger age of participants could affect the overall result. No Follow-up periods.

Author(s), year, country	Design	Setting/sample/sample size	Brief description of participants	Independent variables	Study tools	Main findings	Study limitations & strengths
Parikh et.al. (2016) US	Longitudinal cohort observational study	Women aged 50–79 years from 1993–1995 participate in Women Health Initiative Observational Study *n* = 93,676	Postmenopausal women	Age at first birth, stillbirth, miscarriage, breastfeeding one baby for at least one month	Questionnaire regarding reproductive factors, clinical examination (BMI, BP), medication use for hypertension and diabetes. Questionnaire and self-report for physical activity, family history for premature CHD.	Increased risk of CHD in women with younger first birth, history of stillbirth, miscarriage	Median follow-up of 12 years, BP checked directly, findings of the study were modest in effect size. Information on pre-eclampsia/ pregnancy-induced hypertension, GDM, gestational age, and infant birth weight were not available. Premenstrual CHD events were not adjudicated, dyslipidemia and diabetes were assessed by self-report.
Parker et al. (2014) US	Prospective cohort study	Postmenopausal women enrolled from 1993–1998 at 40 clinical centres throughout the US *n* = 77,701	Women aged 50–79 years	Miscarriage, recurrent miscarriage, stillbirth	Screening and enrolment questionnaires by interview and self-report	Increased risk of CHD in women with history of stillbirth and miscarriage. No increase in ischemic stroke.	Pregnancy loss (including miscarriage and stillbirth) was measured according to self-report which could lead to misclassification bias. Miscarriage might be underestimated, which affects the overall result.
Peters et al. (2017) China	The nationwide China Kadoorie Biobank	Women from 10 diverse localities between June 2004 and July 2008 *n* = 302,669	Women aged 30–79 years	Miscarriage, induced abortion, stillbirth	Participants recruited from 5 urban and 5 rural areas of China between 2004 and 2008. Trained health workers administered a laptop-based questionnaire on sociodemographic and socioeconomic status, lifestyle factors, personal and family medical history, and women's reproductive factors, with information with number of pregnancies, miscarriages, induced abortions, and stillbirths. Physical measurements (e.g. height, weight, waist, blood pressure) were taken using standard methods. Blood sample was collected for long-term storage and future analyses.	Increased risk of circulatory disease, CHD, and stroke in women with history of pregnancy loss (miscarriage, induced abortion, and stillbirth)	Follow-up for 7 years. Recruited participants from 10 different locations. Considered potential confounders.

Author(s), year, country	Design	Setting/sample/sample size	Brief description of participants	Independent variables	Study tools	Main findings	Study limitations & strengths
Peters et al. (2018) UK	Prospective population-based cohort study	UK biobank between 2006 and 2010, women from 22 centres across UK *n* = 2,677,440	Women aged 40–69 without history of CVD at baseline	Age at menarche, number of live births, age at first birth, history and number of miscarriages and stillbirths, history of and age at hysterectomy and oophorectomy, menopausal status, age at natural menopause	Participants provided electronic informed consent and completed questionnaires on their lifestyle, environment, and medical history, had physical and functional measures performed, and had samples of blood, urine and saliva collected.	Risk of CHD, CVD, and stroke based on reproductive history	Large sample size. Prospective design and availability of detailed information on reproductive and other lifestyle factors.
Ranthe et al. (2013) Denmark	Prospective population-based cohort study	From the National Patient Register from 1977–2008 *n* = 1,031,279	All women aged ≥ 12 years with at least one pregnancy ending in a live singleton birth, miscarriage, or stillbirth registered in the Medical Birth Register	Miscarriage, stillbirth, or live singleton birth	Data from The National Patient Register, The Medical Birth Register, The National Diabetes Register	Increased incidence of MI, cerebral infarction, and renovascular hypertension in women with stillbirth and miscarriage	Followed for > 15,928,900 person-years. Large sample size. Considered potential confounders.
Smith et al. (2003) Scotland	Retrospective cohort study	Eligible women recorded through routine national maternity data, who delivered between 1981 and 1985 *n* = 129,290	All women who delivered their first live-born infant in Scotland during the specific period	Early miscarriage	Used national death and discharge data	Increased risk of future CHD in women with history of early miscarriage	A large study controlled for some co-founding factors, but not smoking and diabetes
Tsulukidze et al. (2022) US	Prospective longitudinal study	Medical record between 1999 and 2014 for Medicaid beneficiaries born after 1982 in the US *n* = 1,157,980	The study was limited to young women born in 1983 or later who had at least one pregnancy outcome before 2013 and had been eligible for Medicaid for at least 12 months between 1999 and 2015 inclusive. To maximise identification of first-pregnancy outcomes, data for each beneficiary was rolled in, beginning in the year of her 14th birthday or in 1999, whichever was later, giving a cohort wherein the oldest beneficiaries were 16 years of age in 1999 and 29 years of age in 2012.	Pregnancy loss including spontaneous miscarriage and induced abortion	US medical record	Increased risk of CVD in women with history of pregnancy loss	Follow-up > 12 years. Recruited participants from 16 different states which provided coverage for all reproductive healthcare options and reported all reproductive health services to CMS.

Author(s), year, country	Design	Setting/sample/sample size	Brief description of participants	Independent variables	Study tools	Main findings	Study limitations & strengths
Wagner et al. (2015) Scotland	Cohort	The Aberdeen Maternity and Neonatal Databank recorded women with at least one miscarriage or live birth from 1950–2000 in Aberdeen, Scotland *n* = 60,105	Exposed group: 9,419 women with non-consecutive, 940 with 2 consecutive, 167 with ≥ 3 consecutive miscarriages. Unexposed group: 49,579 women with at least one live birth with no miscarriage.	Non-consecutive, 2 consecutive, ≥ 3 consecutive miscarriages	Linked dataset using probabilistic record linkage to Scottish Morbidity Record for cardiovascular condition and National Records of Scotland for death registrations	Increased risk of CHD in women with history of recurrent miscarriage irrespective of whether consecutive or not	Long follow-up (17 years). Excluded women with pre-existing conditions, which could affect overall assessment. No recall bias due to using prospective data for exposure and national datasets for outcome.

Section 3.2 Association between a history of HDP and risk of CVD

The second literature review concentrated on synthesising the evidence regarding CVD in women with a history of HDP and was published in Nursing for Women's Health (Vahedi et al., 2020). This journal is peer-reviewed and serves as a practice journal dedicated to women's health, obstetric, and neonatal nursing. Its mission is to translate evidence into nursing practice to enhance individuals' health outcomes. In 2021, the journal held an impact factor of 1.02.

Abstract

The review highlights the importance of identifying women with a history of HDP and monitoring their cardiovascular health in later life. The association between HDP and CVD risk emphasises the need for healthcare providers to adopt a holistic approach to women's health, taking into account reproductive and cardiovascular health. Early detection of HDP and appropriate management during pregnancy may help reduce the risk of developing CVD in later life. Health promotion strategies that encourage lifestyle changes, such as a healthy diet and regular physical activity, may also be effective in reducing CVD risk in women with a history of HDP. Healthcare providers should consider the long-term implications of HDP and prioritise preventive measures to promote cardiovascular health in women. Further research is needed to explore the underlying mechanisms linking HDP and CVD risk, to then inform effective preventive strategies.

Problem identification

CVD is the leading cause of death worldwide, with 17.9 million deaths attributed to it each year. Between 2006 and 2016, deaths from CVD increased by 14.5% globally (Benjamin et al., 2019). Despite the fact that one in 4 cardiovascular deaths in women is preventable (Khosla et al., 2021), CVD accounts for one third of all deaths among women, and those who develop CVD are more likely to die from it, particularly if they live in low- and middle-income countries (World Heart Federation, 2017). In the United States, it is estimated that 45.1% of the population will have some form of CVD by 2035 (Benjamin et al., 2019), and the total costs and direct medical costs of CVD are projected to reach US$1.1 trillion and US$748.7 billion, respectively, by 2035 (Benjamin et al., 2019). Therefore, CVD imposes significant financial burdens on healthcare systems.

CVD generally refers to any disease that affects the cardiovascular system and includes, but is not limited to, CHD and cerebrovascular disease (stroke). The terms CHD, IHD and CAD refer to the narrowing or blockage of the coronary arteries, usually caused by atherosclerosis (Mosca et al., 2011b). CHD is the leading cause of death from CVD; in the US, 43.8% of all CVD-related deaths are attributable to CHD alone (Benjamin et al., 2019).

In addition to traditional CVD risk factors that contribute to development of CVD in both sexes, a number of risk factors affect CVD risk in women only (Leening et al., 2014). Conditions such as a history of polycystic ovary syndrome (Mahendru & Morris, 2013; Osibogun et al., 2020), GDM, intrauterine growth restriction (Rich-Edwards et al., 2014; Täufer Cederlöf et al., 2022), preterm birth, HDP, and miscarriage (Cusimano et al., 2014; Täufer Cederlöf et al., 2022) have been found to be associated with increased risk of CVD in women.

This literature review aimed to examine the relationship between HDP and women's risk of developing CVD later in life. HDP encompass a range of conditions, including chronic hypertension, pre-eclampsia, chronic hypertension with superimposed pre-eclampsia, gestational hypertension, eclampsia, and postpartum hypertension. In 2013, the American College of Obstetricians and Gynecologists updated its definitions of HDP, clarifying that chronic hypertension is blood pressure of 140/90 mmHg or higher detected after conception or before 20 weeks of pregnancy. Gestational hypertension refers to new-onset blood pressure elevation of 140/90 mmHg or higher, typically closer to term and without proteinuria. Pre-eclampsia is defined as blood pressure of 140/90 mmHg or higher in 2 separate measurements at least 4 hours apart, after 20 weeks of pregnancy in women with previously normal blood pressure. Lastly, superimposed pre-eclampsia is chronic hypertension that is associated with pre-eclampsia (American College of Obstetricians and Gynecologists, 2013).

There is evidence suggesting that HDP is associated with an increased risk of CVD in later life. The global incidence of HDP has increased from 16.3 million to 18.08 million, representing a 10.92% increase from 1990 to 2019 (Wang et al., 2021). In the US, HDP complicates 5–10% of pregnancies (Hauspurg et al., 2019; Ying et al., 2018). Studies have shown that pre-eclampsia and gestational hypertension are associated with a 2–4-fold increased risk of heart failure, IHD, and other cardiovascular morbidities in the long term (Oikonomou et al., 2020). Pre-eclampsia is also responsible for up to 15% of maternal deaths (Oikonomou et al., 2020), and it occurs in 5–7% of all pregnancies (American College of Obstetricians and Gynecologists, 2013). However, the incidence rate is lower in developed countries (2–5%) than in developing countries (Brown et al., 2013).

Methods

This review utilised an integrative review approach, allowing for the inclusion of various types of studies. The integrative review is a systematic and comprehensive research methodology employed to analyse and synthesise existing literature on a specific research topic (Whittemore & Knafl, 2005). Following the stages recommended by Whittemore &

Knafl (2005), this review commenced with problem identification, literature search, data evaluation, data analysis, and the presentation of the findings.

Literature search

An extensive search of literature published from January 2000 through November 2022 was carried out using electronic databases including MEDLINE and CINAHL to access the literature on associations between HDP and CVD. MEDLINE and CINAHL were selected because these databases are renowned for their comprehensive coverage of healthcare and nursing literature, making them the most relevant to the field of current research. Adopting only two databases could help streamline data management effectively. The keywords used for exposure included: ‘hypertensive pregnancy disorders*’, ‘hypertension*’, ‘pregnancy-induced hypertension*’, ‘gestational hypertension*’, ‘hypertensive disorders of pregnancy*’, ‘preeclampsia*’, ‘pre-eclampsia*’, ‘postpartum hypertension*’, ‘eclampsia*’, and ‘pregnancy complications*’. The search terms for outcomes included: ‘cardiovascular disease*’, ‘heart disease’, ‘coronary heart disease*’, ‘coronary artery disease*’, ‘myocardial infarction*’, ‘acute coronary syndrome*’, and ‘ischemic heart disease*’. All primary studies that investigated the associations between HDP and the risk of developing CVD in later life were eligible for inclusion in this literature review. No restriction on the length of the follow-up period was considered. Non-English literature and review studies were excluded, as well as conference abstracts, letters to the editor, and editorial articles. However, the reference lists of the included studies and previously excluded review studies were searched for additional potential studies.

Study selection

Overall, a total of 748 publications were identified from the initial search. After excluding non-English articles and limiting the search to the specified years, 465 articles remained. The articles were imported into an EndNote library, where review articles and duplicates were subsequently eliminated. This process resulted in 307 papers that were deemed suitable for further analysis. Out of these, 151 articles were excluded after screening the titles and abstracts. The remaining 156 articles underwent full-text review, leading to the exclusion of a further 134 articles. The final number of articles included in this review was 22 (Figure 3.).

Quality assessment

The quality of all 22 articles was assessed using the Critical Appraisal Skills Programme tool (Critical Appraisal Skills Programme, 2016). The supervisory team oversaw the entire process, which included database search, article selection, quality assessment, data extraction, interpretation of results, and presentation of findings. They conducted random audits of articles to ensure accuracy in quality assessment and data extraction. None of the studies were rated as poor quality, and all 22 studies were included in the review. Table 3.3 provides a summary of the quality assessment of the studies, followed by Table 3.4, which summarizes the included studies.

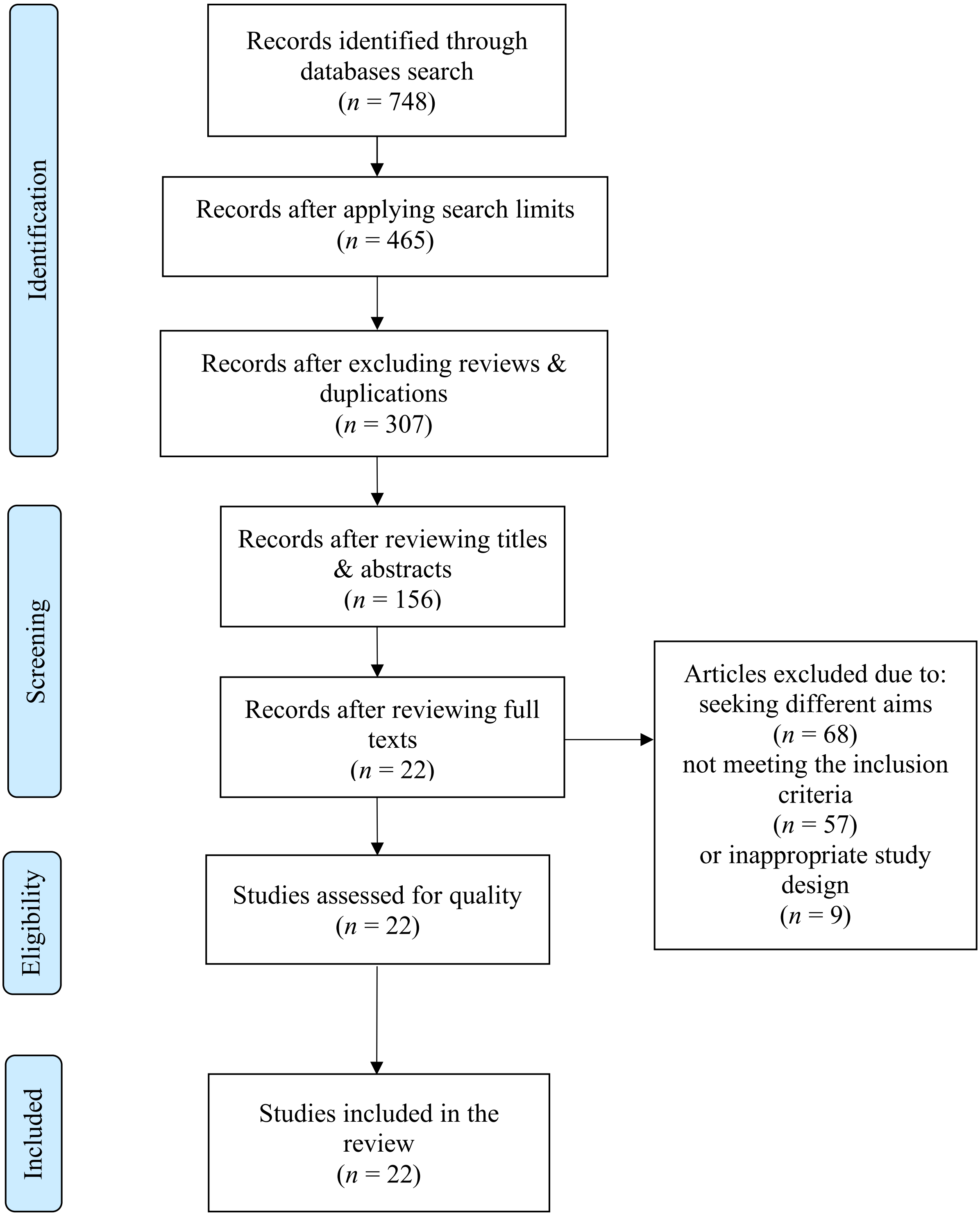

Figure 3.2 *PRISMA flow diagram of the literature search (HDP)*

Findings

The reviewed studies were predominantly large population-based cohort studies that investigated the risk of CVD events and mortality in women with a history of HDP (n = 9,285,228). Of the included articles, 16 were conducted in Europe (3 in the UK (excluding Scotland), 3 in Finland, 5 in Norway, and one each in Iceland, the Netherlands, Sweden, Scotland, and Denmark), 2 in the US, one in Australia, 2 in Taiwan, and one in Israel. The results of this review are presented in the following 5 themes, including pre-eclampsia and risk of CVD, gestational hypertension and risk of CVD, significance of severity of HDP, CVD risk according to the order of pregnancy, and time of HDP diagnosis, and number of HDP diagnosis.

Pre-eclampsia and risk of CVD

The association between history of HDP and risk of CVD in women was examined in 9 studies (Funai et al., 2005; Gastrich et al., 2020; Haug et al., 2019; Irgens et al., 2001; Leon et al., 2019; Lin et al., 2011; Männistö et al., 2013; Oliver-Williams et al., 2022; Smith et al., 2001). Those studies consistently suggested that HDP is associated with an increased risk of CHD, MI, heart failure, and stroke.

In a recent retrospective cohort study of national medical records from all National Health Service hospitals in the UK, researchers compared the risk of CVD outcomes for women with and without a history of HDP (Oliver-Williams et al., 2022). The study included 2,359,386 women who had one or more live singleton births in the UK between 1997 and 2015, and it followed them up for 18 years. The incidence of total CVD for women without HDP was 57.1 (95% CI 55.9 to 58.3) per 100,000 person-years, whereas the incidence of total CVD in women with prior gestational hypertension was 85.8 (78.6 to 93.5) per 100,000 person-years and for those with pre-eclampsia this rate was 99.3 (90.9 to 108.2) per 100,000 person-years. The study found that HDP was a statistically significant risk factor for the incidence of CVD in these women. Women with pre-eclampsia in their first pregnancy were at a higher risk of CHD (HR 1.62; 95% CI 1.48 to 1.78), acute MI (HR 2.46; 95% CI 1.72 to 3.53), and ischemic stroke (HR 1.77; 95% CI 1.30 to 2.42), and these associations were generally stronger than those observed with gestational hypertension. The study also reported that compared to women without HDP in their pregnancies, women with pre-eclampsia in their first pregnancy were at more than a twofold higher risk of acute MI (Oliver-Williams et al., 2022).

In another study, researchers conducted a retrospective matched case–control study in the US, using the New Jersey Electronic Birth Certificate database and the Myocardial Infarction Data Acquisition System, to assess the risk of cardiovascular outcomes over 15 years from 1999 through 2013 among pregnant women with pre-eclampsia (cases), compared to women with their first pregnancy who did not develop pre-eclampsia (controls) (Gastrich et al., 2020). The researchers found that women with pre-eclampsia (n = 6,360) were more likely to suffer from MI, cardiovascular death, and all-cause death compared to controls (n = 325,347). They reported that women with pre-eclampsia had 3.94 times higher hazard for MI (95% CI 1.25 to 12.4), 4.66 times higher hazard of cardiovascular death (95% CI 1.52 to 14.26), and 2.32 times higher hazard of all-cause death (95% CI 1.34 to 4.02) than matched controls. Even after adjusting for sociodemographic and comorbidities, the hazard ratios of MI and cardiovascular deaths were still significantly higher compared to matched controls (p = 0.0196 and p = 0.007, respectively) (Gastrich et al., 2020).

In a prospective cohort study conducted in Norway, researchers (Haug et al., 2019) aimed to investigate the association between a history of HDP and the risk of CVD in women. The study included 23,885 parous women, of which 21,766 had normotensive pregnancies, while 2,199 women experienced one or more pregnancies complicated by HDP before the age of 40 years. The researchers found that women with a history of HDP had an increased risk of CVD (HR 1.57; 95% CI 1.32 to 1.87), MI (HR 1.86; 95% CI 1.40 to 2.48), and heart failure (HR 1.59; 95% CI 0.92 to 2.73) compared with women with normotensive pregnancies, during a median follow-up of 18 years. The excess risk of CVD in women with a history of HDP was associated with blood pressure and BMI up to 77%, while glucose and lipid levels were associated with smaller proportions (25% and 24%, respectively). The researchers concluded that women with a history of HDP had approximately 60% excess risk of CVD until the age of 70 years compared to women without such a complication (Haug et al., 2019).

A large longitudinal population-based cohort study in the UK (Leon et al., 2019) used linked routine electronic health records from 1997 to 2016 to investigate the association between HDP and subsequent diagnosis of different types of CVD. The study included 1.3 million women, with a mean age at delivery of 28 years, and nearly 1.9 million completed pregnancies were defined. During the 20-year study period, researchers observed 18,624 CVD incidences, of which 65% occurred in women under 40 years. Compared to women without HDP, women with one or more pregnancies affected by pre-eclampsia had a higher risk of cardiac atherosclerotic events (HR 1.67; 95% CI 1.54 to 1.81), heart failure (HR 2.13; 95% CI 1.64 to 2.76), cardiovascular deaths (HR 2.12; 95% CI 1.49 to 2.99), and chronic hypertension (HR 4.47; 95% CI 4.32 to 4.62) (Leon et al., 2019).

In a cohort study in Norway, researchers aimed to evaluate the association between HDP in the first pregnancy and subsequent risk of maternal CVD after adjusting for established CVD risk factors measured after pregnancy (Riise et al., 2019). The study included 20,075 women with a first delivery registered in the Medical Birth Registry of Norway, who participated in health surveys a mean of 10.7 years after delivery. The women were followed up for a median of 11.4 years for an incident fatal or non-fatal CVD event through linkage to the Cardiovascular Disease in Norway database and the Norwegian Cause of Death Registry. After adjusting for established modifiable and non-modifiable CVD risk factors such as BMI, smoking, hypertension, diabetes, serum glucose, and lipid levels, researchers reported an increased risk of maternal CVD after HDP in the woman's first pregnancy (HR 1.5; 95% CI 1.2 to 1.8). The corresponding HR for the combined endpoint of acute MI/acute cerebral stroke was 1.8 (95% CI 1.1 to 2.9), and for CHD it was 1.5 (95% CI 0.9 to 2.6) (Riise et al., 2019).

A population-based prospective cohort study in Finland followed 12,055 multiparous women who gave birth in 1966 for 40 years (Männistö et al., 2013). The study found that any form of HDP was associated with an increased risk of cardiac events and diabetes later in life. Women with a history of pre-eclampsia/eclampsia, compared to women with normal blood pressure during pregnancy, were more likely to develop CVD (HR 1.4; 95% CI 1.1 to 1.7), IHD (HR 1.36; 95% CI 1.01 to 1.83), heart failure (HR 1.6; 95% CI 1.1 to 2.5), and arterial hypertension (HR 2.33; 95% CI 1.88 to 2.88). While the risks of developing MI (HR 1.2; 95% CI 0.73 to 2.0), experiencing death from MI (HR 1.44; 95% CI 0.51 to 4.08), and developing ischemic cerebrovascular disease (HR 1.19; 95% CI 0.68 to 2.09) also increased, they were not statistically significant. The risks were particularly higher if women had superimposed pre-eclampsia/eclampsia or chronic arterial hypertension and then developed pre-eclampsia/eclampsia (Männistö et al., 2013).

The authors of a population-based cohort study in Israel conducted an analysis of death rates among 37,061 women who gave birth in Jerusalem between 1964 and 1976, with a median follow-up of 30 years (range 24.5–36.5 years) (Funai et al., 2005). They concluded that women diagnosed with pre-eclampsia had a significantly higher relative death rate of 2.13 (95% CI 1.8 to 2.5; $p < 0.001$) compared to women with normal blood pressure readings during pregnancy, and deaths from CVD were the largest contributor to this increase.

Researchers in Taiwan conducted a large population-based cohort study with the aim of investigating the risk of major CVD events and mortality during pregnancy and within 3 years postpartum (Lin et al., 2011). They recruited 1,132,064 women who had given birth between 1999 and 2003 through the linkage between birth certificates and national health insurance hospital discharge data. After adjusting for known CVD risk factors, the authors found that women with a history of pre-eclampsia/eclampsia had significantly greater risks of major cardiac events and mortality in later life. Specifically, they had a 13.0 times greater risk of MI (95% CI 4.6 to 6.3; $p < 0.001$), an 8.3 times greater chance of heart failure (95% CI 4.2 to 16.4; $p < 0.001$), a 14.5 times greater risk of stroke (95% CI 1.3 to 165.1; $p < 0.03$), a 6.4 times greater incidence of overall death (95% CI 3.8 to 10.9; $p < 0.001$), and a 2.3 times greater incidence of CVD-related death (95% CI 1.6 to 3.1; $p < 0.001$) compared with those without this condition (Lin et al., 2011). These results support the findings of Funai et al. (2005), who reported significantly more deaths from CVD in women with a history of pre-eclampsia.

A retrospective population-based cohort study conducted in Scotland recruited 129,920 women who had their first live child between 1981 and 1985 from the Scottish Morbidity Record. The authors aimed to examine the associations between pre-eclampsia and the risk of future fatal and nonfatal CHD (Smith et al., 2001). Out of the cohort, 22,781 women developed pre-eclampsia during their pregnancies, and 107,139 women did not. Following the women for 15 to 19 years, the researchers found that the rate of CHD events was twice as high (95% CI 1.5 to 2.5) in women who had a history of pre-eclampsia compared with the control group (Smith et al., 2001). Similarly, authors of a population-based cohort study in Norway recruited 626,272 women through the Norwegian medical birth registry who had given birth from 1967 to 1992, with a median follow-up of 13 years. They found that pre-eclampsia was associated with an 8.12-fold (95% CI 4.3 to 15.3) increased risk of death from CVD (Irgens et al., 2001).

Gestational hypertension and risk of CVD

The relationships between gestational hypertension and risk of CVD in later life were examined in 8 studies (Arnadottir et al., 2005; Chen et al., 2018; Garovic et al., 2010; Lykke et al., 2009; Männistö et al., 2013; Oliver-Williams et al., 2022; Riise et al., 2018; Wikström et al., 2005). The results of these studies were consistent in finding a positive association between the experience of gestational hypertension and CVD in later life. For instance, a retrospective cohort study in the UK found that women with a history of gestational hypertension in their first pregnancy were at increased risk for CHD (HR 1.55; 95% CI 1.31 to 1.83), heart failure (HR 1.71; 95% CI 1.21 to 2.41), ischemic stroke (HR 1.59; 95% CI 1.17 to 2.16), and haemorrhagic stroke (HR 1.42; 95% CI 1.05 to 1.92) compared to women without gestational hypertension (Oliver-Williams et al., 2022).

In a study conducted in Norway, researchers aimed to evaluate the association between gestational hypertension and risk of CVD among women. The researchers collected data from the Medical Birth Registry of Norway and linked it to the Cardiovascular Disease project and the Norwegian Cause of Death Registry (Riise et al., 2018). The study included 2 cohorts of women: 617,589 women with a first birth from 1980 to 2009 aged 16–49 years with parity 5 or less and 421,770 multiparous women with a first birth from 1980 to 2009 aged 16–49 years with parity 5 or less. The women were followed up for a median of 14.3 years, and the researchers found that women with gestational hypertension in the first pregnancy had a 1.8-fold increased risk of subsequent CVD compared with women without this condition (95% CI 1.7 to 2.0). The risk was further increased in the presence of concomitant pregnancy-related complications such as small for gestational age and/or preterm deliveries. However, the effects of important confounders such as smoking, BMI, and alcohol consumption were not controlled in this study due to the lack of relevant data. Therefore, it is possible that these confounders played a role in the association between gestational hypertension and CVD, and this cannot be ruled out (Riise et al., 2018).

Likewise, a nationwide population-based retrospective cohort study in Taiwan focused on the association between HDP and the risk of heart failure (Chen et al., 2018). Among the 23.3 million individuals registered in the National Health Insurance Research Database in Taiwan, researchers identified 29,186 women aged 20–50 years with HDP between January 2000 and December 2013, and matched them with 116,744 women without HDP in their pregnancies. They also considered pregnancy characteristics, including age, parity, gestational age, gestational number, and major comorbidities at baseline. The study found that the overall incidence of heart failure was greater in the HDP group than the control group (9.83 vs 1.67 per 10,000 person-years), with a significant IRR (5.88; 95% CI 5.84 to 5.92; $p < 0.0001$). When stratified by age, parity, gestational age, number of pregnancies, and follow-up years, the IRR for subsequent heart failure remained significantly higher in the HDP group in all stratifications. Moreover, heart failure was more likely to develop within 5 years postpartum (Chen et al., 2018).

A registry-based cohort study in Denmark recruited 782,287 women from 15 to 50 years old who had their first birth, with median follow-up of 14.6 years (Lykke et al., 2009). In this study, the risk of CHD increased by 1.5 times (95% CI 1.25 to 1.76; $p < 0.001$) in women with a history of gestational hypertension. They were also at 5.3 times greater risk of developing subsequent hypertension (95% CI 4.90 to 5.75; $p < 0.001$) in the future (Lykke et al., 2009).

Similarly, the results of a cohort study recruiting 4,782 participants in the Family Blood Pressure Program study between 2000 and 2004 in Finland reported that women with a history of gestational hypertension were at greater risk for developing hypertension in the future compared with their normotensive counterparts (Garovic et al., 2010). The increased risk remained significant after the authors controlled for known CVD risk factors including race, family history, smoking, dyslipidaemia, and diabetes mellitus (adjusted HR 1.8; 95% CI 1.4 to 2.3; $p < 0.001$). In addition, hypertension developed at earlier ages in these women (50% hypertensive at the age of 53 years vs 60 years, respectively; $p < 0.001$; (Garovic et al., 2010). The relatively greater risk of future hypertension observed in the study by Lykke et al., (2009) may be due to the lack of complete adjustments for CVD risk factors, such as obesity (Lykke et al., 2009).

Authors of a cross-sectional population-based study in Sweden analysed the risk of fatal or nonfatal CHD events in 403,550 women who had given birth between 1973 and 1982, with a follow-up of 15 years (Wikström et al., 2005). They found that, compared with women with normotensive pregnancies, women with a history of gestational hypertension in their first pregnancy had an increased risk of developing CHD in later life (relative risk 1.6; 95% CI 1.3 to 2.0) (Wikström et al., 2005).

A similar study was conducted in Iceland, in which researchers recruited participants ($n = 325$ case patients and $n = 650$ individuals in the control group) who had given birth at the University Hospital in Reykjavik, Iceland, between 1931 and 1947, and followed them until 1996. They found that the risk of mortality from CHD among women with a history of HDP was 24.3%, compared with 14.6% in women without the condition (relative risk 1.66; 95% CI 1.27 to 2.17) (Arnadottir et al., 2005). These results are consistent with the findings of Wikström et al. (2005) and Garovic et al. (2010). Arnadottir et al. (2005) reported that women with gestational hypertension survived 3–9 years less than those without this condition. Männistö et al. (2013) also found that women with gestational hypertension were at increased risk for CHD (HR 1.44; 95% CI 1.24 to 1.68), MI (HR 1.75; 95% CI 1.40 to

2.19), death from MI (HR 3.00; 95% CI 1.18 to 3.09), and ischemic stroke (HR 1.59; 95% CI 1.24 to 2.04) (Männistö et al., 2013).

Significance of severity of HDP

The relationship between the severity of HDP and risk of future CVD was assessed in 4 studies (Luoto et al., 2008; Lykke et al., 2009; Oliver-Williams et al., 2022; Wikström et al., 2005), and these authors found that severity of HDP was a factor in aggregating the risk. Lykke et al. (2009) found that the risk of CHD increased by 1.57 times (95% CI 1.44 to 1.72) and 1.61 times (95% CI 1.34 to 1.94) in women with mild pre-eclampsia and severe pre-eclampsia, respectively, indicating no significant difference in future CHD risk according to the severity of pre-eclampsia after a median of 14.6 years follow-up. However, compared with women with mild pre-eclampsia (relative risk [RR] 3.61; 95% CI 3.43 to 3.80), those with severe pre-eclampsia were at greater risk for developing hypertension in later life (RR 6.07; 95% CI 5.45 to 6.77) (Lykke et al., 2009).

The impact of increased systolic blood pressure during pregnancy on future CVD risk – without specifying the type of HDP – was evaluated in a study in which authors derived data from a cohort of 4,090 women who gave birth between 1954 and 1963 in Finland, with a follow-up period of approximately 44 years (Luoto et al., 2008). Mortality data were collected from the Finnish Cause of Death Registry. Results showed that the CVD mortality rate was considerably greater in women who had a history of systolic hypertension during pregnancy, whether developed in early or late stages of pregnancy. For each 13 mmHg rise in systolic blood pressure during early pregnancy, CVD mortality increased by 20%, and for one standard deviation increase in systolic blood pressure in late pregnancy, the mortality rate increased by 14% (Luoto et al., 2008). The authors concluded that an increase in systolic blood pressure alone during pregnancy could be considered as an important predictor of future CVD risk and mortality in women (Luoto et al., 2008). In another study, the risk of future IHD increased by 1.9 times (95% CI 1.6 to 2.2) in women with mild pre-eclampsia compared with women without the condition, but with a greater increase in women with severe pre-eclampsia (RR 2.8; 95% CI 2.2 to 3.7) (Wikström et al., 2005).

A recent study conducted in the UK found that the association between pre-eclampsia and total CVD risk was greater with increasing severity of the condition during the first pregnancy. Women with severe pre-eclampsia had the highest risk (HR 1.91; 95% CI 1.57 to 2.32). The risk of CVD, including CHD and cardiomyopathy, as well as stroke, including ischemic stroke and intracerebral haemorrhage, also increased with the severity of pre-eclampsia (Oliver-Williams et al., 2022).

CVD risk according to the order of pregnancy, time of HDP diagnosis, and number of HDP diagnoses

Several studies have examined the association between HDP and future CVD, considering factors such as order of pregnancy, timing, and number of HDP incidents (Arnott et al., 2020; Grandi et al., 2018; Oliver-Williams et al., 2022; Riise et al., 2019; Skjaerven et al., 2012; Theilen et al., 2018; Wikström et al., 2005).

Skjaerven and colleagues conducted a prospective population-based cohort study in Norway to investigate the relationship between the order of pregnancy, time of onset of pre-eclampsia, and mortality from CVD (2012). The study included 836,147 women recruited from the Medical Birth Registry of Norway between 1967 and 2002, and they were followed until 2009. Of these women, 34,824 developed pre-eclampsia during their pregnancy. The authors found that women who developed term pre-eclampsia in their first pregnancy were more likely to die from CVD than those without the condition in their first pregnancy (adjusted HR 1.6; 95% CI 1.4 to 2.0) (Skjaerven et al., 2012). The risk was even greater for women who developed preterm pre-eclampsia (< 37 weeks) (adjusted HR 3.7; 95% CI 2.7 to 4.8). Women who developed preterm pre-eclampsia in their first pregnancy and did not have additional children were at greater risk of CVD death compared with women who had subsequent children (9.2% vs 1.1%) (Skjaerven et al., 2012).

For women who had term pre-eclampsia and had only one child, the risk of death from CVD was 2.8%, which fell to 1.1% for those who had 2 or more children (Skjaerven et al., 2012). However, all-cause mortality for women with 2 or more lifetime births who had preterm pre-eclampsia in their first pregnancy did not increase (adjusted HR 1.1; 95% CI 0.87 to 1.14), even if they had preterm pre-eclampsia (Skjaerven et al., 2012). Overall, the results suggested that mortality from CVD was particularly greater in women with early pre-eclampsia in their first pregnancy who did not have subsequent children (Skjaerven et al., 2012).

In a retrospective cohort study in Australia, researchers used a linked population health administrative database in New South Wales between 2002 and 2016 to assess the association between new-onset HDP and hospitalisation or death due to ischemic or hypertensive heart disease, or stroke (Arnott et al., 2020). They included women aged 12–55 years who were New South Wales residents during their first birth. Among 528,106 women, 10.3% experienced HDP in their first pregnancy. The researchers reported that the HR for women with early-onset HDP who did not smoke was 4.90 (95% CI 3.00 to 7.80) compared to women who did not develop HDP in their pregnancies and did not smoke. They also reported a more than doubling of the risk of a cardiovascular event or death in those with late-onset HDP and almost 5 times the risk following early-onset HDP in women, compared to those without this complication. The study concluded that HDP, especially early-onset, conferred a clear increase in the risk of CVD, with amplification by smoking (Arnott et al., 2020).

In contrast to the findings of the Arnott et al. (2020) study, which showed that the risk of death from CVD was particularly greater in women with early pre-eclampsia in the first pregnancy who did not have subsequent children, the Grandi et al. (2018) study did not find any differences in the risk of incident CVD based on the early or late onset of HDP. They identified 146,748 women, aged 15–45 years, with a first recorded pregnancy in the Clinical Practice Research Datalink. They observed that women with early-onset HDP (< 34 weeks) have a twofold increased risk of CVD (95% CI 1.5 to 4.3) and fivefold increased risk of hypertension (95% CI 1.5 to 4.3) compared to women with no HDP. Similar results were observed among women with late-onset HDP. Wide confidence intervals precluded any conclusions regarding a difference in the risk of incident CVD and hypertension in women with early- versus late-onset HDP (HR 0.90; 95% CI 0.50 to 1.62 and HR 1.06; 95% CI 0.87 to 1.28, respectively). Overall, the study concluded that HDP in at least one pregnancy is associated with increased risks of subsequent CVD and hypertension, irrespective of its time of onset (Grandi et al., 2018). Grandi et al. (2018) in consistent with the other 2 studies by Arnott et al. (2020) and Skjaerven et al. (2012) reported increased risk of CVD in women with HDP based on the timing of onset of complication, but the difference in the risk of CVD based the early or late onset of HDP was not statistically significant.

Researchers aimed to investigate the association between recurrent HDP and increased risk of CVD mortality in women. They conducted a retrospective cohort study in the US, using the Utah Population Database to identify women who gave birth from 1939 through 2012 (Theilen et al., 2018). The study included 49,598 women with one affected pregnancy, 7,786 women with 2 or more affected pregnancies, and 114,768 unexposed women who were matched to the affected women. The study found that women with 2 or more pregnancies affected by HDP had a higher mortality risk from all causes (adjusted HR 2.04; 95% CI 1.76 to 2.36), ischemic heart disease (adjusted HR 3.30; 95% CI 2.02 to 5.40), and stroke (adjusted HR 5.10; 95% CI 2.62 to 9.92). The increased risks for early all-cause and cause-specific mortality were significant for deaths occurring at age 50 years or younger. For women whose index pregnancy was delivered from 1939 through 1959, those with 2 or more pregnancies affected by HDP had shorter additional life expectancies than mothers who had only one or no HDP (48.92 vs 51.91 vs 55.48 years, respectively). Theilen et al. (2018) concluded that HDP are associated with increased risks for early all-cause mortality and some cause-specific mortality, and these risks increase further with recurrent disease. Their findings suggest that women with recurrent HDP may benefit from close monitoring and aggressive management of risk factors to prevent premature mortality.

Additionally, a retrospective cohort study conducted in the UK showed that the risk of CHD and all strokes increased with the number of pregnancies affected by pre-eclampsia. Women with 2 pregnancies affected by pre-eclampsia had over twice the risk of CHD and stroke compared to women with normotensive pregnancies, with HR 2.81 (95% CI 1.75 to 4.53) and HR 2.35 (95% CI 1.22 to 4.53), respectively. Women with 2 gestational hypertension pregnancies also had approximately twice the risk of CHD and stroke compared to women with normotensive pregnancies, with HR 1.93 (95% CI 1.16 to 3.20) and HR 2.16 (95% CI 1.19 to 3.90), respectively (Oliver-Williams et al., 2022).

An earlier cross-sectional study from 2005 included over 20,000 women pregnant for the first time with HDP and 2,000 women with recurrent HDP. Women with HDP were compared with women without such complications, with a follow-up period of 15 years. The study reported that the adjusted IRR for later development of IHD was 1.6 (95% CI 1.3 to 2.0) when the first pregnancy was complicated by gestational hypertension without proteinuria. Women with gestational hypertension in their first pregnancy but not in their second had an adjusted IRR of 1.9 (95% CI 1.5 to 2.4) for the development of IHD, while women with gestational hypertension in both pregnancies had an increased IRR of 2.8 (95% CI 2.0 to 3.9) compared with women with 2 healthy pregnancies (Wikström et al., 2005).

HDP and risk of future stroke

The relationship between HDP and stroke has been examined in several studies, and the results consistently demonstrate a positive association between HDP and increased risk of stroke in later life (Arnadottir et al., 2005; Leon et al., 2019; Lin et al., 2011; Lykke et al., 2009; Männistö et al., 2013). For instance, a longitudinal population-based cohort study in the UK reported a HR of 1.9 (95% CI 1.53 to 2.35) for any stroke in women who had one or more pregnancies complicated by pre-eclampsia compared with those who had normotensive pregnancies (Leon et al., 2019). Additionally, a population-based prospective cohort study in Finland found that gestational hypertension increased the risk of future ischemic stroke (HR 1.59; 95% CI 1.24 to 2.04) (Männistö et al., 2013).

A population-based cohort study in Taiwan found that women with a history of pre-eclampsia or eclampsia had a significantly higher adjusted risk of developing stroke (HR 14.5; 95% CI 1.3 to 165.1), major adverse cardiovascular events without stroke (HR 7.3; 95% CI 5.5 to 9.7), and death from major adverse cardiovascular events (HR 2.3; 95% CI 1.6 to 3.1) compared to women without pre-eclampsia or eclampsia (Lin et al., 2011). These findings are consistent with those of other studies. For example, Arnadottir et al. (2005) reported a higher rate of death from cerebrovascular events including stroke in women with a history of HDP compared to women without the condition (RR 1.46; 95% CI 0.94 to 2.28). Lykke et al. (2009) also found that the risk of stroke was elevated in women with a history of HDP with mild pre-eclampsia compared with severe pre-eclampsia, indicating that the severity of HDP is a concern. Specifically, they reported that the risk of stroke was elevated 1.51 times (95% CI 1.26 to 1.81; $p < 0.001$) in women with a history of gestational hypertension, 1.4 times (95% CI 1.30 to 1.58; $p < 0.001$) in women with mild pre-eclampsia, and 1.58 times (95% CI 1.23 to 2.03; $p < 0.001$) in women with severe pre-eclampsia.

Discussion

In this literature review, 22 studies involving more than 9 million women were examined, with the results suggesting consistent associations between any type of HDP with future CVD events and mortality in women. The findings suggest that women with a history of pre-eclampsia, gestational hypertension, or elevated systolic blood pressure during pregnancy are at greater risk for morbidity and mortality from MI, heart failure, hypertension, and stroke in later life (Gastrich et al., 2020; Haug et al., 2019; Luoto et al., 2008; Lykke et al., 2009; Männistö et al., 2013; Oliver-Williams et al., 2022). HDP appears to add to the burden of CVD in women; however, due to the heterogeneity across the reviewed studies in terms of population, exposure variables, outcome variables, and follow-up periods, it was challenging to combine the results statistically in a meta-analysis to derive a pooled estimate of the impact of HDP conditions on CVD risk. Nonetheless, the consistent findings across the studies indicate the importance of HDP as a risk factor for CVD in women, and further research is needed to identify potential mechanisms and effective interventions to prevent or mitigate the adverse cardiovascular outcomes associated with HDP.

Although the exact mechanisms linking HDP to increased risk of CVD are not fully understood (Aykas et al., 2015; Garovic et al., 2010; Lykke et al., 2009; Valdiviezo et al., 2012), it is likely that this association is due to shared risk factors between the 2 conditions. Women who experience HDP are more likely to have hypertension, high serum uric acid levels, high microalbuminuria, and high serum triglyceride levels, all of which increase the risk of CVD (Aykas et al., 2015; Valdiviezo et al., 2012). In addition, women with a history of gestational hypertension or severe pre-eclampsia are more likely to develop T2DM, which is a strong risk factor for CVD in women (Larsson et al., 2018; Lykke et al., 2009).

Some studies have found that women with a history of HDP may have altered endothelial function, increased arterial stiffness, and reduced vascular compliance, which can also increase their risk of CVD. The inflammation and oxidative stress associated with HDP may also contribute to the increased risk of CVD (Aykas et al., 2015; Garovic et al., 2010; Valdiviezo et al., 2012).

Furthermore, some studies have suggested that genetic factors may play a role in the development of HDP and subsequent CVD risk. Women with a family history of HDP or CVD may be at greater risk for both conditions (Goddard et al., 2018; Grandi et al., 2018).

In summary, the increased risk of CVD among women with a history of HDP may be due to shared risk factors, vascular damage, altered endothelial function, inflammation, oxidative stress, and genetic factors. It is important for healthcare providers to monitor and manage CVD risk factors in women with a history of HDP to prevent or delay the onset of CVD.

In addition, Canti et al. (2010) found that women with pre-eclampsia had significantly greater BMI ($p = 0.019$) and abdominal circumference measurements ($p = 0.026$) compared with normotensive pregnant women. Obesity, particularly increased waist circumference, is a known risk factor for CVD (Lahey & Khan, 2018; Xue et al., 2021), and thus may contribute to the increased CVD risk seen in women with HDP. While there are significant synergistic effects between HDP conditions and traditional CVD risk factors, HDP has also been shown to independently contribute to the risk of CVD in women (Garovic et al., 2010; Lin et al., 2011; Männistö et al., 2013; Oliver-Williams et al., 2022; Skjaerven et al., 2012; Wikström et al., 2005). Therefore, pregnancy should be considered a cardiovascular stress test, and the experience of HDP indicates greater susceptibility to CVD in the future (Hermes et al., 2013; Veerbeek et al., 2015). Early identification of these high-risk women, followed by education and counselling to engage in risk-reducing programs and behaviours, is crucial in reducing the burden of CVD in this population.

Limitations

It is important to note that the definition and classification of HDP varied across the studies included in this review, which may have contributed to differences in the reported associations between HDP and CVD risk. For instance, Männistö et al. (2013) defined pre-eclampsia as blood pressure of 145/95 mmHg or higher with proteinuria, while Funai et al. (2005) used blood pressure of 140/90 mmHg or higher with proteinuria as diagnostic criteria. Such variations in definitions and criteria could potentially affect the accuracy and comparability of the findings. Therefore, caution should be taken when interpreting the results and generalising the findings to the larger population.

Implications for practice

The findings of this review have several implications for practice. The evidence highlights the importance of considering pregnancy history when assessing a woman's CVD risk. CVD risk assessment tools, such as the Framingham Risk Score (Selvarajah et al., 2014), the SCORE (Selvarajah et al., 2014), and the Reynolds Risk Score (Ridker et al., 2007) enable healthcare providers to identify high-risk population subgroups for close monitoring, early diagnosis, and therapy (Lloyd-Jones, 2010). It has been shown that the effects of HDP on the cardiovascular system are reflected in the existing CVD risk estimation tools. For example, in a longitudinal follow-up study in the Netherlands (Hermes et al., 2013), in which researchers used the Framingham Risk Score, the estimated 10-year and 30-year CVD risks of 300 women with a history of HDP were compared with the estimated CVD risks of 94 women with normotensive pregnancies. After a mean follow-up of 2.5 years, the estimated 10-year CVD risk of women with HDP was significantly greater than the risk of women who did not have the condition (7.2% vs 4.4%, respectively; IRR 5.8; 95% CI 1.9 to 19; $p < 0.001$). The estimated 30-year CVD risk was also greater in women with HDP than women without the condition (11% vs 7.3%, respectively; IRR 2.7; 95% CI 1.6 to 4.5; $p < 0.001$).

The results were consistent when the SCORE and the Reynolds Risk Score were applied (Hermes et al., 2013). Likewise, Garovic et al. (2010) reported that women with a history of hypertension during pregnancy compared with women without the condition had an increased estimated risk for CHD (14% vs 11% at 70 years, respectively; $p = 0.009$) and stroke (8% vs 5% at 70 years, respectively; $p = 0.009$) (Garovic et al., 2010).

Bearing in mind that women of reproductive age are younger and may not manifest the symptoms of CVD for many years, the use of appropriate CVD risk estimation tools is a pragmatic approach to identifying high-risk women who can benefit from risk modification interventions (Lloyd-Jones, 2010; Markovitz et al., 2019). However, the ability of the available tools to predict CVD risk is poorer in women than in men, particularly among younger women (Hermes et al., 2013; Wenger, 2017). It is suggested that future research evaluates the possibility of improving the accuracy of existing CVD assessment tools for women by including female-specific risk factors, such as history of HDP. The pooled cohort equations (Goff Jr et al., 2014), endorsed by the American College of Cardiology and the AHA, aim to improve CVD risk estimation for women by considering their greater lifetime CVD risk; however, overestimation of CVD risk with advanced age is a concern with this tool (Wenger, 2017).

Efforts should also be made to increase awareness of the link between HDP and CVD among healthcare providers and women with these conditions. Nurses can play an essential role in increasing women's awareness of cardiovascular health and risk factors and encouraging them to discuss their cardiovascular health with a general practitioner or cardiologist (Upendrababu & Gowda, 2020). The Association of Women's Health Obstetric and Neonatal Nurses has recommended in its position statement on women's cardiovascular health that nurses should provide women with regular cardiovascular health screening and education during healthcare visits to promote their awareness of CVD risk factors. Increasing women's knowledge of CVD risk factors and helping them develop a reasonable risk perception is crucial in facilitating active engagement in risk-reducing behaviours (Abushaikha et al., 2021; Gholizadeh et al., 2010). To achieve this goal, healthcare providers should themselves be knowledgeable about traditional and sex-specific CVD risk factors, such as HDP.

Moreover, effective communication and shared decision-making between healthcare providers and women can improve the effectiveness of CVD risk management. Women's values, beliefs, and preferences should be considered when developing care plans and treatment goals (Bairey Merz et al., 2017). Patient-centred care is essential in promoting women's engagement and adherence to risk-reduction strategies. Nurses can facilitate this by using a patient-centred approach that involves active listening, empathy, and collaboration in care planning (Abushaikha et al., 2021). Health literacy and cultural competence should also be considered to ensure that women understand the importance of CVD risk reduction and can participate effectively in their care (Gholizadeh et al., 2010). Overall, a collaborative and patient-centred approach to CVD risk management can lead to better outcomes for women at risk of CVD.

Future research should prioritise the evaluation of the knowledge and awareness of healthcare providers and women about the link between HDP and CVD. This should be accompanied by efforts to identify, implement, and evaluate strategies to address any gaps in knowledge and improve the cardiovascular health outcomes for women with a history of HDP. Such strategies may include targeted educational programs for healthcare providers and women, the integration of HDP into existing CVD risk assessment tools, and the development of tailored prevention and management programs for women with a history of

HDP. Additionally, research should also explore the feasibility and effectiveness of involving community health workers or peer educators to increase awareness and support among women with HDP. By addressing these gaps, it may be possible to reduce the burden of CVD among women with a history of HDP and improve their overall cardiovascular health outcomes.

Conclusion

Women with a history of HDP are at a significantly higher risk for developing CVD later in life, and healthcare providers should identify this high-risk subgroup and offer them appropriate screening and counselling. It is important to encourage these women to discuss their cardiovascular health with healthcare providers and support them in reducing their future CVD risk through the adoption of a healthy lifestyle and recognition and improvement of modifiable risk factors. Nurses play a crucial role in helping women with HDP understand and act on their risk for CVD later in life. Future research should focus on assessing healthcare providers' and women's knowledge and awareness of the CVD risk associated with HDP and identifying, implementing, and evaluating strategies to improve the cardiovascular health outcomes for women with a history of HDP.

Table 3.3 *Quality assessment of the included studies (HDP)*

Author(s), year, country	Did the study address a clearly focused issue?	Was the cohort recruited in an acceptable way?	Was the exposure accurately measured to minimise bias?	Was the outcome accurately measured to minimise bias?	Have the authors identified all important confounding factors?	Was the follow-up of the subjects complete/ long enough?	What are the results of this study?	How precise are the results?	Can the result be applied to the local population?	Do the results of this study fit with the other available evidence?	What are the implications of this study for practice?
Arnadottir et.al. (2005) Iceland	Yes	Yes	Yes	Yes	Yes	Yes	Higher death rate from IHD cerebrovascular event, and cancer in women with pre-eclampsia	95% CI	Yes	Yes	Women with pre-eclampsia should be followed up and be given medical advice regarding their increased risk
Arnott et al. (2020) Australia	Yes	Yes	Yes	Yes	Yes	Yes	Higher risk of fatal and non-fatal CVD event in women with HDP, higher risk in early HDP	95% CI	Yes	Yes	Pregnancy is an ideal opportunity to identify at-risk women and target modifiable risk factors such as smoking. Postpartum follow-ups for at-risk women need to be urgently developed and effectively implemented.
Chen et al. (2018) Taiwan	Yes	Yes	Yes	Yes	Yes	Yes	HDP presented an increased risk for heart failure later in life. HDP was an independent risk factor for future heart failure.	95% CI	Yes	Yes	Long-term assessment of cardiac function needed in patients with a history of HDP, especially in its severe or recurrent forms
Funai et al. (2005) Israel	Yes	Yes	Yes	Yes	Yes	Yes	Higher death rate in women with pre-eclampsia (RR 2.1)	95% CI	Yes	Yes	Their findings give evidence that pre-eclampsia is a risk marker for mortality from CVD, and that clinicians should consider pre-eclampsia as a CVD risk factor, even if subsequent pregnancies are normative
Garovic et al. (2010) Finland	Yes	Unclear	Yes	Yes	Yes	Yes	Increased risk of IHD, stroke, diabetes mellitus, hypertension, dyslipidaemia	95% CI	Yes	Yes	To inform women with history of high BP in pregnancy regarding to their increased risk of high BP and CVD incidence in their future life. Also to have routine BP checks and be treated for modifiable risk factors.

Author(s), year, country	Did the study address a clearly focused issue?	Was the cohort recruited in an acceptable way?	Was the exposure accurately measured to minimise bias?	Was the outcome accurately measured to minimise bias?	Have the authors identified all important confounding factors?	Was the follow-up of the subjects complete/ long enough?	What are the results of this study?	How precise are the results?	Can the result be applied to the local population?	Do the results of this study fit with the other available evidence?	What are the implications of this study for practice?
Gastrich et al. (2020) US	Yes	Yes	Yes	Yes	Yes	Yes	Increased risk of MI, stroke, CVD related death	95% CI	Yes	Yes	More studies, including screening studies, are needed to assess long-term evidence
Grandi et al. (2018) UK	Yes	Yes	Yes	Yes	Yes	Yes	Increased risk of CVD and hypertension, irrespective of the timing of onset of HDP	95% CI	Yes	Yes	HDP, regardless of onset time, should be considered when assessing future risks of CVD and hypertension
Haug et al. (2019) Norway	Yes	Yes	Yes	Yes	Yes	Yes	Increased risk of CVD, MI, heart failure, cerebrovascular disease	95% CI	Yes	Yes	The association of conventional risk factors, especially blood pressure and BMI, with the development of CVD in women with history of HDP shows that preventive efforts with the aim of decreasing the levels of these risk factors could reduce CVD risk in women with history of HDP
Hermes et al. (2013) The Netherlands	Yes	Yes	Yes	Yes	Yes	Yes	Significant differences in the risk of CVD between women with and women without complicated pregnancy with hypertension	95% CI	Yes	Yes	To offer screening and counselling for CVD risk factors after pregnancy to women with a history of pre-eclampsia at term to calculate and estimate CVD events risk
Irgens et al. (2001) Norway	Yes	Yes	Yes	Yes	Unclear	Yes	Death from CVD	95% CI	Yes	Yes	Women with pre-eclampsia that ends in a preterm delivery have an eightfold higher risk of death from CVD compared with women with normal BP and their pregnancy goes to term

Author(s), year, country	Did the study address a clearly focused issue?	Was the cohort recruited in an acceptable way?	Was the exposure accurately measured to minimise bias?	Was the outcome accurately measured to minimise bias?	Have the authors identified all important confounding factors?	Was the follow-up of the subjects complete/ long enough?	What are the results of this study?	How precise are the results?	Can the result be applied to the local population?	Do the results of this study fit with the other available evidence?	What are the implications of this study for practice?
Leon et al. (2019) UK	Yes	Yes	Yes	Yes	Yes	Yes	Increased risk of stroke, heart failure, CVD deaths, chronic hypertension	95% CI	Yes	Yes	Viewing pregnancy as a stress test for future increase of chronic disease. Further work is required to estimate how many CVD events could be avoided by applying interventions such as active high blood pressure detection and control in women that had experienced HDP.
Lin et al. (2011) Taiwan	Yes	Yes	Yes	Yes	Unclear	Yes	Increased rate of MI, IHD, fatal and non-fatal CVD events in women with history of pre-eclampsia	95% CI	Yes	Yes	Best way to follow up and deliver treatment goal to women with history of pre-eclampsia in postpartum period
Luoto et.al. (2008) Finland	Yes	Yes	Yes	Yes	Yes	Yes	Long-term cardiovascular mortality following systolic hypertension in early/late pregnancy	95% CI	Yes	Yes	Improve knowledge about increased risk of CVD after pre-eclampsia to minimise the rate of associated morbidity and mortality
Lykke et al. (2009) Denmark	Yes	Yes	Yes	Yes	Unclear	Yes	Increased risk of MI, IHD, stroke, hypertension, diabetes mellitus in women with history of pre-eclampsia	95% CI	Yes	Yes	Strong association between pre-eclampsia and future CVD, and to include the history of women's pregnancy outcome when assessing the risk of CVD
Männistö et al. (2013) Finland	Yes	Yes	Yes	Yes	Unclear	Yes	IHD, MI, MI death, heart failure, chronic kidney disease, diabetes mellitus	95% CI	Yes	Yes	Early monitoring, risk-factor assessment, and interventions can benefit women with hypertension disorder in pregnancy
Oliver-Williams et al. (2022) UK	Yes	Yes	Yes	Yes	Yes	Yes	Total CVD, acute MI, dilated cardiomyopathy, hypertrophic cardiomyopathy	95% CI	Yes	Yes	Recommendations for public health to monitor CVD risk amongst women following pregnancy with gestational hypertension as well as pre-eclampsia

Author(s), year, country	Did the study address a clearly focused issue?	Was the cohort recruited in an acceptable way?	Was the exposure accurately measured to minimise bias?	Was the outcome accurately measured to minimise bias?	Have the authors identified all important confounding factors?	Was the follow-up of the subjects complete/ long enough?	What are the results of this study?	How precise are the results?	Can the result be applied to the local population?	Do the results of this study fit with the other available evidence?	What are the implications of this study for practice?
Riise et al. (2018) Norway	Yes	Yes	Yes	Yes	Yes	Yes	CVD, CHD, cerebrovascular disease	95% CI	Yes	Yes	Findings identify a new severity of gestational hypertension with regard to future maternal health and underline the need for further attention toward these affected women
Riise et al. (2019) Norway	Yes	Yes	Yes	Yes	Yes	Yes	CHD, acute MI, acute cerebral stroke	95% CI	Yes	Yes	Even among young women, a healthy lifestyle is important in prevention of CVD. Targeted follow-up programs should be initiated to assess prevention of CVD at an early stage.
Skjaerven et al. (2012) Norway	Yes	Yes	Yes	Yes	Unclear	Yes	CVD mortality rate after pre-eclampsia	95% CI	Yes	Yes	Pre-eclampsia can be a useful marker of women's CVD risk especially among primiparous women and those with preterm pre-eclampsia
Smith et al. (2001) Scotland	Yes	Yes	Yes	Yes	Unclear	Yes	Fetal and non-fetal IHD	CI 95%	Yes	Yes	There are strong associations between birthweight for gestational age, preterm birth, and a diagnosis of pre-eclampsia in the first pregnancy and the mother's risk of fatal and non-fatal IHD in later life
Theilen et al. (2018) US	Yes	Yes	Yes	Yes	Yes	Yes	Recurrent HDP is associated with increased risk for early all-cause mortality	95% CI	Yes	Yes	Study constitutes a meaningful contribution to the literature on long-term health outcomes in the US for women following HDP. Still, prospective studies are needed to determine whether adjusted health screening schedules may be beneficial in this population.
Wikström et al. (2005) Sweden	Yes	Yes	Yes	Yes	Yes	Yes	Higher rate of fatal or non-fatal IHD in women with pre-eclampsia	95% CI	Yes	Yes	Severe pre-eclampsia has stronger association with IHD than mild pre-eclampsia, and recurrent pre-eclampsia has stronger association with IHD than non-recurrent pre-eclampsia

Table 3.4 *Characteristics of the included studies (HDP)*

Author(s), year, location	Design e.g. a qualitative research	Setting/ sample	Sample size	Brief description of participants	Outcome variables	Study tools	Study limitations & strengths
Arnadottir et.al. (2005) Iceland	Case–control study	A review of 7,453 maternity records from 1931 to 1947, at the Landspitali University Hospital in Reykjavik	n = 629	Exposed group: 325 women with hypertension in pregnancy Control group: 650 matched women for parity and age with normal blood pressure during pregnancy	IHD, cerebrovascular events, and cancer	Maternity record data from a university hospital, national identity files from statistical bureau of Iceland, and death certificates	Lack of records regarding blood pressure before 20 weeks of pregnancy, also lack of follow-up investigation
Arnott et al. (2020) Australia	Retrospective cohort study	Linked population health administrative datasets were used in New South Wales, Australia, between 2002 and 2016	n = 528,106	HDP in the first pregnancy n = 54,323	Fatal and non-fatal CVD	Linked population health administrative datasets and the Maternal, Child and Family Health Register	Lack of information regarding all CVD risk factors of participants
Chen et al. (2018) Taiwan	Nationwide population-based retrospective cohort study	The National Health Insurance Research Database between January 2000 and December 2013	n = 145,930	Identified women aged 20–50 diagnosed with HDP without history of heart failure, then monitored them until index heart failure HDP group: n = 29,186 Control group: n = 116,744	Heart failure	Data from National Health Insurance Research Database	Lack of information on blood pressure, proteinuria, cardiac function, serum biomarkers, and other symptoms. Adjusted for age, parity, gestational age, gestational number, HDP severity, number of HDP occurrences and hypertension.
Funai et al. (2005) Israel	Population-based cohort study	Determine death among women who delivered in Jerusalem between 1964 to 1976, with 24 to 36 years follow-up	n = 37,061	n = 1,070 women with pre-eclampsia n = 35,991 women without pre-eclampsia	Death from CVD	Data from Jerusalem perinatal study, community-based record-link survey. Cox proportional hazard models were used to estimate the risk of mortality.	Long-term follow-up > 25 years. Controlled for potential confounders.
Garovic et al. (2010) Finland	Cohort study	Women from 2,443 sibships participated in the Family Blood Pressure Program study between 2000 and 2004	n = 4,782	n = 4,064, 85% with at least one pregnancy n = 643, 13% with hypertension in at least one pregnancy n = 209, 4.4% with pre-eclampsia	IHD, stroke, diabetes mellitus, hypertension, dyslipidaemia	Standard questionnaire, standardised physical examination and blood test, blood pressure check	Possible recall bias because of using data based on self-reported, physician-diagnosed hypertension in pregnancy and CVD
Gastrich et al. (2020) US	Case–control study	Cases and controls were selected from the New Jersey Department of	n = 331,707	HDP group: n = 6,360 Control group: n = 325,347	Cardiac disease, diabetes, stroke, MI	Used data from the New Jersey EBC database and the Myocardial	Lack of patient-level data in the databases, lack of information pertaining to the trimester in which the women were diagnosed with pre-eclampsia, lack of information of abnormal glycaemic status, elevated blood pressure, overweight/obesity, or family history

Author(s), year, location	Design e.g. a qualitative research	Setting/ sample	Sample size	Brief description of participants	Outcome variables	Study tools	Study limitations & strengths
		Health Electronic Birth Certificate (EBC) and Perinatal Database, obtained from the Bureau of Vital Statistics and Registration between 1999 and 2013				Infarction Data Acquisition System	
Grandi et al. (2018) UK	Population-based study	Data from the UK's Clinical Practice Research Datalink between 1999–2015	*n* = 146,748	HDP group: *n* = 5,399 Control group: *n* = 141,379	CVD, hypertension	Data from the UK's Clinical Practice Research Datalink	Considered other confounders such as BMI and diabetes, smoking and alcohol use
Haug et al. (2019) Norway	Population-based study	Cohort of women participated in the Nord-Trondelag Health Study in Norway between 1984 and 2015	*n* = 23,885	HDP group: *n* = 2,117 Control group: *n* = 21,752	CVD, MI, heart failure, cerebrovascular disease	Linked data from the Nord-Trondelag Health Study to validated hospital records, the Cause of Death Registry, and the Medical Birth Registry of Norway	Long-term follow-up. Used clinically measured information about conventional CVD risk factors. The available tests for CVD changed throughout the study period and this could have potentially affected the estimates. May have missed nonfatal events where the patient was not admitted to hospital.
Hermes et al. (2013) The Netherlands	Cohort/ longitudinal follow-up study	Women with HDP vs women with normotensive pregnancy (NTP) from June 2008 to November 2010	HDP women: *n* = 300 NTP women: *n* = 94	Women with HDP at term vs women with NTP at term	The significant differences in the risk of CVD between women with and women without complicated pregnancy with hypertension	Risk prediction models such as Framingham Risk Score, SCORE, Reynolds Risk Score	Young age of participants. Relatively healthy compared group could result in overestimation of the risk. Women's maternal history is not considered. The data for HDP were collected at baseline, but data for NTP were collected through medical review at the time of inclusion of the study. The exclusion criteria were not listed.
Irgens et al. (2001) Norway	Cohort study	Data from Norwegian medical birth registry 1967–1992	*n* = 626,272	Mothers with or without a history of pre-eclampsia during the pregnancy that ended up delivering first baby	Death from CVD	Data on the cohorts were collected from the Medical Birth Registry of Norway	Presence of non-differential misclassification, which might not bias the result. Incomplete follow-up of the cohort with median 15 years follow-up. Relatively young participants.
Leon et al. (2019) UK	Population-based study	Linked electronic health records between 1997 and 2016	*n* = 1,303,365	HDP group: *n* = 25,554 Control group: *n* = 1,277,811	All CVD, any stroke, MI, heart failure, cardiovascular deaths, chronic hypertension	Analysed data from women who were selected from cardiovascular research using linked bespoke studies and electronic health records (EHR).	Study period of 20 years conducted an extensive validation of pre-eclampsia, phenotype beyond simple comparisons of baseline risk factors. Substantial level of missing information in the EHR records of pre-pregnancy BMI and smoking (> 60%) limited the validity of using multiple imputations and precluded their inclusion in the final models.

Author(s), year, location	Design e.g. a qualitative research	Setting/ sample	Sample size	Brief description of participants	Outcome variables	Study tools	Study limitations & strengths
Lin et al. (2011) Taiwan	Population-based cohort study	Data from 3 main sources for women who delivered from 1999 to 2003,	*n* = 1,132,064	Compared women with pre-eclampsia or eclampsia with women with healthy pregnancy	MI, IHD, fatal and non-fatal CV events	Data from birth registers provided by the ministry of the interior, the National Health Insurance hospital discharge, and death file	Some important variables such as history of smoking and BMI not measured. The severity of pre-eclampsia and eclampsia, and also further follow-ups by cardiologist are not clear in the study.
Luoto et.al. (2008) Finland	Cohort study	Data from cohort Finnish women who delivered from 1954 to 1963	*n* = 4,090	85% of Helsinki women who delivered were registered in maternity centres, and all data were collected from maternity cards	Long-term mortality following systolic hypertension in pregnancy	Mortality data collected from Finnish Cause of Death Registry	Presence of potential confounding factors like smoking and BMI. Unable to determine if hypertension in pregnancy was due to an underlying complication presented before pregnancy.
Lykke et al. (2010) Denmark	Registry-based cohort study	Data about women aged 15–50 who delivered from 1987–2007 from The Danish National Registries	*n* = 7,82,287	*n* = 7,449 had gestational hypertension *n* = 26,810 had mild pre-eclampsia *n* = 7,016 had severe pre-eclampsia	MI, IHD, stroke, hypertension, diabetes mellitus	Data from The National Patient Registry	No adjustment for BMI or history of smoking.
Männistö et al. (2013) Finland	Prospective cohort study	The Northern Finland Birth Cohort 1966 considered all expected births from one year	*n* = 12,055	All women with history of high BP were recruited	CVD, chronic kidney disease, diabetes mellitus	Data were collected from Finnish registries	Prospectively collected BP. Relatively long follow-up for 39.4 years. Adjustment for BMI and smoking. Presence of some misclassification.
Oliver-Williams et al. (2022) UK	Retrospective cohort study	Cohort of women's national medical records from all National Health Service hospitals in England between 1997 and 2015	*n* = 2,359,386	*n* = 159,819 women had pre-eclampsia or gestational diabetes	Total CVD, acute MI, dilated cardiomyopathy, hypertrophic cardiomyopathy	Data collected from all National Health Service hospitals	Could define a wide range of CVD assessment of prevalence of HDP over time and age. Long-term follow-up (18 years). Out of CVD risk factors, they only adjusted for diabetes recorded in the hospital record.
Riise et al. (2018) Norway	Cohort	Medical Birth Registry of Norway between 1980 and 2009	*n* = 617, 589	Cohort 1: *n* = 617,589 Cohort 2: *n* = 421,770	CVD, CHD, cerebrovascular disease	Data from the Medical Birth Registry of Norway were linked to the Cardiovascular Disease in Norway project and the Norwegian Cause of Death Registry	Follow-up for over 14 years, large sample size. Study did not apply the new stricter criteria for gestational hypertension that requires at least 2 high BP recordings. Did not adjust for several confounders including smoking, BMI, and alcohol use, because of missing information in the registries.

Author(s), year, location	Design e.g. a qualitative research	Setting/ sample	Sample size	Brief description of participants	Outcome variables	Study tools	Study limitations & strengths
Riise et al. (2019) Norway	Population-based study	Medical Birth Registry of Norway between 1994 and 2009	*n* = 20,075	HDP group: *n* = 1,246, Control group: *n* = 18,829	CHD, acute MI, acute cerebral stroke	Linked data from the Medical Birth Registry of Norway to cohort of Norway health surveys, the cardiovascular disease in Norway 1994–2009 database, and the Norwegian Cause of Death Registry (1980–2009)	Large national cohort with a median follow-up of 11.4 years. Information on diet, genetic, and other risk factors was not available. Residual confounding may also have occurred due to inappropriate or imprecise measurements of the CVD risk factors.
Skjaerven et.al. (2012) Norway	Prospective population-based cohort study	Medical data of all birth from the Medical Birth Registry of Norway 1967–2002	*n* = 836,147	Women with first live singleton birth	CVD mortality	Medical data, including maternal disease, and data from national Cause of Death Registry	A large national cohort of women with comprehensive prospective registration of exposure and outcome, follow-up to 42 years. Lack of information on underlying CVD risk factors before and after pregnancy. No details about the reason of having only one child in those women.
Smith et.al. (2001) Scotland	Retrospective cohort study	All eligible women recorded by routine national maternity data who delivered between 1981 and 1985	*n* = 129,290	*n* = 22,781 with pre-eclampsia *n* = 107,139 without pre-eclampsia	Fatal and non-fatal IHD	Data from The Scottish Morbidity Record (SMR) system, which collected routine discharge data on all patients admitted to Scottish National Health Service acute (SMR1) and maternity (SMR2) hospitals.	Prevented bias due to type of study. No information on smoking status, so there wasn't an adjustment for its potential confounding effect.
Theilen et al. (2018) US	Retrospective cohort study	Birth certificate data for each woman who delivered in Utah 1939–2011	*n* = 172,152	Women with ≥ 1 HDP: *n* = 57,384 Matched unexposed women: *n* = 114,768	Increased risk of mortality from diabetes mellitus, IHD, and stroke	Used Utah Population Database to identify women	Large population sample and retrospective design. Potential selection bias and residual confounding.
Wikström et al. (2005) Sweden	Cross-sectional population-based study	Data from Swedish Medical Birth Register 1973–1982	*n* = 403,550	*n* = 20,469 had hypertensive disease *n* = 9,718 had pregnancy induced hypertension *n* = 9,718 had mild pre-eclampsia, *n* = 2,815 had severe pre-eclampsia *n* = 347,870 had normal pregnancy	Fatal or non-fatal IHD	Sociodemographic and administrative data from the Swedish Medical Birth Register	Nationwide study, no loss of follow-up. Follow-up period for 15 years. No bias recruitment. Both hospitalisation and death because of CVD were included. The result put on to relatively young women with median age of 48 years old. No adjustment for BMI and smoking.

Section 3.3 Risk of CVD in women with a history of gestational diabetes

The third literature review, providing a comprehensive examination of the association between a history of GDM and future CVD, was recently published in Acta Scientific MEDICAL SCIENCE (Asgharvahedi et al., 2022). This journal was chosen for its relevance and rigorous peer-review process, which endeavors to thoroughly explore the frontiers of the scientific field. The journal boasted an impact factor of 1.403 in 2021.

Abstract

Despite significant improvements in cardiovascular care over the past decades, CVD remains the leading cause of morbidity and mortality in women globally. Apart from traditional CVD risk factors, gender-specific conditions such as GDM increase the burden of CVD in women. This review aimed to investigate the associations between GDM and the risk of future CVD in women. A comprehensive search of the literature was conducted in MEDLINE, CINAHL, and Cochrane Library, and was limited to studies published in English between January 2015 and October 2022. After applying study inclusion and exclusion criteria, 12 studies were included in the review. The findings of this review suggest that women with a history of GDM are at higher risk for future CVD events. These findings highlight the importance of early assessment and risk-factor management in the postpartum period among women with a history of GDM. Healthcare providers should be aware of the link between GDM and future CVD risk and develop health promotion strategies to reduce the risk in this high-risk group of women.

Problem identification

CVD is the leading cause of death worldwide, with more people dying from CVD each year than any other group of diseases. In 2016, CVD accounted for almost 17.9 million deaths globally, which represents 31% of all deaths worldwide. Of those deaths, 85% were due to MI and stroke, according to the WHO (2017). CHD, which refers to the disease of the blood vessels supplying the heart muscle, is a common form of CVD and is responsible for 30–50% of all CVD diagnoses (Wilson & Douglas, 2015).

In the United States, CVD remains the leading cause of death (Virani et al., 2020). Thus, it is essential to adopt healthy lifestyle practices and manage risk factors such as high blood pressure, high cholesterol, smoking, diabetes, and obesity to reduce the burden of CVD. Early detection and management of CVD through regular medical check-ups and appropriate interventions can also help reduce the risk of CVD-related deaths.

In Australia, CVD is the primary cause of death, accounting for 26% of all deaths in 2018, in line with international trends (Australian Institute of Health and Welfare, 2020b). Of those deaths, 42% were due to CHD, 20% were due to stroke, and 10% were due to heart failure and cardiomyopathy (Australian Institute of Health and Welfare, 2020b). The prevalence of CVD among Australians has remained relatively stable, with around one in 20 (4.8%) affected in 2017–2018 (Australian Bureau of Statistics, 2018a).

CVD is a significant burden in developing countries, where it accounts for more than 75% of CVD-related deaths (WHO, 2017). Both modifiable and non-modifiable risk factors contribute to the development of CVD in both men and women (Mohammadnezhad et al., 2016). Non-modifiable risk factors include gender, age, family history, ethnic background, and previous MI. Common modifiable risk factors include hypertension, hypercholesterolemia, diabetes, obesity, dyslipidemia, smoking, and physical inactivity (Mohammadnezhad et al., 2016). It is crucial to manage these risk factors through healthy lifestyle practices and appropriate medical interventions to prevent and manage CVD. Early detection through regular medical check-ups is also essential to reduce the risk of CVD-related deaths.

While some risk factors for CVD are shared between both men and women, there exist risk factors that are specific to women, such as complications during pregnancy, including a history of pregnancy loss or hypertensive disorders during pregnancy (Asgharvahedi et al., 2019; Grandi et al., 2019; Vahedi et al., 2020). In addition, some individual studies have reported an association between GDM and the future risk of CVD, including conditions such as MI and hypertension.

For many years, GDM was defined as any degree of glucose intolerance with onset or first recognition during pregnancy, but this definition had several limitations (American Diabetes Association, 2020a). The latest update by the American Diabetes Association defines GDM based on 2 approaches: 1) the 'one-step' 75 g oral glucose tolerance test (OGTT) derived from the International Association of Diabetes and Pregnancy Study Groups criteria, and 2) the older 'two-step' approach with a 50 g (non-fasting) screen followed by a 100 g OGTT for those who screen positive (American Diabetes Association, 2020a). The management of GDM through medications or diet depends on the severity of the condition (American Diabetes Association, 2020a).

Globally, the prevalence of GDM ranges from 1–28%, with trends indicating growth in prevalence in the last decades, reflecting the rising rates of obesity and T2DM within the general population (Di Cianni et al., 2018). In 2019, approximately one in 6 pregnancies was affected by GDM (International Diabetes Federation, 2020). The global prevalence of GDM varies greatly among different nations, mainly due to the use of different screening and diagnostic criteria (Di Cianni et al., 2018).

To date, there has been no review study that has sought to consolidate the prior evidence concerning the association between gestational diabetes mellitus and the subsequent risk of CVD. Establishing the link between GDM and future CVD is crucial for identifying high-risk groups of women and for developing and delivering targeted CVD risk reduction interventions to mitigate their future risk of CVD.

Methods

This review employed an integrative review approach, enabling the inclusion of various types of studies. The integrative review is a systematic and comprehensive research methodology utilized to analyse and synthesize existing literature on a specific research topic (Whittemore & Knafl, 2005). Following the stages recommended by Whittemore & Knafl (2005), this review began with problem identification, literature search, data evaluation, data analysis, and the presentation of findings.

Literature search

A thorough examination of literature spanning from January 2015 to October 2022 was conducted utilising electronic databases such as MEDLINE, CINAHL, and Cochrane Library to evaluate the evidence linking GDM and the subsequent risk of CVD. MEDLINE and CINAHL were specifically chosen for their renowned comprehensiveness and coverage of healthcare and nursing literature, aligning closely with the focus of current research in the field. Additionally, recognising the importance of a more condensed timeframe, the Cochrane Library was incorporated alongside MEDLINE and CINAHL to ensure a robust and evidence-based literature review, particularly for healthcare-related research. The search was limited to the English language. The keywords for exposure included: ‘gestational diabetes mellitus*’, ‘gestational diabetes*’, and ‘GDM*’. The search terms for outcome included: ‘cardiovascular disease*’, ‘heart disease*’, ‘coronary heart disease*’, ‘coronary artery disease*', 'myocardial infarction*', 'acute coronary syndrome*', 'ischaemic heart disease*', and 'ischemic heart disease*'. All studies that examined associations between GDM and the risk of developing CVD in later life were included.

Study selection

Initially, 182 publications were retrieved from the search. Following the restriction to English-language articles within the defined time period, 88 articles remained for screening. These articles were then imported into the EndNote library, where review articles and duplicates were subsequently removed. This curation process yielded 50 papers deemed suitable for further analysis. Subsequently, during the title and abstract screening phase, 29 additional articles were excluded. The full texts of the remaining 21 studies were thoroughly reviewed for relevancy, leading to the exclusion of 9 papers. Ultimately, 12 studies met the criteria for inclusion in the review (Figure 3.3)

Quality Assessment

The 12 articles underwent quality assessment using the Critical Appraisal Skills Programme tool (Critical Appraisal Skills Programme, 2016). The supervisory team oversaw the entire process, including database search, article selection, quality assessment, data extraction, interpretation of results, and presentation of findings. They conducted random audits of articles to ensure accuracy in quality assessment and data extraction. None of the studies were rated as poor quality, and thus, all 12 studies were included in the review. Table 3.5 provides a summary of the quality assessment of the included studies, followed by Table 3.6, which presents a summary of the included studies.

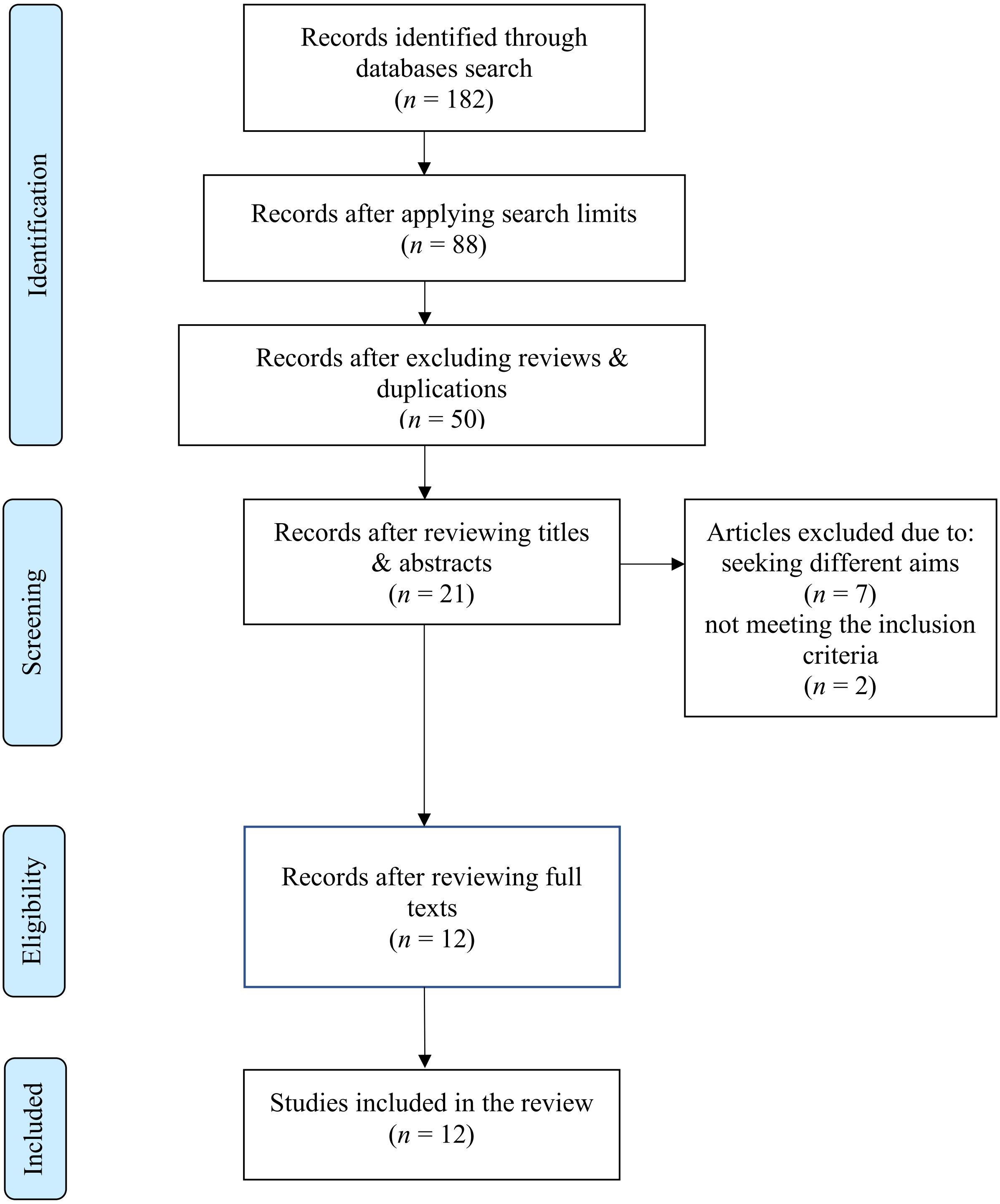

Figure 3.3 *PRISMA flow diagram of the literature search (gestational diabetes)*

Findings

There were 12 articles included in the literature review, and of those, 7 were large population-based cohorts with a total sample size of 6,662,369. One study was a cross-sectional study, and one was a case–control study with a sample size of 6,880. Four studies were conducted in Canada, 2 in the US, 4 in Europe (2 in the UK, one each in Denmark and France), and 2 in Asia (one each in Korea and Israel) (Table 3.4).

In a population-based prospective cohort study in the UK, researchers included 219,330 women aged 40–69 who had at least one live birth between 2006 and 2010, with follow-up of more than 10 years (Lee et al., 2022). The researchers used UK Biobank to examine the association between GDM and an increased risk of long-term cardiovascular outcomes. They excluded women with a history of diabetes and congenital heart disease and collected information on sociodemographic, lifestyle, environmental, medical history, and physical measurements. Among the included women, 1,390 were diagnosed with GDM. After adjusting for other CVD risk factors such as age, race, BMI, smoking, early menopause, and hysterectomy, women with GDM had an increased risk for overall CVD outcomes (adjusted HR 1.36; 95% CI 1.18 to 1.55), including CAD (adjusted HR 1.31; 95% CI 1.08 to 1.59), MI (adjusted HR 1.65; 95% CI 1.27 to 2.15), ischemic stroke (adjusted HR 1.68; 95% CI 1.18 to 2.39), and heart failure (adjusted HR 1.41; 95% CI 1.06 to 1.87). GDM was also associated with an increased risk of diabetes (23%), hypertension (11%), and dyslipidemia (10%). The study concluded that GDM was associated with several adverse cardiovascular outcomes and contributed to the development of other CVD risk factors, such as diabetes, hypertension, and dyslipidemia (Lee et al., 2022).

In a population-based cohort study with a median follow-up of 16.2 years in Denmark, using several national registers, researchers included 1,002,486 women who had at least one pregnancy between 1978 and 2016. The aim of the study was to assess the associations of GDM with overall and specific CVD outcomes. They controlled for potential confounders such as parity, age, race, smoking, and family history of CVD. Among the included women, 2.1% had a history of GDM, with an increased prevalence of GDM over time, reaching 3.1% during 2011–2016. They found that women with a history of GDM had a 40% higher overall CVD risk (HR 1.40; 95% CI 1.35 to 1.45) compared to women without GDM. The risk for stroke increased by 65% and more than twofold for MI, heart failure, and hypertensive disease among women with GDM compared to women without GDM (Yu et al., 2022).

In another population-based retrospective cohort study using the Korean national health insurance service claim database, researchers assessed the association between GDM and incident CVD events, including MI and heart failure (Sun et al., 2021). They included a total of 1,500,165 women who had at least one pregnancy, with a median follow-up of 12.8 years, and 10.60% of women had experienced GDM. In this study, women with GDM showed an increased risk for total CVDs (multivariable-adjusted HR 1.06; 95% CI 1.00 to 1.12), MI (multivariable-adjusted HR 1.08; 95% CI 0.86 to 1.37), and heart failure (multivariable-adjusted HR 1.16; 95% CI 1.03 to 1.31), compared with women without this complication. Women with GDM who subsequently developed T2DM were associated with an even higher CVD risk (HR 1.74; 95% CI 1.40 to 2.15). The researchers highlighted the need for close screening and follow-up for women with a history of GDM to minimise their future risk of CVD (Sun et al., 2021).

A population-based cohort study, using information from the Ministry of Health and Long-term Care of Ontario (Canada) healthcare administrative databases, identified 906,319 eligible women in Ontario with a live singleton delivery between 2007 and 2018, of whom 5.5% had developed GDM. After 7 years of follow-up, women with a history of GDM showed a higher incidence of hospitalisation due to heart failure (adjusted HR 1.62; 95% CI

1.28 to 2.05) compared with women without GDM. The study concluded that GDM was associated with an increased risk of hospitalisation due to heart failure, emphasising the importance of primary prevention strategies for GDM to reduce its impact on future cardiovascular health (Echouffo-Tcheugui et al., 2021).

A retrospective cohort study in the UK used a large primary care database from 1 February 1990 to 15 May 2016 to match 9,118 women diagnosed with GDM with 4 pregnant-woman controls without GDM (37,281) by age and timing of pregnancy. Women younger than 50 years old and all their pregnancy records were included. The findings revealed that women with GDM were over 2.5 times more likely to develop IHD (RR 2.78; 95% CI 1.37 to 5.66; $p = 0.005$) compared to women without GDM (Daly et al., 2018).

Similarly, in a population-based retrospective cohort study conducted in Quebec, Canada, researchers enrolled 1,070,667 women who had live births in hospitals between 1989 and 2013 and followed 67,356 women with GDM and 1,003,311 without such a history for a maximum of 25.2 years after the index pregnancy. The aim of the study was to compare the incidence of CVD events in these 2 groups (McKenzie-Sampson et al., 2018). The study conducted in Quebec found that women with a history of GDM had a positive relationship with increased risk of CVD, even 25 years post-delivery. The researchers reported a greater risk for developing IHD (HR 1.23; 95% CI 1.12 to 1.36), MI (HR 2.14; 95% CI 1.15 to 2.47), and coronary angioplasty (HR 2.23; 95% CI 1.87 to 2.65) in comparison to women without GDM (McKenzie-Sampson et al., 2018).

A large population-based cohort study in Ontario using a healthcare administrative database identified 1,515,079 women aged 15–54 years who delivered between April 1994 and March 2014, and followed them for a median period of 10 years to identify the relationship between GDM and CVD (Retnakaran & Shah, 2017). The study found that the risk of CVD increased among women with a history of GDM ($n = 56,884$), irrespective of developing T2DM in following years. The HR of CVD among those who did and did not develop T2DM was 2.82 (CI 2.41 to 3.30; $p < 0.0001$) and 1.30 (CI 1.07 to 1.59; $p = 0.008$), respectively. Additionally, the risk of CHD was higher in both groups (HR 3.54; CI 2.96 to 4.23; $p < 0.0001$; and HR 1.41; CI 1.11 to 1.80; $p = 0.005$, respectively) (Retnakaran & Shah, 2017).

A longitudinal prospective cohort study in the US investigated the incidence of long-term CVD in women with a history of GDM using data from the Nurses' Health Study II. The study included 116,430 nurses aged between 24 and 44 years between 1989 and 2015, and data were collected using questionnaires at baseline and every 2 years. Of the 89,479 eligible parous women without prior CVD and cancer, who self-reported GDM in at least one pregnancy, the study found that GDM was positively associated with CVD later in life. Women with GDM had a 60% higher risk of CVD during the follow-up period compared to parous women without GDM (HR 1.60; 95% CI 1.26 to 2.04; $p < 0.001$). After adjusting for potential confounding factors, the association was somewhat reduced but still significant (HR 1.29; 95% CI 1.01 to 1.65; $p = 0.04$). The study also found a positive correlation between GDM and the risk of MI (HR 1.45; 95% CI 1.05 to 1.99; $p = 0.02$) but not stroke, after adjusting for potential confounding factors (Tobias et al., 2017).

Another study investigated the relationship between a previous history of GDM and CVD in 8,127 parous women aged 20 years and older from 2007–2014, using the National Health and Nutrition Examination Survey in the US (Shostrom et al., 2017). The study found that women with a history of GDM had a higher risk of developing CVD compared to those without such a history. After adjusting for sociodemographic, socioeconomic, and lifestyle factors, a history of GDM was associated with a 63% higher risk of CVD (OR 1.63; 95% CI 1.02 to 2.62; $p = 0.04$). Further adjustment for BMI moderately reduced the association (OR 1.52; 95% CI 0.95 to 2.44; $p = 0.08$) (Shostrom et al., 2017).

In another population-based retrospective study conducted in France, researchers used a nationwide French medico-administrative database to investigate the relationship between GDM and CVD (Goueslard et al., 2016). The study recruited 2 groups of women, those with GDM and those without GDM who gave birth between 2007 and 2008 and followed them up for 7 years. Among 1,518,990 deliveries during that period, 62,958 women developed GDM. After adjusting for age, diabetes mellitus, BMI, and HDP, GDM was found to be significantly associated with a higher risk of CVD (adjusted OR 1.25; CI 1.9 to 2.20), and MI (adjusted OR 1.92; CI 1.36 to 2.71) (Goueslard et al., 2016).

A retrospective case–control study in Israel investigated the relationship between glucose levels during pregnancy and long-term maternal atherosclerotic morbidity, including CVD (Charach et al., 2016). The study included all women who delivered between 2000 and 2012 and subsequently developed atherosclerotic morbidity (n = 815) and randomly matched them by age and year of delivery with women without this outcome (n = 6,065). After a follow-up period of 74 months, a significant linear association was found between glucose levels during pregnancy and long-term maternal atherosclerotic morbidity, with the highest incidence of severe atherosclerotic morbidity among those women who had high glucose levels (> 5.5 mmol/L) (HR 1.29; 95% CI 1.1 to 1.5; p = 0.003). The study concluded that a high glucose level during pregnancy, even if within the range of slight glucose intolerance, may serve as a marker for future maternal atherosclerotic morbidity (Charach et al., 2016).

Another retrospective cohort study conducted in Canada recruited 474,348 women with live singleton deliveries between April 1999 and March 2010, categorised them according to their pre-pregnancy weight and GDM status, and examined the incidence of CVD (Kaul et al., 2015). The study found that the incidence of CVD in the group of women with GDM was 1.9% compared to the control group of 1.0%, with a median follow-up of 5.3 years. The study concluded that there was an increased rate of CVD events in women with

GDM, and this rate was even higher among women who had GDM and a high BMI (Kaul et al., 2015).

Discussion

This review shed light on the impact of GDM on the future cardiovascular health of women. The studies included in this review were mainly large cohort studies, and the findings were consistent in demonstrating that women with a history of GDM have an increased risk of developing CVD events in the years following their index pregnancy, with this risk being evident as early as the first decade after the index pregnancy (Goueslard et al., 2016). Consequently, the diagnosis of GDM presents an opportunity to identify the future risk of heart disease in young women (Ferranti et al., 2016).

While the exact pathophysiology of pregnancy complications is not fully understood, it is known that some physiological changes during pregnancy place stress on the cardiovascular system, including an increase in plasma volume, lipidemia, and a shift in glucose metabolism (Grandi et al., 2019). These changes, coupled with the increasing age of mothers in recent years, increase the likelihood of pregnancy complications, which may in turn have long-term negative impacts on maternal health. Thus, these changes during pregnancy play a critical role as cardiometabolic stressors that may unmask underlying metabolic and vascular abnormalities in women (Ferranti et al., 2016).

It was previously believed that the physiological and metabolic changes in pregnancy would return to pre-pregnancy levels shortly after delivery (Grandi et al., 2019), but emerging evidence suggests that women who had complicated pregnancies with GDM are still at a higher risk for developing different metabolic abnormalities, even after a normal glucose tolerance test shortly after delivery (Di Cianni et al., 2018). This increased risk seems to be independent of traditional risk factors for CVD, such as obesity, hypertension, family history, and hypercholesterolemia (Shostrom et al., 2017; Tobias et al., 2017), indicating that GDM may be a potential burden for CVD in women (Grandi et al., 2019). Notably, women with a previous history of GDM are more insulin resistant compared to women with uncomplicated pregnancies (Bassily et al., 2019).

In addition, there is ample evidence that shows that a previous history of GDM is associated with increased cardio metabolic risk, including obesity and larger waist circumferences. Women with a history of GDM are more likely to have hypertension, dyslipidaemia, lower HDL-C levels, and higher fasting glucose during the first 10 years after an index pregnancy complicated by GDM, compared with those without such a complication (Bassily et al., 2019; Perera et al., 2019). Moreover, part of this risk can be attributed to the fact that women with a history of GDM are at greater risk for developing T2DM, which is a strong risk factor for developing CVD. GDM is a significant public health burden, with a history of GDM increasing the risk of developing T2DM later in life (Di Cianni et al., 2018). It has been reported that 10–31% of parous women with a history of GDM are diagnosed with T2DM later in life (Di Cianni et al., 2018). Furthermore, 30–50% of women with a history of GDM develop T2DM within 3–5 years postpartum, and 70% within 10 years (Daly et al., 2018). However, at least one study (Retnakaran & Shah, 2017) reported that the risk of developing CVD following a history of GDM was independent of the development of T2DM.

This review highlighted the significant impact of GDM on the future cardiovascular health of women. Women with a history of GDM are at increased risk of developing CVD events in the years after index pregnancy, with the risk manifesting itself as early as the first decade after pregnancy. The increased risk seems to be independent of traditional risk factors for CVD, such as obesity, hypertension, family history, and hypercholesterolemia. Lifestyle modifications and pharmacological interventions may be beneficial in reducing the risk of CVD in high-risk groups, including women with a history of GDM. Moreover, adherence to diabetes prevention programs can help prevent the risk of developing GDM and subsequent T2DM (Carr et al., 2006; Sun et al., 2021). Overall, the diagnosis of GDM offers an exceptional opportunity to detect the future risk of heart disease in young women, and pregnancy provides a unique chance for the detection of underlying health conditions (Corcoy, 2019).

Implications for practice

This literature review emphasised the importance of recognising the obstetric history of women in assessing their risk for CVD. Women who have a history of GDM can benefit from early interventions, such as regular monitoring, lifestyle modifications, and treatment, to reduce their risk for CVD-related morbidity and mortality later in life (Di Cianni et al., 2018). It is important to increase awareness among women and healthcare providers about the link between GDM and CVD risk through appropriate educational programs (Ferranti et al., 2016). The pregnancy period provides a unique opportunity for nurses and other healthcare professionals to play a critical role in the process of CVD risk assessment and promoting a healthy lifestyle (Corcoy, 2019). However, it is not enough to simply have knowledge of the risk; specific intervention programs and long-term follow-up guidelines need to be developed by healthcare providers and policy makers to decrease the impact of GDM on women's cardiovascular health (Corcoy, 2019). The appropriateness of existing guidelines for managing CVD risk in high-risk groups needs to be examined for women with a history of GDM.

Conclusion

There is consistent evidence of a positive association between a history of GDM and the development of CVD in later life. Women with a history of GDM appear to develop CVD at a relatively younger age, and the risk seems to be independent of the subsequent development of T2DM. It is important for all healthcare providers to consider this knowledge more closely and to apply it in practice to reduce the risk of CVD in this high-risk group.

Table 3.5 *Quality assessment of the included studies (GDM)*

Author(s), year, country	Did the study address a clearly focused issue?	Was the cohort recruited in an acceptable way?	Was the exposure accurately measured to minimise bias?	Was the outcome accurately measured to minimise bias?	Have the authors identified all important confounding factors?	Was the follow-up of the subjects complete/ long enough?	What are the results of this study?	How precise are the results?	Can the result be applied to the local population?	Do the results of this study fit with the other available evidence?	What are the implications of this study for practice?
Charach et al. (2016) Israel	Yes	Yes	Yes	Yes	Yes	Yes	Higher death rate from IHD cerebrovascular event, and cancer in women with pre-eclampsia	95% CI	Yes	Yes	While additional research is necessary, the glucose levels during pregnancy could potentially function as an indicator of future atherosclerotic health issues, even in the absence of a clinical diagnosis of GDM. These findings may prompt adjustments to existing risk assessment and screening protocols for atherosclerotic conditions, with obstetricians, as well as primary care physicians and cardiovascular specialists, potentially playing a role in this. To explore this distinct connection between GDM and later-life atherosclerotic health issues, further extensive studies with extended follow-up periods are warranted.
Daly et al. (2018) UK	Yes	Yes	Yes	Yes	Yes	Yes	Higher risk of fatal and non-fatal CVD event in women with HDP, higher risk in early HDP	95% CI	Yes	Yes	The identification of women with history of GDM within primary care and addressing cardiovascular risk factors could enhance their long-term prognosis. Guideline recommendations for screening and management of hypertension, lipids, and smoking cessation are lacking and need to be reviewed.
Echouffo-Tcheugui et al. (2021) Canada	Yes	Yes	Yes	Yes	Yes	Yes	HDP presented an increased risk for heart failure later in life. HDP was an independent risk factor for future heart failure.	95% CI	Yes	Yes	In a large observational study, GDM was linked to a heightened risk of HF. As a result, screening for diabetes during pregnancy is recommended as a means of identifying women who may be at risk for HF.
Goueslard et al. (2016)	Yes	Yes	Yes	Yes	Yes	Yes	Higher death rate in women with pre-eclampsia (RR 2.1)	95% CI	Yes	Yes	A previous history of GDM has been recognised as a risk factor for CVD, in the seven years following childbirth. Encouraging and aiding in

Author(s), year, country	Did the study address a clearly focused issue?	Was the cohort recruited in an acceptable way?	Was the exposure accurately measured to minimise bias?	Was the outcome accurately measured to minimise bias?	Have the authors identified all important confounding factors?	Was the follow-up of the subjects complete/ long enough?	What are the results of this study?	How precise are the results?	Can the result be applied to the local population?	Do the results of this study fit with the other available evidence?	What are the implications of this study for practice?
France											the adoption of lifestyle changes from the postpartum period onward is advisable.
Kaul et al. (2015) Canada	Yes	Unclear	Yes	Yes	Yes	Yes	Increased risk of IHD, stroke, diabetes mellitus, hypertension, dyslipidaemia	95% CI	Yes	Yes	The similarity in the links between excess weight on its own, GDM on its own, and hypertension and CVD underscores the necessity for effective interventions to address both of these conditions in order to enhance the well-being of these patients.
Lee et al. (2022) UK	Yes	Yes	Yes	Yes	Yes	Yes	Increased risk of MI, stroke, CVD related death	95% CI	Yes	Yes	Study findings suggest that regular screening and long-term proper strategies for CVD prevention are needed for women with a history of GDM.
McKenzie-Sampson et al. (2018) Canada	Yes	Yes	Yes	Yes	Yes	Yes	Increased risk of CVD and hypertension, irrespective of the timing of onset of HDP	95% CI	Yes	Yes	After pregnancy, women who have experienced GDM might benefit from more vigilant monitoring to prevent CVD.
Retnakaran et al. (2017) Canada	Yes	Yes	Yes	Yes	Yes	Yes	Increased risk of CVD, MI, heart failure, cerebrovascular disease	95% CI	Yes	Yes	The present evidence indicating that assessing both the history of GDM and the subsequent development of T2DM can help stratify CVD risk, even when the incidence is low within the initial ten years after giving birth, opens up the potential that this insight could be applicable for assessing and mitigating risk factors in later life as these women progress into middle age, a period associated with an elevated occurrence of vascular issues. Ultimately, the clinical significance of this knowledge and the cost-effectiveness of implementing strategies based on it in later life will require direct evaluation in future research.

Author(s), year, country	Did the study address a clearly focused issue?	Was the cohort recruited in an acceptable way?	Was the exposure accurately measured to minimise bias?	Was the outcome accurately measured to minimise bias?	Have the authors identified all important confounding factors?	Was the follow-up of the subjects complete/ long enough?	What are the results of this study?	How precise are the results?	Can the result be applied to the local population?	Do the results of this study fit with the other available evidence?	What are the implications of this study for practice?
Shostrom et al. (2017) US	Yes	Yes	Yes	Yes	Yes	Yes	Significant differences in the risk of CVD between women with and women without complicated pregnancy with hypertension	95% CI	Yes	Yes	For women, the standard screening for GDM presents a distinct and valuable chance, at a relatively early stage of life, to identify their potential for developing CVD in the future. Given the observed heightened risk of CVD following GDM, there's an opportunity to introduce tailored interventions aimed at reducing this risk in women with GDM, offering potential advantages such as enhanced cardiovascular well-being and more.
Sun et al. (2021) Korea	Yes	Yes	Yes	Yes	Unclear	Yes	Death from CVD	95% CI	Yes	Yes	The findings of the study reinforce the need for implementation of post-delivery diabetes interventions to reduce future CVD risk in women who experienced GDM. Further study is needed to evaluate the impacts of severity of GDM on the risk of CVD.
Tobias et al. (2017) US	Yes	Yes	Yes	Yes	Unclear	Yes	Increased rate of MI, IHD, fatal and non-fatal CVD events in women with history of pre-eclampsia	95% CI	Yes	Yes	The study findings endorse the significance of lifestyle choices in averting CVD in high-risk women who have previously experienced GDM. It is essential to gather further data through continuous follow-up of these women to assess the extended health consequences associated with a history of GDM.
Yu et al. (2022) Denmark	Yes	Yes	Yes	Yes	Yes	Yes	Higher rate of fatal or non-fatal IHD in women with pre-eclampsia	95% CI	Yes	Yes	Sustained surveillance of women who have experienced gestational diabetes (GDM), particularly those with pre-pregnancy obesity or a maternal history of CVD, could offer improved chances for lowering their cardiovascular risk

Table 3.6 *Characteristics of the included studies (GDM)*

Author, year, country	**Design**	**Setting/ sample**	**Sample size**	**Follow-up period**	**Risk of CVD after previous GDM**
Charach et al. (2016) Israel	Retrospective case–control	All women who delivered between 2000 and 2012, and later developed atherosclerotic morbidity	n = 6,880 Exposed group: n = 815, Control group: n = 6,065	6.2 years	High risk
Daly et al. (2018) UK	Retrospective cohort	Primary care database	n = 46,399 Exposed group: n = 9,118, Control group: n = 37,281	26.3 years	Higher risk
Echouffo-Tcheugui et al. (2021) Canada	Population-based cohort	Canada's Ministry of Health and Long-Term Care healthcare administrative database	n = 906,319 Women diagnosed with GDM: n = 50,193	Median 7 years	Higher risk
Goueslard et al. (2016) France	Population-based retrospective (longitudinal)	French medico-administrative database	n = 1,518,990	7 years	High risk
Kaul et al. (2015) Canada	Retrospective cohort	All women with live singleton deliveries between April 1999 and March 2010 in Alberta, Canada	n = 474,348	5.3 years	High risk
Lee et al. (2022) UK	Population-based prospective cohort	UK Biobank	n = 219,330 Women diagnosed with GDM: n = 1,390	> 10 years	Higher risk
McKenzie-Sampson et al. (2018) Canada	Retrospective cohort	Women who had live births in hospitals within Quebec, Canada	n = 1,070,667 Exposed group: n = 67,356 Control group: n = 1,003,311	25.2 years	High risk
Retnakaran et al. (2017) Canada	Population-based cohort (longitudinal)	Healthcare administrative database	n = 1,515,079	10.0 years	High risk

Author, year, country	Design	Setting/ sample	Sample size	Follow-up period	Risk of CVD after previous GDM
Shostrom et al. (2017) US	Population-based cross-sectional survey	National Health and Nutrition Examination Survey	n = 8,217	7 years	High risk
Sun et al. (2021) Korea	Population-based retrospective cohort	Korean National Health Insurance Service claim database	n = 1,500,165 Exposed women: n = 159,066 Unexposed women: n = 1,341,102	Median 12.8 years	Higher risk
Tobias et al. (2017) US	Prospective cohort (longitudinal)	Data from the Nurses' Health Study II	n = 89,479	25.7 years	High risk
Yu et al. (2022) Denmark	Population-based cohort	Data from several national registers	n = 1,002,486 Women diagnosed with GDM: n = 21,353	Median 16.2 years	Higher risk

Conclusion of the chapter

This chapter provided an extensive review of the literature concerning the CVD risk in women with a history of pregnancy complications and established a clear link between these complications and subsequent CVD. The available evidence consistently demonstrates an increased risk of CVD associated with a history of miscarriage, stillbirth, HDP, and GMD (Parikh et al., 2021; Wagner et al., 2015; Riis et al., 2018). This association is observed across numerous studies and in diverse patient populations. It is likely that these pregnancy complications share common underlying physiological pathways and may be linked to similar predisposing factors in women (Hauspurg et al., 2018).

Future research endeavors should aim to enhance our understanding of the underlying mechanisms involved in these pregnancy complications to effectively prevent them. This is crucial not only from reproductive and mental health perspectives but also for preventing associated health complications such as CVD.

Moreover, timely identification and targeted interventions for these women are essential for effectively managing associated health complications, including the risk of CVD. Given that pregnancy often occurs at relatively younger ages, timely identification of women with pregnancy complications provides a unique opportunity to comprehensively assess their CVD risk profile (Parikh et al., 2021; Riis et al., 2018). This facilitates the implementation of meaningful risk-reduction strategies, particularly through more intensive lifestyle modifications and medical therapies to address other modifiable CVD risk factors (Hauspurg et al., 2018).

However, as discussed in Chapter One, the development of CVD involves multiple factors, and behaviour change is a complex process influenced by several factors, as detailed in Chapter Two. One of the key factors influencing a person's engagement in changing behaviours is their awareness and perception of risk, which is the primary focus of the current research. The subsequent chapter will outline the methodology of the study.

Chapter Four: Methodology

Introduction to the chapter

Chapter Three presented the review of the literature concerning the risk of CVD in women with a history of complications of pregnancy and concluded that some complications of pregnancy including pregnancy loss, HDP, and GDM are associated with an increased risk of CVD in women in their future life.

Timely recognition of the cardiovascular risk, assessment, prevention, and treatment plan can help improve cardiovascular health in women. However, this requires that both the affected women and healthcare providers are aware of the associated risk and actively engage in CVD risk-reducing programs. This chapter explains the study aims, research design, and the methods used in this thesis.

Aims of the study

The aim of this study was to evaluate the level of knowledge and awareness regarding CVD risk in women with a history of complications of pregnancy, such as pregnancy loss, HDP, and GDM. Additionally, the study aimed to investigate how these women manage their CVD risk. Another objective was to assess healthcare providers' knowledge of CVD risk in this population group and explore their approach to reducing the risk among this high-risk population.

Study questions

1. What is the level of knowledge and awareness regarding the risk of CVD among women who have experienced complications during pregnancy?

2. What are the current behaviours and practices related to reducing CVD risk among women who have a history of pregnancy complications?

3. What is the level of knowledge and awareness among healthcare providers regarding the risk of CVD in women, particularly in those who have experienced complications during pregnancy?

4. What are healthcare providers' current practices towards the assessment, prevention, and management of CVD risk in women with a history of complications of pregnancy?

Research design

This study employed a quantitative research approach, utilising a descriptive cross-sectional survey design. It comprised two separate but interrelated surveys: the first survey (the women's study) aimed to evaluate the knowledge and awareness of CVD risk in women with a history of complications of pregnancy, such as pregnancy loss, HDP, and GDM, and explore their engagement in CVD risk-reducing behaviours. The second survey (the healthcare providers' study) addressed the knowledge and awareness of CVD risk associated with complications of pregnancy among healthcare providers and examined their engagement in CVD risk management for this high-risk population.

In conducting research, selecting the most appropriate research design is crucial to comprehensively address research questions and reduce bias. A considered research design can generate new knowledge and introduce novel ideas that challenge current practices (Leavy, 2022; Sousa et al., 2007). Cross sectional surveys involve gathering measurable and quantifiable data to explore a phenomenon and address specific quantitative research questions (Baker, 2017; Johnson & Welch, 2011).

Due to an array of associated advantages, cross-sectional surveys are extensively employed in nursing and healthcare research. They are often more cost-effective compared to longitudinal studies, requiring fewer time and resources since data is collected at a single point in time. Conducting cross-sectional surveys is efficient, making them a quicker option for collecting data, which is beneficial when there are budget or time constraints. Results from cross-sectional surveys can often be generalised to the broader population (Creswell, 2013), making them useful for drawing broad conclusions about the characteristics or prevalence of a phenomenon. Cross-sectional surveys are also valuable for identifying associations or relationships between variables (Couper, 2017; Glasow, 2005). They prove particularly effective for assessing attitudes, a dimension often challenging to measure through observational techniques (Couper, 2017; Ponto, 2015).

Despite these advantages, surveys may not be suitable for investigating the historical context of phenomena, limiting the understanding of how and why certain patterns or characteristics have emerged (Ponto, 2015). Cross-sectional studies provide a snapshot at a single point in time, limiting the ability to observe changes or developments over time. Since data are collected at a specific moment, cross-sectional surveys are susceptible to bias, such as recall bias or social desirability bias (Glasow, 2005; Couper, 2017; Ponto, 2015). Additionally, cross-sectional studies can identify associations between variables but cannot establish causation (Ponto, 2015).

The women’s study: Knowledge and risk-reducing behaviours of women with a history of complications of pregnancy about their CVD risk

Study aims

This study aimed to assess the knowledge and awareness of CVD risk and risk factors in women with a history of complications of pregnancy and explore their engagement in cardiovascular risk-reducing behaviours.

Study population

The study population refers to the entire group of individuals or elements that meet the criteria for inclusion in a research study. This group is the target for data collection and analysis, and findings from the study are often generalised to this larger population (Thacker, 2020). In the women's study, the study population consisted of women who had experienced miscarriage, stillbirth, HDP, or GDM in one of their pregnancies. The definition of the study population is crucial for the external validity or generalizability of research results (Thacker, 2020).

Sampling

In this study, a convenience sampling method was employed. Convenience sampling is a non-probability sampling method where researchers select participants based on their availability and accessibility. This approach is convenient because it involves choosing individuals who are easy to reach or readily available, often due to proximity or convenience (Pace, 2021). This method is commonly used in situations where time, budget constraints, or logistical considerations make it challenging to employ more rigorous sampling techniques (Pace, 2021). Nevertheless, convenience sampling may introduce bias into the sample, as the participants may not be representative of the entire population. Therefore, findings from convenience samples may not be generalisable to the entire population, reducing the external validity of the study. In addition, since participants are selected based on convenience, the sample may lack diversity, leading to a more homogenous group with shared characteristics

(Wilson, 2016). To address these limitations, the researcher implemented specific strategies in participant recruitment to improve the representativeness of the study sample, as detailed in the participant recruitment section.

Sample size

It is advisable for the researcher to collaborate with a statistician for precise calculations and determination of the appropriate sample size, as was done in this study. The sample size was computed based on findings from prior studies investigating knowledge of cardiovascular disease (CVD) risk. For example, a national survey conducted by the American Heart Association (AHA) in 2019 revealed that only 44% of the public was aware that heart disease is the leading cause of death among women (Cushman et al., 2021). Other studies have reported a range of awareness of CVD risk from 10–20% (Gooding et al., 2019; Mosca et al., 2000). Additionally, a cross-sectional study in Kuwait indicated that public knowledge about CVD was at a moderate level (Awad & Al-Nafisi, 2014), while a study in South Korea found that patients with rheumatoid arthritis had poor knowledge of modifiable CVD risk factors (Boo et al., 2017).

Building on insights from these studies and in consultation with a statistician, the researcher assumed that only 25% of the target population would possess general knowledge of CVD and its association with complications of pregnancy. Employing the Select Statistical Services Population Proportion Sample Size Calculator, a sample size of 288 participants was deemed necessary for the survey. A total of 299 women were recruited for the study, incorporating a margin of error of 5% and a 95% confidence interval.

Study setting

This study took place in Sydney, Australia. Women were recruited from Westmead Hospital and Royal North Shore Hospital, involving both in-patient hospital wards and outpatient clinics, such as women's health ambulatory clinics, antenatal clinics, and early pregnancy clinics. These hospitals are two major metropolitan teaching referral hospitals situated in Sydney's western and northern suburbs, respectively. They offer a comprehensive range of care to pregnant women and those requiring medical care for complex conditions during their pregnancy, such as endocrine and renal diseases, multiple pregnancies, drug addictions, mental health disorders, and complications of pregnancy.

Inclusion and exclusion criteria

To qualify for participation in the survey, women had to meet specific criteria, including being 19 years of age or older, having a history of at least one complication of pregnancy (miscarriage, stillbirth, hypertensive disorders of pregnancy, or gestational diabetes mellitus, being proficient in speaking, reading, and understanding English, and providing informed consent to take part in the study. However, women with severe physical health issues or self-reported mental and/or cognitive impairment were excluded from the study.

Participant recruitment

Women were recruited from various inpatient and outpatient settings at two tertiary teaching referral hospitals in Sydney: Westmead Hospital and Royal North Shore Hospital. The recruitment from these two hospitals aimed to include individuals with diverse sociocultural backgrounds. This approach was implemented to enhance the representativeness of the study sample. The study flyers were displayed on notice boards in various wards of the participating hospitals. The clinical midwifery consultants in each hospital introduced the study and the researcher to staff in various wards, encouraging their support and assistance in participant recruitment. Furthermore, the researcher and one of the supervisors were employees of the hospitals, fostering rapport with the hospital administration and garnering their support for the study.

To broaden the representation of the sample, the study flyer was additionally shared online on various Facebook pages, including 'High-Risk Pregnancy Support,' 'High-Risk Pregnancy Support Group,' 'Gestational Diabetes Support & Meal Ideas,' 'Rainbows After A Storm - Ttc, Pregnancy and Babies After Loss,' and 'High-Risk Pregnancy Center.' These pages were chosen due to their substantial number of active online members, many of whom met the inclusion criteria. However, only about 25% women participants were recruited through online channels.

The researcher primarily approached eligible women through selected hospitals, outlining the study objectives. Participants were informed of their rights as research participants, and a copy of the participant information sheet (Appendix C) was supplied. Upon addressing any questions, interested participants were invited to sign the study consent form (Appendix D) and complete the survey. The survey was offered in both hard copy and electronic versions, with participants opting for the electronic format receiving a provided link.

All participants were assured of the anonymity of the survey and explicitly informed that there was no need to include their names on the study questionnaires. Completion and submission of the survey were considered indicative of their consent to participate in the study. The online survey remained accessible for 10 months, from February to December 2021, during which the requisite number of participants was recruited for the study.

Data collection

In survey studies, multiple methods are available for data collection, including direct administration of surveys, mail surveys, telephone surveys, interviews, email surveys, and internet-based program surveys such as REDCap and SurveyMonkey (Creswell, 2013). This study utilised both administering the survey directly and employing an internet-based program through REDCap for data collection. The incorporation of various methods can enhance participant recruitment and cater to individual preferences (Ponto, 2015). This approach was particularly important during the COVID-19 pandemic to ensure a higher response rate from targeted women.

REDCap was chosen due to its secure and reliable platform, ease of use, and support from the UTS where the study was conducted. The use of both direct administration and an internet-based program survey allowed for a diverse range of participants to choose their preferred method and increased the likelihood of obtaining accurate and reliable data. In addition, the online format enabled efficient data collection and management, while the paper format was useful for participants who did not have access to the internet or preferred a hard copy.

Study instruments

The survey package (Appendix E) was developed by the researcher after conducting a comprehensive review of related literature and consulting with the supervisory team and experts in the field. It consisted of several sections, including sociodemographic and obstetric history (n = 9), participants' CVD risk factors and risk-reducing behaviours (n = 17), and the Knowledge of Risk and Risk Factors in Women with a History of Complications of Pregnancy Questionnaire (n = 33).

The survey package was designed to capture detailed information about the participants' sociodemographic and obstetric history, as well as their CVD risk factors and risk-reducing behaviours. The Knowledge of Risk and Risk Factors in Women with a History of Complications of Pregnancy Questionnaire was included to assess participants' knowledge of CVD risk and risk factors.

Overall, the survey package was carefully designed to ensure the collection of accurate and reliable data, and the use of both online and paper formats allowed for a diverse range of participants to be included in the study.

Section 1: Sociodemographic and obstetric history

This section consisted of questions about participants' sociodemographic characteristics, including age, marital status, education, ethnicity, and financial status, as well as their obstetric history, including the history of miscarriage, stillbirth, HDP, and GDM.

Section 2: Participants' CVD risk factors and risk-reducing behaviours

This section consisted of questions about traditional CVD risk factors among participants and their engagement in risk-reducing behaviours. This included questions about their history of high blood pressure, diabetes, and hyperlipidaemia, family history of CVD, BMI, physical inactivity, smoking status, and whether they were aware of their risks or had regular medical assessments.

Section 3: The knowledge of cardiovascular risk and risk factors in women with a history of complications of pregnancy questionnaire

Women who have experienced complications during pregnancy have a higher risk of developing CVD in their future lives. It is crucial for these women to be aware of their CVD risk factors, symptoms, and the importance of maintaining a healthy lifestyle to prevent the disease or seek timely treatment when symptoms first appear. To appropriately assess the knowledge needs of these women, there is a need for a valid questionnaire, as noted by Bergman et al. (2011) and John et al. (2009).

While there are several relevant questionnaires available to assess knowledge related to CVD, such as the 40-item Coronary Heart Disease Knowledge Test developed for men (Smith et al., 1991), it is not suitable for the current study. The questionnaire was specifically designed for men with a history of heart disease such as MI, or who have had coronary artery bypass surgery, and focuses on domains such as the nature of heart disease, cardiopulmonary resuscitation, type A and B behaviour, stress management, diet, physical activity, and problems related to home and family (Smith et al., 1991).

There are other questionnaires available that have been developed for patients with specific comorbid diseases, such as diabetes or rheumatoid arthritis. For instance, the Heart Disease Fact Questionnaire (HDFQ) was created to assess CHD knowledge in patients with diabetes, focusing on major CHD risk factors (Wagner et al., 2005). Similarly, the Heart Disease Fact Questionnaire-Rheumatoid Arthritis (HDFQ-RA) was developed specifically for individuals with a history of rheumatoid arthritis, incorporating 2 main domains: general CVD risk factors and risk factors specific to patients with rheumatoid arthritis. The first domain of the HDFQ-RA questionnaire was developed using the first 15 questions from the HDFQ (John et al., 2009).

These general CVD risk-factor questions were used to develop the questionnaire for the current study. Additionally, Thanavaro et al. (2010) created a CHD knowledge tool (CHDK) to assess CHD knowledge and awareness in women without a history of heart disease. The CHDK consists of 25 multiple-choice questions with scores ranging from zero to 25, with a higher score indicating better CHD knowledge (Thanavaro et al., 2010). The CHDK demonstrated good reliability (test-retest, $r = 0.70$) and internal consistency (Cronbach's alpha coefficient = 0.70). While this questionnaire would have been useful for the current study, the full version of the questionnaire was not available online at the time of study design, and efforts to obtain a copy of the questionnaire and permission from the developers to use it were unsuccessful through author correspondence. Nonetheless, the information provided about the questions in a published article was utilised in creating the questionnaire for the current study (Thanavaro et al., 2010).

In addition, the Heart Disease Knowledge Questionnaire (HDKQ) was developed by Bergman et al. (2011) and consists of 30 items. This questionnaire is not specific to gender and can be used for both men and women. The HDKQ is a concise tool that covers 5 knowledge domains related to CHD, including dietary knowledge, epidemiology, medical information, CHD risk factors, and heart attack symptoms (Bergman et al., 2011). Bergman et al. (2011) introduced this tool as easily administered with a reading level appropriate for a wide range of individuals with varying literacy abilities. The HDKQ has good psychometric properties with a Comparative Fit Index of 0.82, Tucker-Lewis Index of 0.88, and Root Mean Square Error of Approximation of 0.03. While this questionnaire could have been a suitable tool for the current study, a new questionnaire was developed by adapting questions from this questionnaire to create a more comprehensive and relevant tool.

Therefore, to address the limitations of existing tools in meeting the objectives of the current study, a new questionnaire was developed. This was achieved by conducting a comprehensive review of relevant literature and adopting items from previously developed and validated tools, specifically the HDFQ and the HDKQ (Appendix E). The questionnaire aimed to assess participants' awareness of CVD risk in women (n = 5), with questions adapted from the American Heart Association national surveys conducted in the US since 1997, which regularly track women's awareness and knowledge of CVD (Cushman et al., 2021). The questionnaire also evaluated participants' knowledge of CVD risk and risk factors, including a history of pregnancy complications (n = 28). To avoid acquiescence biases, both positive and negative items were considered in designing the questionnaire (Valencia, 2020). Answer options included 'true', 'false', and 'I don't know'. Each correct answer was given a score of one, and incorrect or ‘I don’t know’ responses were given a score of zero. The total knowledge score was calculated by summing up the correct answers, which could range from zero to 33, with higher scores indicating greater knowledge. Knowledge scores were categorised into 3 categories: poor (0–16), moderate (17–23), and good knowledge (24–33), using Bloom’s cut-off points: poor knowledge (a score ≤ 50% of correct responses), moderate knowledge (a score within 51–69% of correct responses), and good knowledge (a score ≥ 70% of correct responses and above) (Bloom et al., 1956).

The survey package developed for this study was designed to gather information on various aspects of participants’ health, including sociodemographic factors, obstetric history, CVD risk factors and risk-reducing behaviours, as well as their knowledge of CVD in women and associated complications during pregnancy. The researcher was careful to strike a balance in the number of questions included in the package. While tools with few questions may not capture participants’ knowledge levels accurately and may raise concerns about content validity, tools with too many questions may lead to respondent burden and make it impractical for use in settings with limited time, such as during health practitioner visits. Therefore, the researcher aimed to include an optimal number of questions to achieve the necessary level of sensitivity without unduly burdening the respondents. (Mosca et al., 2000; Rowley, 2014).

To simplify the scoring process, the survey package was designed to avoid open-ended questions and continuous response items. Open-ended questions can generate a wide variety of responses, making it challenging to score them objectively. Instead, closed-ended questions with predetermined response options were used. The response options included an ‘I don’t know’ option to minimise guessing and ensure accuracy in the data collected (Rowley, 2014).

Validity and reliability of the survey tool

Validity is a crucial factor to consider when selecting or applying an instrument in research. It refers to the extent to which an instrument measures what it is intended to measure (Bolarinwa, 2015). There are several types of validity, including face validity, content validity, construct validity, and criterion validity (Taherdoost, 2016).

Face validity is a subjective assessment of how well the measuring instrument appears to measure what it is intended to measure. It assesses the instrument's presentation, relevance, clarity, and explicitness. It is often based on a layperson's acceptance of the instrument's soundness and relevance, rather than a true psychometric assessment tool (Bolarinwa, 2015; Oluwatayo, 2012). In general, if an instrument's content appears relevant to the person taking the test, it has face validity (Taherdoost, 2016). Content validity, on the other hand, refers to the degree to which the items in an instrument adequately measure or represent the content of the property that the researcher intends to measure. It assesses whether the items in the instrument capture all the relevant aspects of the construct being measured (Straub et al., 2004; Taherdoost, 2016). In other words, content validity ensures that the instrument measures what it is intended to measure and covers all relevant aspects of the construct.

The determination and quantification of content validity involves 2 main stages: the developmental stage and the judgement-quantification stage (Bolarinwa, 2015). The developmental stage begins in the earliest stages of instrument development and involves identifying the domain, generating items, and forming the instrument (Bolarinwa, 2015). The judgement-quantification stage involves experts' assertion, by a specific number, that the items are content valid (Bolarinwa, 2015). The number of experts needed for this stage and the level of agreement between them can be determined using the standard error of the proportion. Typically, a minimum of 5 experts would provide a sufficient level of control for the validity of the content (Bolarinwa, 2015).

Construct validity refers to how well a researcher translates or transforms a concept or an idea into a functioning and operating reality (Taherdoost, 2016). This stage of validity mainly applies when the study involves cause-and-effect behaviours (Taherdoost, 2016). Criterion validity, on the other hand, refers to the level to which a measure is associated with an outcome. It assesses how well one measure can predict an outcome for another measure. In other words, a test has criterion validity if it is useful for predicting performance or behaviour in a past, present, or future situation (Taherdoost, 2016).

In addition to being valid, an instrument needs to be reliable to ensure that it consistently measures what it is intended to measure. Reliability refers to the consistency of the measurement and the degree to which it provides stable and consistent results over time (Huck et al., 2012).

In the current study, the survey package for the women's study underwent a thorough validation process. Content and face validity were assessed by a panel of 10 women with a history of complications of pregnancy. They were asked to independently evaluate each statement in the tool and express their opinion about its appropriateness by indicating whether they agreed or disagreed. The statements that were rated as 'agree' by more than 80% of the panel members were included in the final version of the tool. The panel members were excluded from participating in the main survey.

To assess the internal consistency of the Knowledge and Awareness of CVD Risk in Women with a History of Complications of Pregnancy Questionnaire, Cronbach's alpha coefficient was calculated, and it was found to be 0.869. This indicated that the questionnaire had reliable interval reliability, meaning that it consistently measured what it was intended to measure over time (Taber, 2018).

The healthcare providers' study: Knowledge and management approach of healthcare providers about CVD risk in women with a history of complications of pregnancy

Study aims

The healthcare providers' study aimed to assess healthcare providers' knowledge of CVD risk associated with complications of pregnancy and explore their practice in relation to management of the risk in this high-risk group.

Study population

The study population included general practitioners, registered midwives, obstetricians, gynaecologists, and cardiologists. This population was considered due to their professional interactions with women and opportunities to engage them in CVD risk assessment and management.

Sampling

A non-probability convenience sampling method was applied to select participants for the current study including general practitioners, registered midwives, obstetricians, gynaecologists, and cardiologists.

Sample size

Prior to designing this study, no research had been conducted to evaluate healthcare providers' knowledge and practice in relation to CVD risk in women, including those with a history of pregnancy complications. However, Mosca et al. (2000) conducted a study that examined physicians' awareness, attitude, and adherence to guidelines regarding CVD risk in women. The study revealed that primary care physicians, obstetricians, and cardiologists were more likely to categorise women at moderate risk for CVD, as determined by the

Framingham Risk Score, as being at lower risk than men ($p < 0.0001$). Physicians rated themselves as not very effective in assisting patients in preventing CVD, and less than one in 5 physicians knew that annual CVD-related mortality in women is higher than in men. The results of this study were considered by the researcher, who consulted a statistician to determine the necessary sample size for the current study. Using the Select Statistical Services Population Proportion Sample Size Calculator and considering a margin of error of 5% with 95% CI and an effect size of 50%, which provides the largest sample size (Fitzner & Heckinger, 2010), a sample size of 383 participants was required. A total of 397 healthcare providers were recruited for this study.

Study setting

The study was conducted in primary and acute care settings across the Australian Capital Territory, New South Wales, and Western Australia. Healthcare providers were recruited primarily through the Royal Australian College of General Practitioners (RACGP) and the NSW Nurses and Midwives' Association. Information about the study was distributed through the organisations' magazines and newsletters.

Inclusion and exclusion criteria

To be eligible for recruitment in the healthcare professional study, participants needed to be practising as general practitioners, midwives, obstetricians, gynaecologists, or cardiologists in Australia, with a minimum of one year of practice experience. Additionally, participants were required to provide their consent to participate in the study.

Participant recruitment

The healthcare providers' study recruited participants from primary and acute care settings in the Australian Capital Territory, New South Wales, and Western Australia. The RACGP and the NSW Nurses and Midwives' Association were the main organisations that facilitated recruitment by distributing information about the study, including the participant information sheet (Appendix F) and the survey link, through their magazines and newsletters. The study was also promoted three times on social media sites such as the Facebook pages of RACGP, Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG), RANZCOG Advocacy Group, Cardiology Australia, and Australian College of Midwives (ACM), to reach out to targeted healthcare providers. To enhance recruitment, details about the study were featured three times in the organisations' magazines and newsletters, continuing until the necessary number of participants was reached.

Moreover, the researcher recruited some participants face-to-face by approaching managers and supervisors in designated areas both in person and through email. In-services were organised to meet with healthcare providers for recruitment purposes. During the meetings, the researcher explained the study's aims and invited participants to take part. Those who showed interest were given a copy of the participant information sheet (Appendix F), signed the study consent form (Appendix G), and received the survey package (Appendix H). Participants were asked to return completed surveys to a designated box in the ward or clinic. Alternatively, those who preferred to complete the survey online provided their email address or mobile phone, and the researcher sent them the survey link. Completion and submission of online surveys were considered as consent to participate in the study.

Study instruments

To conduct the healthcare providers' study, the researcher developed a survey package (Appendix H) after conducting a comprehensive review of the related literature and consulting with the supervisory team and experts in the field. The package consisted of 3 sections, including sociodemographic and practice-related information (*n* = 10), the Healthcare Providers' Knowledge of CVD Risk in Women with Complications of Pregnancy Questionnaire (*n* = 29), and Healthcare Providers' Approach in Managing CVD Risk in Women with a History of Complications of Pregnancy Questionnaire (*n* = 6). The survey was made available in both online and paper formats and was hosted on the REDCap platform. Participants could choose their preferred mode of completion.

Section 1: Sociodemographic and practice-related information

The sociodemographic and practice-related information section of the survey included questions about healthcare providers' age, gender, years of practice, and whether they worked in the public or private sector. It also gathered information about their specialty, including obstetricians and gynaecologists, cardiologists, general practitioners, and midwives.

Section 2: The Healthcare Providers' Knowledge of CVD Risk in Women with Complications of Pregnancy Questionnaire

This self-administered questionnaire comprises 29 questions that assess the knowledge of healthcare providers regarding cardiovascular disease (CVD) risk factors in women, both in general and specifically related to a history of pregnancy complications. The questions aim to evaluate the healthcare providers' knowledge of the different CVD risk factors, their understanding of the impact of pregnancy complications on CVD risk, and their ability to identify potential risk factors in female patients (Appendix G). At the time of designing this study, there was no available tool to assess healthcare professionals' knowledge about CVD risk factors in women, including the risk associated with a history of complications of pregnancy. The questionnaire was developed following a comprehensive review of the literature on CVD risk factors in women, including the risk associated with complications of pregnancy.

Some questions related to CVD risk knowledge were adopted from available questionnaires, including HDFQ, HDFQ-RA, and HDKQ (John et al., 2009; Thanavaro et al., 2010; Wagner et al., 2005). In addition, the RANZCOG, the AHA, and Australian Heart Foundation's statements were also reviewed and adopted in developing the questionnaire. The researcher considered respondent burden in the development of the tool.

The questionnaire had response options of 'True', 'False', and 'I don't know'. Each correct answer was given a score of one, and incorrect or 'I don't know' answers received a zero score. The total knowledge score was calculated by summing up the correct answers, which ranged from zero to 29. Higher scores indicated more knowledge. The knowledge scores were categorised into 3 categories: poor (0–15), moderate (16–20), and good (21–29) knowledge. These categories were developed using Bloom's cut-off points as follows: poor knowledge (a score ≤ 50% of correct responses), moderate knowledge (a score within 51–69% of correct responses), and good knowledge (a score ≥ 70% of correct responses) (Bloom et al., 1956).

Section 3: Healthcare providers' approach to managing CVD risk in women with a history of complications of pregnancy questionnaire

This section included 6 statements addressing various aspects of healthcare providers' management approach regarding CVD risk in women with complications of pregnancy (Appendix H). A 5-point Likert scale was used to measure participants' agreement level on each statement, with answer options ranging from 1 (strongly disagree) to 5 (strongly agree). The total score for each questionnaire was calculated by summing the scores for individual statements, which could range from 6 to 30, with higher scores indicating better management. The management scores were categorised into 3 categories: poor (6–15), moderate (16–21), and good practice (22–30). The categories were developed using Bloom's cut-off points as follows: poor management (a score ≤ 50% of correct responses), moderate management (a score within 51–69% of correct responses), and good management (a score ≥ 70% of correct responses) (Bloom et al., 1956).

Validity and reliability of the survey package

The survey package designed for the study was evaluated for content validity by 12 experts in the field of CVD and women's health, including 2 cardiologists, 6 obstetricians, and 4 clinical midwife consultants. These experts were asked to independently review the tool and indicate their agreement or disagreement on each question, as well as provide comments on the statements if they wished. Only statements that were agreed upon by at least 80% of the experts were included in the final version of the survey package. The experts were excluded from the main survey.

The internal reliability of the Healthcare Providers' Knowledge of CVD Risk Factors in Women with a History of Complications of Pregnancy Questionnaire and the Healthcare Providers' Approach to Managing CVD Risk in Women with a History of Complications of Pregnancy Questionnaire was assessed using Cronbach's alpha coefficient. The coefficients were 0.766 and 0.717, respectively, indicating reliable internal consistency.

Data analysis

Quantitative research questions can be addressed using statistical analysis. Descriptive statistics are used to summarise and describe the data in a quantitative study. Basic statistics such as mean, standard deviation, and frequency distributions provide an overview of the sample and the distribution of the data (Johnson & Welch, 2011).

The online surveys were designed using REDCap and completed by participants through a provided link. After data collection was complete, the researcher transferred the data from REDCap to the Statistical Package for Social Science, Advanced Statistics, Release 27.0 (IBM Corp. Released 2020. IBM SPSS Statistics for Windows, Version 27.0. Armonk, NY: IBM Corp). The researcher checked the accuracy and completeness of the data and then analysed it using appropriate statistical tests.

The women's study

Descriptive statistics were used to calculate frequencies and percentages of sociodemographic information, obstetric history, CVD risk factors, and knowledge, awareness, and management of CVD among the women. Normally distributed continuous data were summarised using mean ± standard deviation. Analysis of variance (One-Way ANOVA) was used to calculate the mean score of women's CVD risk knowledge and their CVD risk knowledge associated with complications of pregnancy across different groups of sociodemographic and clinical characteristics.

The healthcare providers' study

Descriptive statistics were used to summarise sociodemographic, practice-related data, and knowledge, awareness and management of CVD. Data on the Knowledge of CVD Risk in Women with Complications of Pregnancy Questionnaire were not normally distributed; therefore, median (interquartile) was calculated for these data. Non-parametric tests, including Kruskal-Wallis and Mann-Whitney U tests, were used to assess the associations of sociodemographic characteristics and median knowledge score of healthcare providers. Spearman's rank correlation was computed to assess the relationship between the level of knowledge and CVD risk management among the healthcare providers. Bivariate correlation test was used to calculate the correlation between participants' level of knowledge and CVD risk management. A p-value < 0.05 was considered statistically significant.

Rigour in quantitative research

Quantitative research is a deductive approach that uses numerical data to explain a factor or situation (Claydon, 2015). Rigor is a core concern of researchers, and it refers to the quality of the research (LoBiondo-Wood & Haber, 2017; Muijs, 2010). Weak research quality might lead to concerns regarding the validity and accuracy of the results (LoBiondo-Wood & Haber, 2017). Rigor in quantitative research is evaluated by examining reliability, validity, and responsiveness. Reliability refers to the consistency of the results when a research instrument is used in different studies. In the current study, the internal reliability of the research instruments was assessed using Cronbach's coefficient.

Validity refers to the extent to which a test measures what it is intended to measure (Taherdoost, 2016). In the current study, face and content validity of the survey package were assessed by experts in the field. The study also collected data from different settings to increase the generalisability of the findings. Sampling in quantitative research is a complex issue, and in the current study, the composition, representativeness, and size of the sample were considered, as these factors can affect the internal and external validity of the survey (Laher, 2016). Non-probability sampling was used in the current study due to its ease and efficiency, and the composition and non-response were explained in the results chapter.

The research instruments used in the current study were sufficiently described to make it clear what they intended to measure (Foxcroft & Roodt, 2005). The statistical analyses used to answer the research questions were explained in detail in the data analysis section. Overall, the current study adheres to the principles of rigor in quantitative research, including reliability, validity, and responsiveness.

Pilot study

A pilot study is an essential component of the study process, and it is critical for the development or refinement of new interventions, assessments, or other study procedures (In, 2017; Leon et al., 2011). Its main purpose is to evaluate the feasibility, duration, cost, and need for improvement of an instrument before using it in a large-scale study (In, 2017; Leon et al., 2011). By conducting a pilot study, researchers can test study instruments and confirm the optimal research method for answering research questions in the main trial (In, 2017). The advantage of conducting a pilot study is that it can alert researchers to potential issues in the main research, or whether the proposed instrument is appropriate for the study (In, 2017). It is important to note, however, that a pilot study is not designed to test a hypothesis, and it does not provide useful information regarding the population effect size due to the small sample size and limited estimations (In, 2017; Leon et al., 2011).

In the current study, two separate pilot studies were conducted using the same methods as those of the main study. The pilot studies allowed the researcher to test the feasibility of the survey and refine the research protocol if necessary (In, 2017). They helped to ensure that study participants could easily understand the questions and interpreted the statements in the same way. Additionally, the pilot studies helped the researcher determine the time required to complete the survey questionnaires (In, 2017; Leon et al., 2011).

After conducting the pilot surveys for each study group, the researcher debriefed the participants to identify patterns in their feedback, suggestions, needs for clarification, and requests for different wording. This information was used to revise the study instruments (In, 2017; Leon et al., 2011). The pilot studies involved a small convenience sample of 10 women with a history of complications of pregnancy and 10 healthcare providers, including obstetricians and gynaecologists, general practitioners, and registered midwives. Those who participated in the pilot studies were excluded from the main studies.

Several strategies can be employed to optimise the response rate. The researcher provided clear information to participants about the purpose of the survey, its importance, and how the data will be used. Reminders were sent to potential participants to encourage participation. It was made easier for respondents to complete the survey by offering multiple modes of response (hard copy or online). The design of the survey was made visually appealing and easy to navigate. The researcher used clear formatting, concise language, and avoided long blocks of text to maintain respondent interest. Participants were assured that their responses would remain anonymous. Participant recruitment took place in hospitals, and the invitation emails were sent to potential healthcare providers via professional organisations. This helped overcome scepticism and reluctance to participate.

Ethical considerations

Research ethics refers to the principles and guidelines that govern the treatment of study participants and the handling of data once it has been collected. In this study, ethical guidelines were adhered to in accordance with the National Statement on Ethical Conduct in Human Research, which was established by the Australian Research Council and the National Health and Medical Research Council (with its most recent update in 2018). The study received ethical approval from the Sydney Local Health District Human Research Ethics Committee (approval No. X19-0437 & 2019/ETH13440) (see Appendix A) and was ratified by the Human Research Ethics Committee at the UTS (see Appendix B).

Participants were informed that they could withdraw from the study at any time without any consequences or negative impact on their healthcare or treatment. To ensure confidentiality and privacy, all data were securely stored, and only the research team had access to it. The data were de-identified and analysed in an aggregated form to maintain the anonymity of the participants. The study also followed the principles of the Declaration of

Helsinki (World Medical Association, 2013) and the Good Clinical Practice guidelines (Commonwealth Department of Health and Aged Care, 2018).

The researcher approached women face to face in selected hospitals, introduced herself, explained the study, and invited them to participate. If the women expressed interest, they were provided with a hard copy of the survey to complete. Privacy of the participants was maintained in accordance with the National Health and Medical Research Council guidelines (2018). The researcher continuously monitored the participants' reactions from a distance while they answered the questions to ensure that they were not feeling anxious. If any participant expressed concern or discomfort, the researcher debriefed with them, encouraged them to speak with their specialist or a general practitioner about their cardiovascular health, and provided information on available counselling services if needed (Hawton et al., 2003; National Health and Medical Research Council, 2018).

The researcher provided participants with her contact details and advised them to ask any questions they may have had about the research. Participants were assured that their responses would be kept confidential and anonymous. To protect the privacy and safety of the participants, data were protected, and only the researcher and supervisors had access to the study data. Participants were informed of how their information would be used. Hard copies of the data were stored in a locked file at the UTS, while digital files were saved in a password-protected computer. The data will be securely stored for a minimum of 5 years before being destroyed.

Conclusion of the chapter

This chapter outlined the methodology of the study, including the study design, setting, study population, sampling, sample size, participant recruitment, data collection methods, and study instruments. It also highlighted the rigor of the study and ethical considerations. The following chapter presents the results of the women's study.

Chapter Five: Results of the Women's Study

Introduction to the chapter

In the previous chapter, the study's methodology was outlined, demonstrating that a survey design was the most suitable approach to achieve the study's objectives. This chapter presents the results of the women's study, beginning with a description of the sociodemographic characteristics, obstetric history, and CVD risk factors of women. This is followed by an assessment of their level of awareness and knowledge of CVD risk and risk factors, including those associated with complications of pregnancy. The section subsequently explores how the participants perceived their risk and their efforts to mitigate the risk.

Sociodemographic characteristics of the participants

Out of the total 364 survey responses received, 65 participants did not complete the entire survey and were excluded from the final analysis, resulting in a total sample of 299 complete responses. The participants had a mean age of 33.2 years (SD ± 5.2, range 19-49. A significant proportion were married (78.3%) and described their financial condition as good (71.2%). The majority identified as Australian, constituting 58.5% of the sample, and more than 60% held a university degree. The sociodemographic characteristics of the participants are presented in Table 5.1.

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Table 5.1 *Sociodemographic characteristics of the study participants (n = 299)*

	Frequency	Percentage*
Age group		
< 25	13	4.3%
25–35	190	63.5%
> 35	96	32.1%
Marital status		
Single/Never married	17	5.7%
Married	234	78.3%
De facto	40	13.4%
Divorced/Separated	8	2.7%
Ethnicity		
Australian including Australian Aboriginal/Torres Strait Islander	175	58.5%
North African/Middle Eastern/Sub Saharan African	71	23.7%
European/British/Irish	25	8.4%
New Zealander	24	8.0%
Southeast Asian/North Asian	4	1.3%
Education		
Primary or Secondary schooling	22	7.4%
Certificate or Diploma	97	32.4%
Bachelor’s or Postgraduate degree	180	60.2%
Financial situation		
Excellent	15	5.0%
Good	213	71.2%
Fair	65	21.7%
Poor	6	2.0%

*Percentages may not add up to 100 due to rounding.

Participants' history of complications of pregnancy

The prevailing pregnancy complication reported by participants was a history of miscarriage, indicated by 72.6% of respondents, followed by HDP at 39.8% and GDM at 38.5%. A relatively lower percentage, 10.7%, reported a history of stillbirth (Figure 5.1).

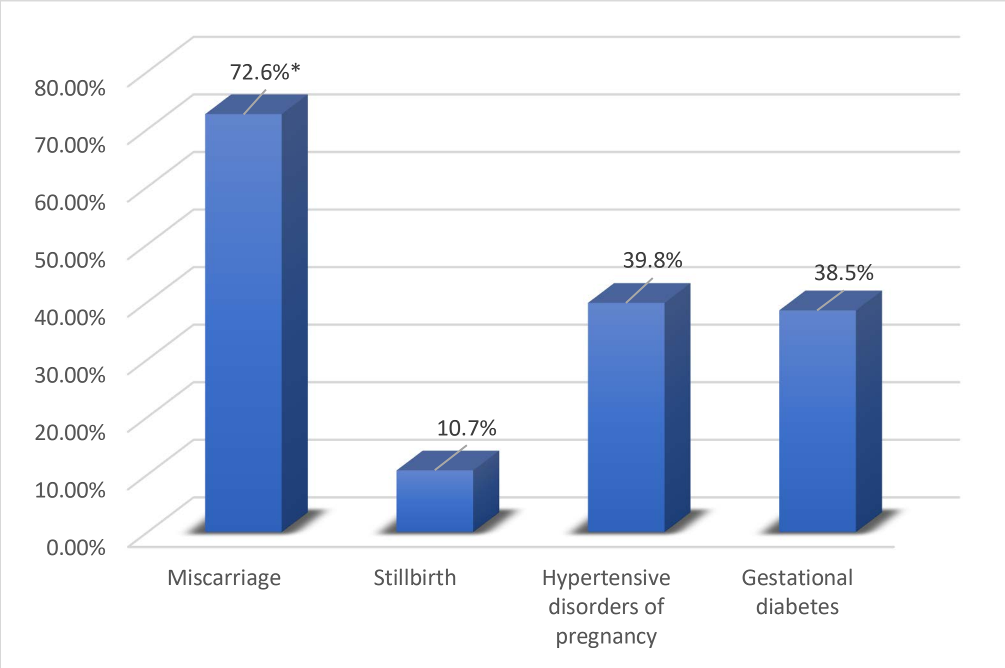

Figure 5.1 *History of complications of pregnancy of the study participants*

* The percentages do not add up to 100 since some women reported multiple complications during their pregnancies.

Out of the participants who reported having a history of miscarriage (72.6%), 37.8% had experienced one miscarriage, 28.1% had experienced 2 miscarriages, and 6.7% had experienced 3 or more miscarriages. Among those who experienced stillbirth (10.7%), 9.4% reported having one stillbirth, and 1.3% reported having two stillbirths (Figure 5.2).

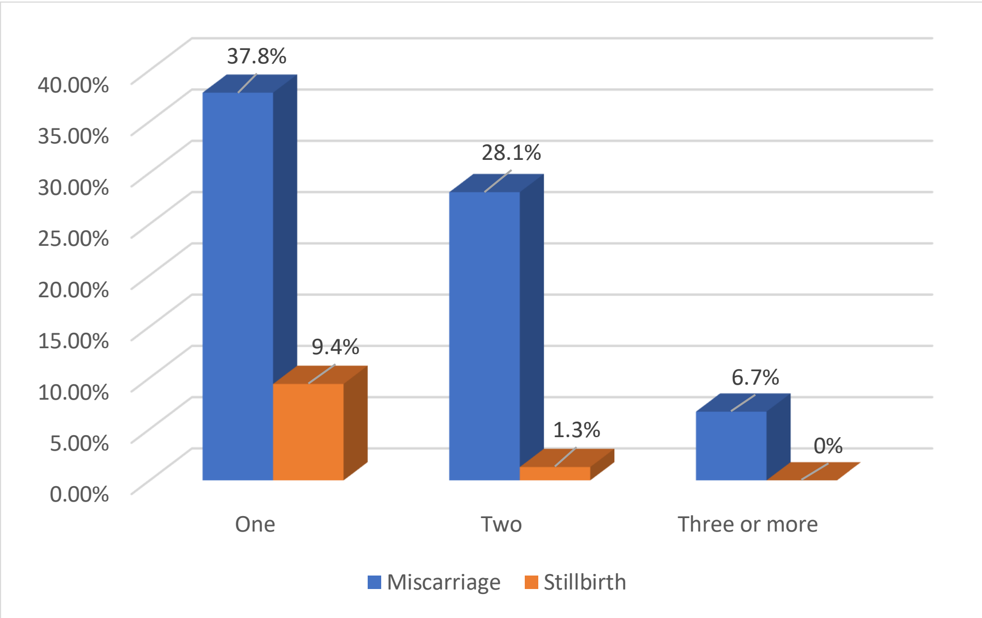

Figure 5.2 *Percentage of miscarriages and stillbirths of the study participants*

Some women experienced multiple complications during their pregnancies. Of the surveyed women, 36.4% reported facing only one complication, while 63.5% experienced more than one type of complication during their pregnancies. Within this group, 30.4% dealt with both miscarriage and HDP, 27.7% confronted both miscarriage and GDM, and 5.3% reported having both HDP and GDM during their pregnancies (Figure 5.3).

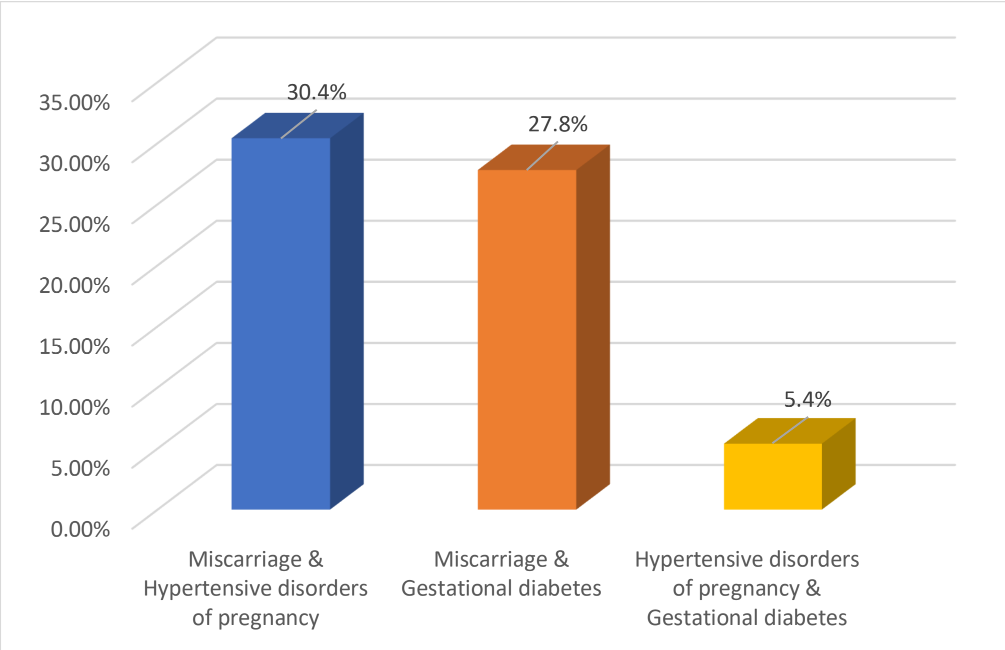

Figure 5.3 *Percentage of multiple complications of pregnancy of the study participants*

CVD risk factors of the participants

In relation to CVD risk factors, more than half of the participants (53.5%) were either overweight or obese, and 4.0% continued to smoke during pregnancy, averaging 10.7 cigarettes per day. Only 7.7% of participants reported engaging in physical activity at a moderate level for at least 150 minutes per week. A history of high blood pressure was reported by 39.8% of participants, while 23.4% had a history of diabetes, and only 6.0% reported a history of hyperlipidemia. About one-third (31.7%) of participants indicated a family history of CVD, with 11.4% occurring in family members under 65 years. In total, 43.1% of participants had at least one CVD risk factor, 25.8% had at least 2 CVD risk factors, and 14.4% had 3 or more CVD risk factors. Table 5.2 displays the CVD risk factors of participants.

Table 5.2 *CVD risk factors of the participants (n = 299)*

	Frequency	Percentage*
BMI		
Underweight (< 18.5 kg/m^2)	3	1.0%
Normal weight (18.5–24.9 kg/m^2)	136	45.5%
Overweight (25–29.9 kg/m^2)	101	33.8%
Obese (≥ 30 kg/m^2)	59	19.7%
Smoking status		
Current smoker	12	4.0%
Physical activity		
Moderate physical activity at least 150 minutes per week	23	7.7%
Moderate physical activity less than 150 minutes per week	270	90.3%
Little or no physical activity	6	2.0%
High blood pressure	119	39.8%
Diabetes	70	23.4%
Hyperlipidaemia	18	6.0%
Family history of CVD	34	11.4%

n= frequencies; *percentages may not add up to 100 due to rounding.

Participants’ awareness of CVD risk

A relatively small percentage of participants (24.4%) were aware that heart disease is the leading cause of death for women in Australia. Moreover, only 28% of respondents were informed that women are more likely to die from heart disease than breast cancer. Nevertheless, most participants (62.2%) were aware that heart disease can manifest as asymptomatic or 'silent' in certain individuals. Regarding knowledge of heart attack signs and symptoms, 65.6% of participants either did not know or were uncertain that feelings of weakness, light-headedness, or fainting could be indicative of a heart attack in women. The outcomes of participants' knowledge and awareness of cardiovascular disease are detailed in Table 5.3.

Table 5.3 *The participants’ awareness of CVD risk in women (n = 299)*

Statements	**True** ***n*** **(%) ***	**False** ***n*** **(%)**	**I don’t know** ***n*** **(%)**
Heart disease is the number one killer of women in Australia.	73 (24.4%)	58 (19.4%)	168 (56.2%)
Women are more likely to die from breast cancer than heart disease.	89 (29.8%)	84 (28.1%)	126 (42.1%)
A woman would always know if she had a heart disease.	52 (17.4%)	186 (62.2%)	61 (20.4%)
Heart disease is better defined as a short-term illness than a chronic or long-term illness.	40 (13.4%)	198 (66.2%)	61 (20.4%)
Feeling weak, lightheaded, or faint are common symptoms of heart attack.	103 (34.4%)	63 (21.1%)	133 (44.5%)

*Percentages may not add up to 100 due to rounding; n= frequency

Knowledge of CVD risk factors in women

The mean knowledge score of women participants regarding CVD risk factors was 14.5 (SD ± 4.6; range 0 - 25). Half of the participants (50.2%) displayed poor knowledge, one-quarter (25.1%) exhibited moderate knowledge, and only 24.7% demonstrated good knowledge of CVD and its risk factors in women.

Although women exhibited reasonable knowledge about certain CVD risk factors, notable gaps in understanding existed for other factors, as indicated in Table 5.4. A significant portion (42.1%) was unaware that the risk of developing heart disease increases with age. Only a small percentage (7.0%) of women were aware that the likelihood of developing heart disease increases after menopause, and merely 10.4% of participants knew that taller individuals are at a higher risk of developing heart disease. Additionally, only slightly above half of the participants (54.8%) were aware that T2DM increases the risk of developing heart disease in the future, and 46.5% perceived stress as the most important cause of a heart attack. Lastly, participants demonstrated a lower level of knowledge regarding the association between diet and cardiovascular health (e.g. e. effects of polyunsaturated fat and trans fats on heart health: only 24.1% and 24.4% correct responses, respectively).

The majority of participants demonstrated knowledge in certain areas: 75.6% were aware that a positive family history of heart disease increases the risk for women in the future, 68.9% correctly identified that a woman has high blood pressure if her blood pressure is equal to or higher than 140/90 (systolic/diastolic), and 82.6% recognised that high blood pressure elevates the risk of developing heart disease. Additionally, a substantial number of participants accurately understood that maintaining blood pressure under control reduces a woman's risk of future heart disease (79.6%), and 73.9% recognised that high cholesterol increases the risk of heart disease. Furthermore, a significant proportion of women were aware that smoking raises the risk of heart disease (86.0%), and 75.3% correctly understood that ceasing smoking lowers a woman's risk of developing heart disease.

Most women were aware that being overweight or obese increases the risk of developing heart disease, regular physical activity lowers the chances of heart disease, and it is not mandatory to exercise at a gym or in an exercise class to reduce the risk of heart disease (86.6%, 86.0%, and 70.6%, respectively).

Table 5.4 *The participants' knowledge of CVD risk factors in women (n = 299)*

Statements	True *n* (%) *	False *n* (%)	I don't know *n* (%)
The chance of developing heart disease in women reduces after menopause.	21 (7.0%)	110 (36.8%)	168 (56.2%)
The older a woman is, the greater her chance of developing heart disease.	173 (57.9%)	62 (20.7%)	64 (21.4%)
A positive family history of heart disease puts women at higher risk of developing heart disease in the future.	226 (75.6%)	21 (7.0%)	52 (17.4%)
Taller people are at greater risk of developing heart disease.	31 (10.4%)	127 (42.5%)	141 (47.2%)
A woman has 'high' blood pressure if her blood pressure is 140/90 (systolic/diastolic) or higher.	206 (68.9%)	21 (7.0%)	72 (24.1%)
Most people would know if they had high blood pressure.	106 (35.5%)	107 (35.8%)	86 (28.8%)
High blood pressure increases the risk of developing heart disease in the future.	247 (82.6%)	18 (6.0%)	34 (11.4%)
Keeping blood pressure under control will reduce a woman's risk of developing heart disease.	238 (79.6%)	15 (5.0%)	46 (15.4%)
T2DM increases the risk of developing heart disease in the future.	164 (54.8%)	30 (10.0%)	105 (35.1%)
High cholesterol increases the risk of developing heart disease.	221 (73.9%)	18 (6.0%)	60 (20.1%)
If your 'good' cholesterol (HDL-C) is high, you are at higher risk of heart disease.	77 (25.8%)	89 (29.8%)	133 (44.5%)
Smoking increases the risk of developing heart disease.	257 (86.0%)	17 (5.7%)	25 (8.4%)

Statements	True *n* (%) *	False *n* (%)	I don't know *n* (%)
A woman who stops smoking will lower her risk of developing heart disease.	225 (75.3%)	32 (10.7%)	42 (14.0%)
Being overweight increases a woman's risk of developing heart disease.	259 (86.6%)	14 (4.7%)	26 (8.7%)
Regular physical activity will lower a woman's chance of developing heart disease.	257 (86.0%)	23 (7.7%)	19 (6.4%)
Only exercising at a gym or in an exercise class will lower a woman's chance of developing heart disease.	39 (13.0%)	211 (70.6%)	49 (16.4%)
Walking and gardening are considered exercise that will help lower a woman's chance of developing heart disease.	227 (75.9%)	25 (8.4%)	47 (15.7%)
The most important cause of heart attack is stress.	139 (46.5%)	87 (29.1%)	73 (24.4%)
Polyunsaturated fats are healthier for the heart than saturated fats.	72 (24.1%)	55 (18.4%)	172 (57.5%)
Trans fats are healthier for the heart than most other types of fats.	46 (15.4%)	73 (24.4%)	180 (60.2%)
Eating a lot of red meat increases the risk of heart disease.	110 (36.8%)	75 (25.1%)	114 (38.1%)
Eating a high-fibre diet does not affect a woman's risk of getting heart disease.	77 (25.8%)	101 (33.8%)	121 (40.5%)

*Percentages may not add up to 100 due to rounding; n= frequency

Knowledge of CVD risk factors according to the participants' sociodemographic and clinical characteristics

Table 5.5 presents the mean knowledge scores based on participants' sociodemographic characteristics. The study found statistically significant differences in knowledge scores based on participants' ethnicity ($p = 0.009$) and education level ($p = 0.007$). Participants with Southeast Asian/North Asian backgrounds had the highest mean knowledge score of 24.0 (SD ± 3.8), while participants with Australian backgrounds, including Australian Aboriginal/Torres Islander backgrounds, had the lowest knowledge level, with a mean score of 15.6 (SD ± 5.3). Participants with a bachelor's or postgraduate degree had the highest level of knowledge compared to other groups, with a mean score of 16.9 (SD ± 5.5).

Table 5.5 *Knowledge of CVD risk associated with complications of pregnancy according to participants' sociodemographic characteristics (n = 299)*

	n	Knowledge Score Mean±SD	F	*p*
Age [a]				
< 25	13	15.0 ± 5.3		
25–35	190	16.1 ± 5.9	0.73	0.479
> 35	96	16.8 ± .6		
Ethnicity [a]				
Australian including Australian Aboriginal/Torres Islander	175	15.6 ± 5.3		
North African/Middle Eastern/Sub Saharan African	71	16.6 ± 5.3	3.43	0.009
European/British/Irish	25	18.0 ± 6.3		
New Zealander	24	16.0 ± 5.4		
Southeast Asian/North Asian	4	24.0 ± 3.8		
Education [a]				
Primary or Secondary Schooling	22	13.7 ± 6.1		
Certificate or Diploma	97	15.4 ± 5.6	5.05	0.007
Bachelor's or Postgraduate Degree	180	16.9 ± 5.5		
Financial Situation [a]				
Excellent	15	18.3 ± 6.7		
Good	213	16.0 ± 5.3	1.00	0.406
Fair	65	16.6 ± 5.6		
Poor	6	16.0 ± 6.9		
Marital Status [a]				
Single/Never married	17	14.1 ± 5.0		
Married	234	16.5 ± 5.6	1.74	0.158
De facto	40	15.2 ± 4.5		
Divorced/Separated	8	17.5 ± 5.9		

[a]: One-Way ANOVA; n=frequency; SD=standard deviation

Table 5.6 illustrates participants' knowledge of CVD and its associated risk factors based on their clinical characteristics. Significant differences in knowledge scores were observed only in relation to participants' smoking status ($p = 0.010$), where current smokers exhibited a lower understanding of CVD risk factors. No statistically significant differences in knowledge scores were found concerning sociodemographic factors or other CVD risk factor profile, including BMI ($p = 0.566$), physical activity ($p = 0.910$), high blood pressure ($p = 0.342$), diabetes ($p = 0.643$), hyperlipidemia ($p = 0.940$), and family history of CVD ($p = 0.202$).

Table 5.6 *The mean knowledge score of participants according to their sociodemographic and clinical characteristics (n = 299)*

	n	Knowledge Score Mean ± SD	F	*p*
BMI [a]				
Underweight	3	19.7 ± 8.9		
Normal weight	136	16.5 ± 5.4		
Overweight	101	16.0 ± 5.1	0.67	0.566
Obese	59	15.9 ± 6.0		
Smoking status [b]				
Current smoker	12	11.3 ± 6.3	10.65	0.010
Currently not smoker	287	16.4 ± 5.3		
Physical activity [a]				
Moderate physical activity at least 150 minutes per week	23	15.1 ± 7.9		
Moderate physical activity less than 150 minutes per week	270	16.4 ± 5.2	2.41	0.910
Little or no physical activity	6	12.0 ± 2.6		
High blood pressure [a]				
Diagnosed with high blood pressure	118	16.1 ± 5.5		
Not diagnosed with high blood pressure	144	16.0 ± 5.6	1.07	0.342
Did not know about blood pressure status	37	17.4 ± 4.8		
Diabetes [a]				
Diagnosed with diabetes	70	15.7 ± 4.8		
Not diagnosed with diabetes	111	16.3 ± 5.6	0.44	0.643
Did not know about blood sugar level status	118	16.4 ± 5.7		
Hyperlipidaemia [a]				
Diagnosed with hyperlipidaemia	18	15.9 ± 4.3		
Not diagnosed with hyperlipidaemia	141	16.3 ± 5.4	0.62	0.940
Did not know about blood cholesterol level	140	16.2 ± 5.5		
Family history of CVD [b]				
Positive family history	34	15.1 ± 5.4	1.63	0.202
Negative family history	265	16.4 ± 5.5		

[a]: One-Way ANOVA; [b] t-test; n= frequency; SD= Standard deviation

Participants' knowledge of CVD risk associated with complications of pregnancy

Above half of the participants were unaware or not sure that women with high blood pressure during pregnancy are at increased risk of developing high blood pressure in the future, and being diagnosed with high blood pressure during pregnancy could have adverse effects on women's hearts in the future (53.2% and 67.9%, respectively). Similarly, 55.9% of participants were unaware or not sure that women with diabetes during pregnancy are more likely to develop diabetes in the future, and 77.6% did not know or were not sure that these women are also at a higher risk of developing heart disease in the future. Table 5.7 outlines participants' knowledge of the CVD risks associated with pregnancy complications.

Table 5.7 *The participants' knowledge of CVD associated with complications of pregnancy (n = 299)*

Statements	True *n* (%) *	False *n* (%)	I don't know *n* (%)
Women who have been diagnosed with high blood pressure during their pregnancies are more likely to have high blood pressure in the future.	140 (46.8%)	35 (11.7%)	124 (41.5%)
Being diagnosed with high blood pressure during pregnancy has no effect on a woman's heart in the future.	28 (9.4%)	96 (32.1%)	175 (58.5%)
Women who have had diabetes in pregnancy are more likely to develop diabetes in the future.	132 (44.1%)	62 (20.7%)	105 (35.1%)
Women who have had diabetes in pregnancy are more likely to develop heart disease in the future.	67 (22.4%)	67 (22.4%)	165 (55.2%)
Women who have had miscarriage(s) are at higher risk of developing heart disease in the future.	22 (7.4%)	95 (31.8%)	182 (60.9%)
Having a history of stillbirth does not affect a woman's heart in the future.	50 (16.7%)	56 (18.7%)	193 (64.5%)

*Percentages may not add up to 100 due to rounding; n=frequency

As presented in Table 5.8, 39.8% of participants reported having high blood pressure (≥ 140/90), 12.4% were not sure if their blood pressure was within the normal range, and 47.5% did not have their blood pressure checked regularly.

Table 5.8 *Blood pressure profile, awareness, and management among the participants (n = 299)*

	Frequency	Percentage
Diagnosed with hypertension	118	39.8%
Did not know if their blood pressure was normal	37	12.4%
Had regular blood pressure checks	157	52.5%

Among the participants, 23.4% reported being diagnosed with diabetes, 1.0% were unsure of their blood sugar levels, and merely 25.8% had undergone blood sugar level checks in the past 12 months (Table 5.9).

Table 5.9 *Blood sugar profile, awareness, and management among participants (n = 299)*

	Frequency	Percentage
Diagnosed with diabetes	70	23.4%
Did not know if their blood sugar level was within normal range	3	1.0%
Had blood sugar level checked within the last 12 months	77	25.8%

As shown in Table 5.10, 6.0% of participants reported having high blood cholesterol level, 26.8% were unaware if their blood cholesterol level was within normal range (< 5 mmol/L), and a considerable number of women (30.1%) reported that they did not have their blood cholesterol level checked within the past 12 months.

Table 5.10 *Blood cholesterol profile, awareness, and management among participants (n = 299)*

	Frequency	Percentage
Diagnosed with high blood cholesterol	18	6.0%
Did not know if they had high blood cholesterol level	80	26.8%
Had blood cholesterol level checked within the last 12 months	209	69.9%

Conclusion of the chapter

This chapter has presented the findings of the women's study, revealing that the women participants faced an increased risk of CVD due to a history of complications during pregnancy, as well as other CVD risk factors. However, the study also highlighted a significant knowledge gap regarding CVD risk factors among these women, including the association between a history of pregnancy complications and CVD risk. In the following chapter, the results of the healthcare providers' study will be presented.

Chapter Six: Results of the Healthcare Providers' Study

Introduction to the chapter

In the previous chapter, the findings of the women's study were discussed. This chapter shifts focus to the results of the healthcare providers' study, beginning with a description of the sociodemographic and practice characteristics of the healthcare providers participating in this study. The chapter then explores the healthcare providers' knowledge of CVD risk factors in women, including the risk associated with complications of pregnancy. Finally, the chapter presents the healthcare providers' management of CVD risk in women with a history of pregnancy complications.

Sociodemographic and practice characteristics of the participants

As presented in Table 6.1, 397 complete surveys were analysed from the 434 healthcare providers who participated in the survey. The average age of participants was 46.1 years (SD ± 9.2; range 23-71), with 69.0% being female. The most common qualification among participants was that of a general practitioner (44.3%), with midwives comprising the second-largest group (30.7%). Most participants acquired their qualifications from an Australian university (82.1%) and had more than 10 years of practice experience (51.1%). Participants were employed in both in-patient and out-patient settings, as well as private and public healthcare facilities.

Table 6.1 The *healthcare providers' sociodemographic and practice-related information (*n *= 397)*

Sociodemographic	**Frequency**	**Percentage***
Age group (range 23–71)		
20–30	22	5.5%
31–40	94	23.7%
41–50	141	35.5%
51–60	126	31.7%
> 60	14	3.5%
Gender		
Female	274	69.0%
Male	123	31.0%
Qualification		
Obstetrician and gynaecologist	86	21.7%
Cardiologist	13	3.3%
General practitioner	176	44.3%
Midwife	122	30.7%
Country of obtaining qualification		
Australia	326	82.1%
United Kingdom	25	6.3%
Iran	25	6.3%
India	10	2.5%
New Zealand	6	1.5%
China	2	0.5%
Other	3	0.8%
Years of practice		
< 10 years	194	48.9%
11–20 years	168	42.3%
> 21 years	35	8.8%
Current area of practice		
Only public hospitals	99	24.9%
Only private hospitals	60	15.1%
Ony private clinics	112	28.2%
Both public and private hospitals	114	28.7%
Both private hospitals and private clinics	3	0.8%
All areas	9	2.3%

* Percentages may not add to 100 due to rounding.

Participants' knowledge of CVD risk factors in women

The median knowledge score among the healthcare providers on CVD risk factors was 8.0 (Interquartile Range (IQR) = 6.0- 9.0). Of the participants, 13.5% displayed poor knowledge, 26.8% exhibited moderate knowledge, and 59.7 % demonstrated good knowledge of CVD and its risk factors in women.

A significant majority of participants (75.3% - 82.4%) were aware of key factors contributing to heart disease risk in women, including family history, diabetes, physical activity, and the importance of monitoring waist circumference, BMI, and pregnancy history.

While the healthcare providers exhibited reasonable knowledge of the mentioned CVD risk factors, significant knowledge gaps were evident in other areas, including menopause, dyslipidemia, HDL-C, LDL-C, TG, NHDL-C levels, and the impact of drinking alcohol with high blood pressure (Table 6.2). More than half of the participants (50.6%) were either unsure or did not know if antioxidant supplements could help in preventing CHD among women, and 59.9% of participants were uncertain or lacked knowledge that estrogen and progestin are not recommended for the prevention of CHD in women.

Furthermore, 68.0% of the participants either did not believe in or were uncertain about the effectiveness of the available programs and treatments in reducing the risk of CVD in high-risk women. Table 6.2 presents the participants' knowledge of CVD risk factors.

Table 6.2 *The healthcare providers' knowledge of CVD risk factors in women (*n *= 397)*

Statements	**True**	**False**	**I don't know**
	n **(%) ***	***n*** **(%)**	***n*** **(%)**
After menopause, women are at the same risk of developing CHD as men.	200 (50.4%)	171 (43.1%)	26 (6.5%)
A family history of CHD increases the risk of developing heart disease.	319 (80.4%)	67 (16.9%)	11 (2.8%)
Diabetes is a stronger risk factor for developing CHD in women than men.	318 (80.1%)	47 (11.8%)	32 (8.1%)
Dyslipidaemia is a risk factor for developing CVD in women, similar to men.	195 (49.1%)	152 (38.3%)	50 (12.6%)
Blood pressure should be kept below 120/80 to reduce the risk of CHD in women.	238 (59.9%)	93 (23.4%)	66 (16.6%)
Women with high blood pressure should not drink more than one standard alcohol drink per day.	280 (70.5%)	78 (19.6%)	39 (9.8%)
To reduce the risk of CHD, women should be encouraged to do at least 150 minutes of moderate physical activity per week.	304 (76.6%)	47 (11.8%)	46 (11.6%)
Regular monitoring of waist circumference and BMI is important in women at high risk of CHD.	299 (75.3%)	46 (11.6%)	52 (13.1%)
A detailed pregnancy history should be considered as part of CVD risk assessment in women.	327 (82.4%)	35 (8.8%)	35 (8.8%)
Antioxidant supplements can help prevent CVD among women.	196 (49.4%)	104 (26.2%)	97 (24.4%)

Statements	True *n* (%) *	False *n* (%)	I don't know *n* (%)
Prescribing estrogen and progestin is recommended for prevention of CHD in women.	156 (39.3%)	159 (40.1%)	82 (20.6%)
In women, LDL-C should be maintained at less than 1.8 mmol/L.	153 (38.5%)	43 (10.8%)	201 (50.6%)
In women, the target HDL-C is more than 2.0 mmol/L.	98 (24.7%)	69 (17.4%)	230 (57.9%)
In women, the target TG is less than 2.0 mmol/L.	92 (23.2%)	67 (16.9%)	238 (59.9%)
In women, NHDL-CL should be maintained at less than 3.5 mmol/L.	118 (29.7%)	32 (8.1%)	247 (62.2%)
The available programs and treatments are ineffective in reducing the risk of CVD in women.	167 (42.1%)	127 (32.0%)	103 (25.9%)

* Percentages may not add to 100 due to rounding; n=frequency

Participants' knowledge of CVD risk associated with complications of pregnancy

The median knowledge score of the healthcare providers on CVD risk associated with complications of pregnancy was 8.0 (IQR = 6.0 – 10.0). About half of the participants (48.9%) displayed poor knowledge, 32.6% exhibited moderate knowledge, and only 18.5% demonstrated good knowledge of CVD risk associated with complications of pregnancy.

A minority of participants were aware of certain correlations between the risk of CHD and factors such as a history of miscarriage, number of miscarriages, and early miscarriage (Table 6.3). Only 53.9% accurately knew that a history of induced abortion does not increase the risk of CHD in women. Less than half (46.6%) were aware of the elevated stroke risk in women with a history of stillbirth. Additionally, only 58.2% knew that women with a history of HDP should be recommended low-dose aspirin to reduce their future CHD risk.

Despite these gaps, healthcare providers demonstrated understanding of certain CVD risks associated with pregnancy complications. For instance, they recognized the increased risk of T2DM or CHD among women with a history of GDM, and the greater risk of hypertension among those with a history of gestational hypertension or pre-eclampsia. A significant proportion (80.1%) knew that women with a history of hypertension in pregnancy or GDM should avoid or discontinue smoking. Additionally, most participants (72.3%) were aware of the need for close monitoring and treatment of modifiable risk factors in women with specific pregnancy complications (Table 6.3).

Table 6.3 *The healthcare providers' knowledge of CVD risk associated with complications of pregnancy (*n *= 397)*

Statements	**True** *n* **(%) ***	**False** *n* **(%)**	**I don't know** *n* **(%)**
Women with a history of miscarriage are at greater risk for developing CHD in the future.	159 (40.1%)	155 (39.0%)	83 (20.9%)
The risk of stroke is higher in women with a history of miscarriage.	129 (32.5%)	167 (42.1%)	101 (25.4%)
There is no relationship between the number of miscarriages and future risk of CHD in women.	170 (42.8%)	136 (34.3%)	91 (22.9%)
There is no relationship between early or late miscarriage and future risk of CHD in women.	162 (40.8%)	146 (36.8%)	89 (22.4%)
Having a history of induced abortion increases the risk of developing CHD in women in the future.	93 (23.4%)	214 (53.9%)	90 (22.7%)
The risk of developing stroke increases in women with a history of stillbirth.	185 (46.6%)	134 (33.8%)	78 (19.6%)

Statements	True *n* (%) *	False *n* (%)	I don't know *n* (%)
The risk of developing T2DM is higher among women with a history of GDM.	336 (84.6%)	55 (13.9%)	6 (1.5%)
Women with a history of GDM are more likely to develop CVD in the future.	289 (72.8%)	66 (16.6%)	42 (10.6%)
GDM increases the risk of future CHD in women.	318 (80.1%)	44 (11.1%)	35 (8.8%)
The risk of future hypertension is higher in women with history of gestational hypertension or pre-eclampsia.	342 (86.1%)	52 (13.1%)	3 (0.8%)
Women with a history of HDP should take a low dose of aspirin to reduce their future risk of CHD.	231 (58.2%)	96 (24.2%)	70 (17.6%)
Women with a history of hypertension in pregnancy or GDM should completely avoid or stop smoking.	318 (80.1%)	51 (12.8%)	28 (7.1%)
Women with a history of specific complications in pregnancy need to be monitored closely for asymptomatic CHD and treated for modifiable risk factors.	287 (72.3%)	55 (13.9%)	55 (13.9%)

* Percentages may not add to 100 due to rounding; n=frequency

Participants' knowledge of CVD risk based on their sociodemographic and practice characteristics

Table 6.4 presents the median knowledge scores of participants based on their sociodemographic and practice characteristics. A statistically significant difference in knowledge scores was noted based on participants' qualifications ($p < 0.001$), with cardiologists achieving the highest median score of 28.0 (IQR = 26.0 – 29.0). However, there were no statistically significant differences in knowledge scores with respect to participants' age ($p = 0.238$), gender ($p = 0.270$), country of qualification ($p = 0.486$), or years of practice ($p = 0.589$).

Table 6.4 *The median knowledge scores of healthcare providers based on sociodemographic and practice characteristics (*n *= 397)*

	Frequency	Knowledge Score Median (IQR)	*p*
Qualification [a]			
Obstetrician and gynaecologist	86	17.0 (15.0–19.0)	< 0.001
Cardiologist	13	28.0 (26.0–29.0)	
General practitioner	176	15.0 (13.0–17.0)	
Midwife	122	14.0 (11.0–17.0)	
Gender [a]			
Female	274	150 (13.0–18.0)	0.270
Male	123	16.0 (14.0–18.0)	
Age [b]			
20–30	22	13.0 (10.0–17.0)	0.238
31–40	94	16.0 (13.0–18.0)	
41–50	141	16.0 (13.0–17.0)	
51–60	126	16.0 (13.8–18.0)	
> 60	14	17.0 (14.0–19.5)	
Country of obtaining qualification [a]			
Australia	326	16.0 (13.0–18.0)	0.486
United Kingdom	25	14.0 (10.0–19.0)	
Iran	25	16.0 (13.0–17.5)	
India	10	14.0 (13.0–15.0)	
New Zealand	6	17.5 (11.3–19.0)	
China	2	13.0 (9.0–13.0)	
Other	3	19.0 (13.0–19.0)	
Years of practice [a]			
< 10 years	194	16.0 (13.0–18.0)	0.589
11–20 years	168	16.0 (13.0–18.0)	
> 21 years	35	16.0 (13.0–18.0)	

[a]: Kruskal Wallis test, [b] Mann-Whitney U test

Management of CVD risk in women with complications of pregnancy

The median score for the management of CVD risk in women with complications of pregnancy across all participant groups was 20 (IQR =10 – 30). Among the participants, 54.9% exhibited poor management of CVD risk in women, 24.9% demonstrated moderate management, and 20.2% reported good practice in managing CVD risk in women. Only a small proportion of healthcare providers agreed or strongly agreed that they frequently assess the risk of CVD in women with a history of pregnancy complications (32.2%). Similarly, a modest percentage expressed confidence in assessing the CVD risk in such women (43.8%), and a minority reported discussing the risk of CVD with women who have experienced pregnancy complications (31.0%). Only 44.6% of the healthcare providers agreed or strongly agreed that they often refer these women to appropriate practitioners/specialists for a comprehensive assessment and management of the risk. Additionally, only 55.2% acknowledged taking measures to reduce the CVD risk in women with a history of complications during pregnancy (55.2%). However, most participants (90.5%) disagreed or strongly disagreed with the notion that it is not their responsibility to assess, refer, or manage the CVD risk in women with complications of pregnancy (Table 6.5)

Table 6.5 *The healthcare providers' management of CVD risk in women with complications of pregnancy (*n *= 397)*

	Strongly disagree *n* (%) *	**Disagree *n* (%)**	**Neither agree nor disagree *n* (%)**	**Agree *n* (%)**	**Strongly agree *n* (%)**
I frequently assess the risk of CVD in women with specific complications of pregnancy.	6 (1.5%)	153 (38.5%)	110 (27.7%)	93 (23.4%)	35 (8.8%)
I am confident in assessing the risk of CVD in women with complications of pregnancy.	9 (2.3%)	106 (26.7%)	108 (27.2%)	143 (36.0%)	31 (7.8%)
I often discuss with women who have a history of complications of pregnancy about their risk of CVD.	7 (1.8%)	137 (34.5%)	130 (32.7%)	100 (25.2%)	23 (5.8%)
I often refer these women to an appropriate practitioner/specialist for detailed assessment and management of the risk.	4 (1.0%)	79 (19.9%)	137 (34.5%)	152 (38.3%)	25 (6.3%)
I take actions to reduce the CVD risk in women with a history of complications of pregnancy.	4 (1.0%)	59 (14.9%)	115 (29.0%)	188 (47.4%)	31 (7.8%)
It is not my role to assess, refer, or manage CVD risk in women with complications of pregnancy.	115 (29.0%)	244 (61.5%)	15 (3.8%)	18 (4.5%)	5 (1.3%)

* Percentages may not add to 100 due to rounding; n=frequency

Correlation between knowledge level and management of CVD risk

A statistically significant positive correlation was identified between knowledge of CVD risk and risk factors and CVD risk management ($p < 0.001$). However, the degree of association was weak, as indicated by a correlation coefficient of 0.244.

Conclusion of the chapter

This chapter has presented the findings of the study conducted among healthcare providers. The results underscore a notable gap in knowledge, awareness, and the management of CVD risk among the participants. This deficit in both knowledge and practice holds potential implications for the early identification and effective management of CVD risk in high-risk women, particularly those with a history of pregnancy complications. The following chapter will thoroughly examine and discuss the results derived from both the Women's Study and the Healthcare Providers' Study.

Chapter Seven: Discussion of the results

Introduction to the chapter

Chapters Five and Six of this thesis presented the results of surveys conducted on women with a history of pregnancy complications and healthcare providers, respectively. In this chapter, the main findings of the study and their implications are examined and discussed in relation to the research objectives, relevant literature, and the study's theoretical framework. Firstly, it analyses the implications of these findings on enhancing the management of CVD risk among women who have encountered pregnancy complications such as pregnancy loss, HDP, and GDM. Subsequently, it deliberates on how this thesis contributes to improving healthcare providers' awareness, management, and treatment of CVD risk among women with a history of pregnancy complications.

Women's awareness of CVD risk

In this study, women with a history of pregnancy complications exhibited a significant gap in their knowledge of CVD risk and related factors. This finding is particularly important as these women are young and in reproductive years, yet at high risk for developing CVD. There is a lack of evidence regarding the awareness of CVD risk among women with a history of pregnancy complications. However, previous studies assessing the knowledge of women, in general, on CVD risk have also identified a considerable knowledge gap. In Canada, Norris et al. (2020) reported that only 28% of women were aware that heart disease and stroke were the leading cause of death in women worldwide.

According to a study conducted by Cushman et al. in 2021, the overall awareness rate of heart disease as the leading cause of death in the US was 65% in 2009, but it decreased to 44% in 2019. This decrease in awareness was particularly significant among younger women.

In the US, a study conducted among young women aged 15–24 years old found that only 10% of participants identified heart disease as the leading cause of death for women (Gooding et al., 2019).

Recent surveys conducted among women from different populations have also revealed that awareness levels regarding CVD as the leading cause of death in women are suboptimal. For instance, in the United Arab Emirates, only 4% of women were aware of CVD as the leading cause of death, whereas in Korea and Chile, the figures were 7.6% and 14.4%, respectively (Khan & Ali, 2017; Kim et al., 2022; Varleta et al., 2020). These findings have implications for developing interventions aimed at increasing women's knowledge and understanding of CVD risk. Raising awareness of heart disease as the leading cause of death among women can be a crucial step towards adopting CVD preventive measures (Monsuez et al., 2017).

The results of the current study align with those of a cross-sectional study conducted in Australia in 2017, which revealed that breast cancer was the most frequently cited cause of death by men and women who participated in the survey, followed by cancer and heart disease (Hoare et al., 2017). Similarly, other studies reported that Emirati women (31.2%), Chilean women (22.7%), and young American women aged 15–24 years (18.7%) listed breast cancer as the leading health concern for women (Gooding et al., 2019; Khan & Ali, 2017; Varleta et al., 2020). A nationwide survey in Korea found that 60.6% of the participants believed that cancer was the leading cause of death in women (Kim et al., 2022). Collectively, previous studies indicate that women under the age of 45 are more likely to cite breast cancer as the leading cause of death, compared to older women who are more likely to associate heart disease as the leading cause of death (Ramachandran et al., 2016). These reports, including the results of the current study, underscore the importance of enhancing awareness regarding CVD as the leading cause of death in women.

This study's results align with findings from the Women's Heart Alliance survey, which revealed that nearly 71% of women rarely discussed heart health with their physician, possibly due to insufficient knowledge about the silent and long-term nature of heart disease. Additionally, the study reported that 38% of participants experienced moments when they suspected heart issues, yet only one third of them sought medical attention (Bairey Merz et al., 2017).

One possible explanation for the low awareness of heart disease among participants in this study is the perception that heart disease is not a significant health issue among younger women of reproductive age. However, it is important to note that heart disease can affect people of all ages, and women with a history of complicated pregnancies are at a higher risk of developing CVD, often at a younger age than those without such history (Vahedi et al., 2020). Therefore, it is crucial to improve women's awareness of heart disease as a chronic and potentially silent condition that can affect anyone, including those in their reproductive age. This can encourage women to prioritise their heart health and seek medical attention when necessary.

Similar to the results of the current study, the Women's Heart Alliance report indicated that more than half of the participants were unaware of the signs of heart attack (Bairey Merz et al., 2017). However, the awareness of heart-attack symptoms among participants in this study was relatively better than that found in a survey of six European countries conducted by Daponte-Codina et al. (2022), where only a small proportion of women (15.4%) could recognise the most common symptoms of a heart attack apart from pain, such as dyspnea, unusual fatigue, dizziness, or weakness. Nevertheless, it is still important to enhance awareness of the signs and symptoms of heart attack and stroke. Early recognition and prompt medical attention can lead to better outcomes and reduce mortality and morbidity. Time-sensitive treatments such as percutaneous coronary intervention and thrombolysis can be critical in improving patient outcomes (Fang et al., 2019). Therefore, raising awareness about the symptoms of heart attack and stroke is crucial for women's health.

Knowledge of CVD risk factors among the women

The findings from the current study emphasise the critical importance of increasing awareness and knowledge about CVD risk factors among women. Having sufficient knowledge and awareness of these risk factors is vital, as it can impact adherence to preventive programs and interventions aimed at modifying these risk factors, ultimately reducing the risk of CVD incidence (Tedesco et al., 2015).

The current study and other research have demonstrated the low awareness among women regarding the link between menopause and heart disease, which underscores the importance of monitoring cardiovascular health during midlife. Early intervention strategies are crucial for reducing the risk of CVD, making midlife a critical period for educating women about this issue. To achieve this, it is essential to improve women's knowledge and understanding of CVD risk factors, allowing them to take preventive measures and make informed decisions about their health. Healthcare providers can play a critical role in educating women about CVD and its risk factors, particularly during menopause. By providing clear and concise information about the association between menopause and CVD risk factors, healthcare providers can empower women to make healthy lifestyle choices and reduce their risk of developing CVD (El Khoudary rt al.,2020). Ultimately, improving awareness and knowledge of CVD risk factors among women is key to preventing heart disease and improving cardiovascular health outcomes.

The findings of the current study (75.9%) align with Khan and Ali's research in the United Arab Emirates, where 63% of participants acknowledged the positive link between family history and future CVD (Khan & Ali, 2017). In contrast, Tedesco et al.'s investigation in Italy revealed that only about one-third of participants (31.5%) recognised family history as a risk factor for CVD (Tedesco et al., 2015). Additionally, a recent study by Varleta et al. in Chile indicated that only 8% of participants identified family history as a main risk factor for CVD (Varleta et al., 2020).

In the current study, participants demonstrated a relatively good understanding of the association between high blood pressure and CVD, which is consistent with the findings of Khan and Ali's study in the United Arab Emirates, where 62.7% of participants identified high blood pressure as a CVD risk factor (Khan & Ali, 2017). Conversely, Varleta et al. in Chile reported that only 22% of women in their study recognised high blood pressure as a primary cause of CVD (Varleta et al., 2020). High blood pressure stands out as a significant modifiable risk factor for developing CVD. According to Fuchs and Whelton (2020), high blood pressure ranks among the most crucial modifiable risk factors for CVD. Substantial evidence suggests that reducing blood pressure in hypertensive individuals can decrease mortality and CVD risk (Poznyak et al., 2022). Given that hypertension acts as an independent risk factor for CVD and can also interact with other risk factors to elevate the likelihood of CVD (Garcia et al., 2016), experts widely agree that the threshold for treating hypertension in individuals at risk of CVD should be lower (Stewart et al., 2017).

Slightly more than half of the participants (54.8%) in this study were aware of the association between T2DM and the increased risk of developing heart disease. This percentage is higher than what has been reported by other studies, such as 33.4% in the United Arab Emirates (Khan & Ali, 2017), 43% in the US (Bairey Merz et al., 2017), and 46.3% in Italy (Tedesco et al., 2015). Similarly, the study by Tedesco et al. (2015) in Italy found that 74.7% of participants identified high cholesterol as a risk factor for CVD. However, other studies have reported lower levels of awareness, such as 53.4% in the United Arab Emirates (Khan & Ali, 2017) and only 30% in the study conducted in Chile (Varleta et al., 2020). Khan and Ali (2017) in the United Arab Emirates also showed that 75.1% of participants recognised obesity as a risk factor for CVD, which was similar to the findings from the current study. However, the study in Chile by Varleta et al. (2020) found that only 36.0% of women identified obesity as a primary cause of CVD. The current study also found that 46.5% of participants believed that stress was the leading cause of heart attacks. This proportion is lower than the 63.3% reported in a study conducted in European countries (Daponte-Codina et al., 2022) but higher than the 26% reported in a study conducted in Chile (Varleta et al., 2020).

In terms of women's knowledge on the association between smoking and risk of heart disease, findings of the current study were like the survey conducted in Italy in which 89.4% of participants identified smoking as a risk factor for CVD (Tedesco et al., 2015). However, in the surveys conducted in the United Arab Emirates and Chile, a lower percentage of participants (37.4% and 32%, respectively) recognised the association between smoking and CVD (Khan & Ali, 2017; Varleta et al., 2020). Smoking has long been recognised as a major risk factor for CVD (Stewart et al., 2017), and no other personal choice has a more negative impact on cardiovascular health than smoking (Bhatnagar, 2017). Although the mechanisms by which smoking increases CVD risk are not fully understood, it seems to affect CVD independent of other risk factors (Bhatnagar, 2017). Stopping smoking is the single most cost-effective intervention in CVD prevention, and benefits can be seen within months of cessation (Eckel et al., 2014; Stewart et al., 2017). All guidelines recommend smoking cessation, and short- and long-term benefits can be observed regardless of the length or intensity of the smoking habit (Stewart et al., 2017).

In this study, there was a lower level of awareness among participants regarding the preventive role of a high-fibre diet in reducing the risk of heart disease. A high-fibre diet is associated with a reduced risk of CVD, likely due to its beneficial effects on lipid profiles, blood pressure, and inflammation (McRae, 2017). Therefore, it is crucial to improve awareness of the role of diet in reducing the risk of heart disease, particularly among women who are at an increased risk during menopause. Healthcare providers can play an important role in educating women about the importance of adopting a healthy lifestyle, including a diet rich in fibre, to reduce the risk of CVD.

As the majority of risk factors for CVD are preventable or controllable, it is crucial for women to have adequate knowledge about these factors to adopt healthy lifestyle behaviours and protect themselves from this disease (Yusuf et al., 2020). CVD risk management aims to keep these risk factors under control, and raising awareness among women is a crucial strategy in achieving this goal. As discussed in the theoretical framework of this study, knowledge is a prerequisite for behaviour change. Greater awareness about the disease can lead to better patient outcomes (Mukattash et al., 2012). Although knowledge alone is not sufficient for good health outcomes, it plays an important role in improving health literacy and empowering individuals to make informed decisions about their health (Mukattash et al., 2012).

In addition to knowledge, health beliefs are also important in predicting health behaviours (Mukattash et al., 2012; Simons-Morton et al., 2012). The Health Belief Model includes constructs such as perceived susceptibility, severity, benefits, barriers, self-efficacy, and exposure to cues to action (Chin & Mansori, 2019). According to this model, an individual's behaviour is influenced by their beliefs about health and their perception of how a particular action can lead to a desired outcome (Abraham C & Sheeran P, 2005; Champion & Skinner, 2008; Janz, 1988; Peltzer & Pengpid, 2018). Furthermore, an individual's perceived severity of a disease can also influence their willingness to take action to prevent or reduce its impact (Champion & Skinner, 2008; Chin & Mansori, 2019). If a person perceives a health issue as severe, they are more likely to take steps to protect their health. Therefore, interventions that aim to improve health beliefs and increase awareness of the severity of CVD risk may result in better adherence to healthy behaviours, ultimately reducing the incidence of CVD among women (Tovar & Clark., 2015).

Understanding the relationships between knowledge and health beliefs related to heart-disease risk is crucial in promoting adherence behaviours among adults at a higher risk of CVD, such as women with complications of pregnancy. As demonstrated in the study by Tovar and Clark (2015), health beliefs play a critical role in adherence to healthy behaviours, and knowledge has a significant influence on health beliefs. Therefore, it is important to investigate the impact of knowledge on health beliefs and adherence behaviours related to CVD risk reduction in these populations. This information can inform the development of effective interventions aimed at reducing CVD risk in women with complicated pregnancies and other high-risk populations.

It is important to acknowledge that participants in this study were from a higher socioeconomic background and were at a higher risk of developing CVD due to their obstetric history, which may suggest that knowledge of CVD risk factors could be even poorer among women from lower sociodemographic backgrounds. To effectively reduce the burden of CVD, it is crucial to improve health literacy related to CVD across all sociodemographic groups. As highlighted by Magnani et al. (2018), improving health literacy and promoting health education can help individuals better understand CVD risk factors, symptoms, and preventive measures, leading to improved health outcomes and reduced CVD burden. Therefore, interventions aimed at enhancing health literacy, particularly among high-risk populations, should be a top priority in reducing the burden of CVD.

The study found statistically significant differences between level of knowledge about CVD based on participants' ethnicity and educational levels. Southeast Asian/North Asian and European/British/Irish participants demonstrated greater knowledge about CVD and its risk factors compared to participants from other ethnicities. This finding contrasts with a study conducted by Cushman et al. (2021) in the US, which found that African American, Hispanic, and Asian women were significantly less knowledgeable about heart disease. Additionally, participants with higher levels of education, including those with bachelor's or postgraduate degrees, demonstrated greater knowledge and awareness of CVD and its risk factors than those with lower levels of education. Several studies have found a positive association between education and CVD knowledge. For example, studies conducted in Sub-Saharan Africa have reported that individuals with higher levels of education tend to have more knowledge about CVD and its risk factors (Aminde et al., 2017; Muhihi et al., 2020). Similarly, a cross-sectional survey conducted in Italy found that women with lower levels of education were less knowledgeable about CVD and its risk factors compared to those with higher levels of education (Tedesco et al., 2015).

Furthermore, a 2019 AHA national survey on women's awareness of CHD indicated that women with higher levels of education had greater awareness (Cushman et al., 2021). Educational inequality is an important socioeconomic factor contributing to CVD. Individuals with higher levels of education tend to have greater knowledge of the disease, healthier behaviours, better working conditions, and better access to healthcare (Kubota et al., 2017). On the other hand, individuals with lower levels of education tend to have more CVD risk factors such as obesity, smoking, physical inactivity, and hypertension (Schultz et al., 2018). Thus, educational achievement may affect health in various ways. In addition to education, poor health literacy has been associated with noncompliance with medical regimens and increased all-cause mortality (Schultz et al., 2018).

Women's knowledge of CVD risk associated with complications of pregnancy

Awareness of CVD risk is critical for its prevention, especially in young women who have experienced pregnancy complications that can affect their future cardiovascular health, and primary prevention offers considerable long-term advantages (Beussink-Nelson et al., 2022). To design and deliver effective educational initiatives for this high-risk population, existing research gaps must be addressed to better understand the current state of knowledge and perception of CVD risk among young women (Beussink-Nelson et al., 2022). Therefore, one of aims of this study was to assess participants' knowledge and awareness of CVD associated with complications of pregnancy.

The results revealed significant knowledge gaps among women regarding CVD risk factors, particularly concerning the association between HDP and future CVD. Compared to findings in other studies, participants in this study exhibited notably lower knowledge levels in this area (Beussink-Nelson et al., 2022; Burgess & Feliu, 2019; Hutchesson et al., 2018). For instance, a recent self-administered online survey adapted from the AHA found that 79.5% of participants who had experienced HDP correctly identified hypertension during pregnancy as a risk factor for CVD (Beussink-Nelson et al., 2022).

There is a dearth of comparable studies that have thoroughly investigated the knowledge of women with a history of pregnancy complications regarding CVD risks associated with their pregnancy complications. However, an online survey aimed at assessing women's self-reported knowledge of the association between pre-eclampsia and future CVD in two pre-eclampsia support groups on Facebook reported that approximately 60% of respondents were aware of this association (Burgess & Feliu, 2019).

Furthermore, an Australian study found that about two thirds of their participants with a recent history of pre-eclampsia had higher knowledge about the risk of future CVD risks (Hutchesson et al., 2018). Further, 96% of the respondents were aware of the higher risk of developing future hypertension, and 66% were knowledgeable about the increased risk of stroke (Hutchesson et al., 2018). In addition, a study in the US found a relationship between severity of complication of pregnancy and knowledge of CVD risk, in that CVD risk awareness was higher in women with severe pre-eclampsia (65%) and chronic hypertension (75%) compared with those with mild pre-eclampsia (43%) (Traylor et al., 2016).

Several studies have indicated that women who have had GDM are at an increased risk of developing T2DM and CVD later in life. However, there is limited research on women's knowledge and awareness of this association. The participants in this study exhibited a noticeably lower level of knowledge about the impact of GDM on their future cardiovascular health outcomes compared to two other studies (Beussink-Nelson et al., 2022; Zera et al., 2013). In a U.S. survey, 71.1% of participants with a history of GDM correctly identified it as a risk factor for CVD (Beussink-Nelson et al., 2022). In another U.S. study, 61% of participants accurately perceived themselves to be at high risk of developing T2DM within the next 10 years (Zera et al., 2013).

The low level of knowledge among women in the current study regarding the relationship between pregnancy complications and an increased risk of future CVD may be attributed to various factors. These include policies, practices, and guidelines that do not sufficiently emphasise education and recommendations about the impact of pregnancy complications on women's cardiovascular health.

Healthcare providers may have failed to discuss the potential consequences of pregnancy complications with women and how to manage the associated risks through lifestyle modifications and follow-up visits with their general practitioners. One possible reason for this lack of education and follow-up could be healthcare providers' unfamiliarity with existing guidelines on best practices for managing CVD risks related to pregnancy complications. In a survey conducted by Burgess and Feliu (2019), nearly 44% of women who gave birth after the AHA’s recommendation for follow-up after pre-eclampsia reported not receiving any counselling on lifestyle changes or follow-up visits after their diagnosis (Burgess & Feliu, 2019). Therefore, simply having guidelines in place may not be enough, and healthcare providers may require additional training to implement guidelines effectively. In addition to healthcare providers’ lack of familiarity with guidelines, financial, time, and resource constraints may also hinder women’s ability to receive appropriate CVD risk education and assessment. To improve CVD awareness, management, and prevention, there is a need for improved education for both women and healthcare providers, adherence to guidelines by healthcare providers, and allocation of adequate time and financial resources (Reiner et al., 2010).

Women’s CVD risk profile

The risk of developing CVD in the future was found to be higher in the women, and this increased risk was attributed to both traditional risk factors and the risks associated with a history of pregnancy complications. A detailed discussion of the women's CVD risk profile is presented in the following section.

Traditional CVD risk factors

The prevalence of high blood pressure among the participants in the current study (39.8%) was higher than international trends and the data reported for Australia. This is likely because the study participants had a history of complications during pregnancy, and many risk factors for these complications align with CVD risk factors including high blood pressure. In 2015, around 22% of adults aged 18 and over had high blood pressure, globally (WHO, 2022). In Australia, based on self-reported data from the 2020–21 National Health Survey, 23% of adults aged 18 and over had high blood pressure (Australian Institute of Health and Welfare, 2022d). High blood pressure is more prevalent in men than women until age 45, but after age

55, women have a higher prevalence than men (Isiadinso & Wenger, 2017). There is a gender difference in the effect of high blood pressure on the cardiovascular system, with women having a greater risk of acute MI associated with hypertension than men (Rørholm Pedersen et al., 2016). Furthermore, hypertension is a significant risk factor for stroke among women (Gorgui et al., 2014). Also, women are also more likely than men to develop left ventricular hypertrophy and heart failure because of hypertension (Gerdts et al., 2008; Wenger et al., 2018).

In addition, the prevalence of T2DM among the participants in the current study (38.5%) was higher than international trends and the data reported for Australia. This is likely due to their history of pregnancy complications, particularly GDM. T2DM reduces life expectancy by up to 10 years and is a leading cause of death and disability worldwide, especially among those with severe diabetes (Einarson et al., 2018). Diabetes is significantly associated with MI in both women and men and in all regions of the world (Einarson et al., 2018; Yusuf et al., 2004). However, it has a greater impact on women's cardiovascular health compared to men. A systematic review found that the incidence of CHD is 44% higher in women with diabetes than in men with the same condition (Peters et al., 2014).

Also, data from the UK Biobank showed that the increased risk of MI associated with diabetes was 29% higher in women than in men (de Jong et al., 2020), and the highest excess risk of cardiovascular events associated with T2DM was found in young women (age ≤ 40 years) with early-onset diabetes (Sattar et al., 2019). Moreover, women with diabetes are 3–7 times more likely to develop CHD compared to women without diabetes (Isiadinso & Wenger, 2017). The prevalence of diabetes among participants in this study was higher (23.4%) than the global trends and the data reported for Australia. In 2021, an estimated 6.5% of adults aged 18 and over had diabetes, internationally (International Diabetes Federation, 2021). In Australia, based on self-reported data from the 2020–21 National Health Survey, 5.5% of adults aged 18 and over had diabetes (Australian Institute of Health and Welfare, 2022a). This higher percentage of diabetes in the study is more likely due to vulnerability of the study participants to diabetes due to their history of GDM.

The prevalence of overweight or obesity (53.5%) among participants in this study was similar to the international trends but lower than the data reported for Australia. In 2016, 52% of adults aged 18 and over were overweight or obese, globally (WHO, 2022). In Australia, however, based on self-reported data from the 2020–21 National Health Survey, 66% of adults aged 18 and over were overweight or obese (Australian Institute of Health and Welfare, 2022e).

In the current study, only 11.4% of women reported a family history of CVD, a figure lower than those observed in other research. For instance, an analysis of the National Health and Nutrition Examination Survey in the US from 2007–2014 revealed that among young people (29–39 years old), about one in 3 cases of CVD could be attributed to a family history of premature heart disease (Moonesinghe et al., 2019). Similarly, a matched case–control study conducted in India reported that the prevalence of any family history of CVD and CHD in the control population was 24% and 21%, respectively (Chacko et al., 2020). This disparity raises the possibility of underreporting or uncertainty among participants regarding their familial history of CVD.

A positive family history is identified as a significant risk factor for CVD, with individuals having specific familial connections showing elevated chances of developing CVD. Studies indicate a 45% higher risk for those with a sibling history, 50% higher for those with a first-degree relative history of stroke, and a 70% higher risk for those with a parental history of heart failure (Kim, Kwon, Lee, et al., 2021; Mozaffarian et al., 2016). The Framingham Study further associates parental CVD with doubled risk in men and a 70% increased risk in women over eight years (Mozaffarian et al., 2016). This increased risk is attributed to genetic factors, as well as shared behavioral and environmental risk factors. Screening for high-risk individuals, especially asymptomatic young adults, is recommended to include inquiries about positive family history (Kim et al., 2021).

The study revealed that 6.0% of women had hyperlipidaemia, which is consistent with the reported data for Australia. In Australia, the prevalence of high cholesterol in 2017–2018 was 6.1% for all people (Australian Bureau of Statistics, 2018b). However, hyperlipidaemia is a well-known risk factor for CVD (Pirillo et al., 2021; Rørholm Pedersen et al., 2016). The levels of blood cholesterol and LDL-C increase dramatically in women within the first year postmenopause (Matthews et al., 2017), and elevated cholesterol has been found to be a significant risk factor for MI in women (Mortensen & Nordestgaard, 2020).

The findings of the present study indicated that 4.0% of participants smoked during the perinatal period, which is lower than the reported data for Australia. According to the Australian Institute of Health and Welfare report in 2019, the percentage of smoking in the first 20 weeks of pregnancy was 9.0% (Australian Institute of Health and Welfare, 2019a). Smoking during pregnancy is the most common preventable risk factor for pregnancy complications (Australian Institute of Health and Welfare, 2019a). It is associated with poorer outcomes for both the mother and infant/child, including preterm birth, low birth weight, long-term damage to the lungs and brain, and an increased risk of sudden infant death syndrome (SIDS). Furthermore, smoking during pregnancy can increase the risk of miscarriage, stillbirth, problems with the placenta, and pre-eclampsia for the mother (Australian Institute of Health and Welfare, 2019a; Australian Government Department of Health and Aged Care, 2021). Quitting smoking during pregnancy is crucial in reducing the risk of complications during pregnancy and birth, as well as reducing adverse health outcomes for the newborn. Even quitting smoking at later stages of pregnancy can still improve health outcomes for the baby, including improved fetal growth (Australian Institute of Health and Welfare, 2019a).

Furthermore, smoking is a significant modifiable risk factor for CVD, contributing to 10% of all CVD cases (Gallucci et al., 2020). Recent research indicates that mortality from CVD is nearly three times higher in current smokers compared to never smokers (Greenhalgh, 2022). According to a large Australian study using data up to 2015, smokers face an elevated risk of various CVD types, with 15% of all cardiovascular deaths in Australia attributable to smoking (Greenhalgh, 2022). Notably, women may be especially vulnerable to the adverse effects of smoking, exhibiting a 25% higher chance of developing CHD compared to men with equivalent exposure to tobacco smoke (Garcia et al., 2016).

The review of the CVD risk profile of the study participants suggests that the women in this study were at an increased risk of developing CVD in the future, not only due to a history of complicated pregnancy but also because of several other CVD risk factors. The study revealed that 43.1% of participants had at least one traditional CVD risk factor, 25.8% had at least 2 CVD risk factors, and 14.4% had 3 or more risk factors. Even one risk factor increases the risk of developing CVD, and the risk becomes greater when the number of risk factors increases. This is because these CVD risk factors are interrelated in such a way that they augment each other, leading to a higher risk of CVD (Najafipour et al., 2018).

CVD risk factors, such as obesity, smoking, high blood pressure, dyslipidaemia, and T2DM often coexist, particularly at older ages, and are thus likely to cluster in an individual (Wang et al., 2017). For instance, being overweight is frequently associated with other traditional risk factors, such as hypertension or dyslipidaemia (Holthuis et al., 2021). Previous studies in the general population have shown that the coexistence of 2 or more risk factors – that is, clustering – is linked to a higher risk of CVD (Holthuis et al., 2021).

In an Asia Pacific Cohort Studies Collaboration, which had a mean follow-up of 7 years and recorded 6,203 CVD events, the high blood pressure–smoking cluster had the highest hazard ratio for individuals with 2 risk factors: HR 4.13 (3.56 to 4.80) for Asia and HR 3.07 (2.23 to 4.23) for Australia and New Zealand. For individuals with 3 risk factors, the high blood pressure–smoking–cholesterol cluster had the highest HR: 4.67 (3.92 to 5.57) for Asia and HR 3.49 (2.69 to 4.53) for Australia and New Zealand. The corresponding population attributable fractions were 13% and 10%. Women's knowledge of the CVD risk associated with clusters is essential in engaging in risk-reducing behaviours to prevent CVD development (Peters et al., 2018). Although the history of complications of pregnancy cannot be reversed, some CVD risk factors such as hypertension, smoking, inactivity, obesity, and high blood glucose level are modifiable through adoption of healthy lifestyles and effective medical therapy to reduce the overall risk of CVD in women with a history of complications of pregnancy (Yusuf et al., 2020).

Complications of pregnancy as risk factors for developing CVD

Complications of pregnancy are relatively common, occurring in 10–20% of all pregnancies. Research has linked these complications to a 1.8–4.0-fold risk of later cardiovascular events, with the risk being higher in cases of more severe complications or when multiple pregnancies are affected (Cho et al., 2020). The AHA has recognised the increased risk of CVD in women with a history of pregnancy complications, and the 2011 guidelines for preventing CVD in women recommend that healthcare providers consider the history of pregnancy complications when assessing a woman's risk of CVD (Ranthe & Boyd, 2015).

Pregnancy loss

Pregnancy loss is a prevalent adverse outcome, affecting 12–24% of clinically recognised pregnancies (Wang et al., 2022). Research has established that women with a history of miscarriage and stillbirth are at greater risk of developing CVD than those without such complications (Liang et al., 2022; Wang et al., 2022). The risk of developing CHD in later life is higher in women with a history of miscarriage and stillbirth compared to those without these complications. This risk is further amplified in women with recurrent miscarriages, whether consecutive or not. Additionally, early miscarriage and the number of early miscarriages strengthen the association between miscarriage and CHD risk (Asgharvahedi et al., 2019).

In addition, women with a history of stillbirth have a higher risk of stroke and premature death compared to those without a history, and this risk appears to be independent of the established CVD risk factors (Asgharvahedi et al., 2019; Parker et al., 2014; Peters & Woodward, 2018). Women with repeated stillbirths (≥ 2) have an even higher risk for stroke compared to those with only one stillbirth experience (Liang et al., 2022). Furthermore, accumulating evidence suggests that pregnancy loss is associated with a higher risk of subsequent metabolic disorders, including T2DM, hypertension, and hyperlipidaemia, all of which are well-known risk factors for developing CVD (Horn et al., 2019; Wang et al., 2022).

Hypertensive disorders of pregnancy

According to the American College of Obstetricians and Gynecologists (2013), HDP is a leading cause of maternal mortality and morbidity globally, complicating 5–10% of all pregnancies worldwide (Sava et al., 2018). Studies suggest that having a history of HDP increases the risk of future cardiovascular events and mortality in women (Grandi et al., 2017; Watanabe et al., 2015). A recent review study suggested that women with pre-eclampsia, gestational hypertension, or even elevated systolic blood pressure alone during pregnancy are at an increased risk of developing myocardial infarction, heart failure, and stroke later in life (Vahedi et al., 2020). Women with a history of HDP are also more likely to have a premature death from cardiovascular disease (Vahedi et al., 2020). Furthermore, women with a history of HDP are more likely to develop type 2 diabetes mellitus and hypertension, which are strong risk factors for cardiovascular disease (Honigberg et al., 2019; Umesawa & Kobashi, 2017). The percentage of HDP in the current study was considerably higher than its global trend, which is related to the study population that included women with a history of pregnancy complications.

GDM has a prevalence ranging from 1–28%, with trends indicating a rise in prevalence in recent decades, reflecting the increase in obesity and type 2 diabetes mellitus within the general population (Di Cianni et al., 2018). Similar to HDP, the proportion of women experiencing GDM in the current study was higher than the global trends, which is attributed to the study population. A history of GDM increases the risk of developing metabolic syndrome and type 2 diabetes mellitus within the first decade after the index pregnancy (Hsu & Sheu, 2018; Newman et al., 2017). Type 2 diabetes mellitus is an independent risk factor for developing cardiovascular disease, and it is a stronger risk factor for developing cardiovascular disease in women than in men (Green, 2021). In addition, women with a history of GDM are at an increased risk of developing cardiovascular disease events in the years following the index pregnancy compared to women without such history, irrespective of developing type 2 diabetes mellitus (Asgharvahedi et al., 2022).

Therefore, it is crucial for women with a history of these complications to be aware of the implications of their obstetric history, including the increased risk of developing cardiovascular disease. This awareness can empower them to adopt preventive behaviours and modify other modifiable cardiovascular disease risk factors, ultimately reducing their risk of cardiovascular disease incidence.

Women's engagement in CVD risk-reducing behaviours

The current study found that women had suboptimal engagement in CVD risk-reducing behaviours. Awareness of high blood pressure and adherence to treatment are critical factors for blood pressure control (Unger et al., 2020; Williams et al., 2018). Several regional or country-specific hypertension treatment programs and guidelines exist, such as the 2018 European Society of Hypertension (ESH) and European Society of Cardiology (ESC) guidelines (Williams et al., 2018), and the 2020 International Society of Hypertension (ISH) guidelines (Unger et al., 2020; Zhou et al., 2019). However, recent studies have shown that there are differences in hypertension awareness, diagnosis, treatment, and control across different countries, and the economic status of countries is an important factor. For instance, Chow et al. (2013) found that only 46.5% of 57,840 individuals with hypertension were aware of their diagnosis, with the highest awareness being observed in upper-middle-income countries (52.5%) and the lowest in low-income countries (40.8%). Similarly, Zhou et al. (2019) analysed data from 526,336 participants aged 40–79 years who took part in 123 national health examination surveys from 1976–2017 in high-income countries, including Australia, and found significant differences in hypertension awareness by country and sex. The participants in the current study primarily came from a higher socioeconomic background and exhibited a high level of awareness regarding their blood pressure status (87.6%), which aligns with patterns observed in high-income countries. The level of awareness of blood pressure status among study participants in this present study is higher than what was reported by Chow et al. (46.5%). There could be several reasons for this, such as increased awareness and education about hypertension, easier access to healthcare services, or improved patient–provider communication. In recent years, healthcare providers have been encouraged to engage in clear communication with patients about their health status and to involve patients in developing their management plan (Kwame & Petrucka, 2021). This could have contributed to the higher level of awareness observed in the current study.

The current study found that only 52.5% of the participants had their blood pressure regularly checked, indicating a relatively low level of management behaviour for the condition. Despite this, the results are still better than those reported in other countries. In a cross-sectional study of 2609 individuals from six European countries from November 2017 to March 2018, Daponte-Codina et al. (2022) reported that only 27.7% of women in their study reported having regular medical check-ups and engaging in hypertension control practices to prevent CVD. In another cross-sectional study of 1,100,507 participants from 44 low- and low-middle-income countries, Geldsetzer et al. (2019) found that only 73.6% of those with high blood pressure had ever had their blood pressure measured, and a mere 39.2% had been diagnosed with hypertension. In Iran, a cross-sectional study conducted among adults aged 20–69 years revealed that only 49.7% of individuals with hypertension were aware of their condition. Among those who were aware, 71.5% reported using medication. However, only 38.9% of those taking medication had their blood pressure under control (Mirzaei et al., 2020). Similarly, in China, a survey conducted among 4,632 participants aged 18–59 years with hypertension found that only 44.9% were aware of their condition. Among those who were aware, only 36.5% reported using hypertensive medications. Shockingly, only 24.3% of those taking medication had their blood pressure under control (Lv et al., 2018).

These findings emphasise the critical need to improve hypertension management practices globally, particularly in low- and middle-income countries where rates of hypertension awareness and control remain low. Despite some progress in hypertension awareness, diagnosis, treatment, and control, recent studies indicate that there is still a need for ongoing efforts to address the issue. This is especially important for low- and middle-income countries, where hypertension continues to be a major public health concern.

Targeted interventions and education programs can be effective in improving awareness and engagement in CVD risk-reducing behaviours, particularly among women who may be at higher risk for developing CVD. Enhancing awareness of hypertension and promoting regular blood pressure checks can play a critical role in identifying individuals with hypertension and facilitating access to appropriate treatment and management.

Overall, sustained efforts are needed to reduce the burden of hypertension and improve cardiovascular health outcomes worldwide. These findings underscore the urgent need for better hypertension awareness and management to mitigate the associated complications, including CVD. Healthcare systems should prioritise increasing the proportion of individuals who attain each step of the 4-step cascade of care: (1) having their blood pressure measured, (2) being diagnosed with hypertension, (3) receiving antihypertensive treatment, and (4) achieving blood pressure control (Geldsetzer et al., 2019). By enhancing hypertension care through the 4-step cascade, the burden of CVD and related conditions can be mitigated.

In the current study, almost all participants reported knowing if their blood sugar level was within the normal range or not. However, only one quarter of them had their blood sugar level checked within the last year. When compared to other studies, it can be concluded that the awareness of diabetes status among participants in this study was notably higher. For instance, a study in South Korea among adults aged 30 and over between 2007 and 2017 found an awareness rate of 72.3%, which remained unchanged over the study period. However, the treatment rate improved from 57.2% in 2007 to 63.5% in 2017, and the proportion of people with diabetes who managed to keep their blood sugar level under control increased from 41.1% in 2007 to 53.2% in 2017 (Shin, 2019). These findings suggest that while awareness of diabetes status may be high, there is still room for improvement in terms of regular blood sugar level checks and effective management of the condition.

In the US, a survey using data from the 2011–2016 National Health and Nutrition Survey found that approximately 30% of non-pregnant women of reproductive age with diabetes were unaware of their condition, and among women with diagnosed diabetes, 51.5% had uncontrolled diabetes (Azeez et al., 2019). Similarly, in China, which has the largest number of people with diabetes mellitus, a cross-sectional study reported that 58.4% of participants with diabetes mellitus were aware of their condition, but only 51.9% of them were receiving treatment, with a control rate of only 14.1% (Yue et al., 2016). These findings emphasise the need for increased awareness, early diagnosis, and effective management of diabetes, including regular blood sugar level checks, to reduce the burden of complications associated with the condition.

The higher awareness of diabetes status among participants in this study is likely due to their history of complications during pregnancy and prior diagnosis of GDM. However, despite this high level of awareness, only 25.8% of participants had their blood sugar level checked in the last 12 months, which is concerning given their increased risk of developing CVD. These findings highlight the need for greater engagement in screening and prevention behaviours among women with a history of GDM, especially given the increased risk of CVD associated with the condition. It is important for healthcare providers to emphasise the importance of regular blood glucose level checks and monitoring, and to provide resources and support to enable women to manage their CVD risk effectively (Takamine et al., 2021).

The prevalence of high blood cholesterol in this study was similar to national trends in Australia. However, the study revealed that a significant proportion of participants (26.8%) were unaware of their blood cholesterol level status, which is concerning as high blood cholesterol is a major risk factor for CVD. This finding is consistent with national data indicating that many Australians with high cholesterol may be unaware of their condition or not consider it a current and long-term health problem (Australian Bureau of Statistics, 2018b). Further, in this study, one third of participants reported not having their blood cholesterol level checked within the last 12 months, which may indicate a lack of engagement in screening and prevention behaviours. Comparing the results to other studies, the awareness rate of dyslipidaemia in the current study was higher than in Korea (Cho et al., 2017; Kim et al., 2021) but lower than in the US (Bucholz et al., 2018), which could be because the US study surveyed those with a family history of hypercholesterolemia who are expected to be more vigilant about this condition. Healthcare providers need to prioritise cholesterol screening and education on the importance of managing high cholesterol to prevent CVD.

In summary, the levels of knowledge and awareness regarding CVD risk, general risk factors, and those associated with pregnancy complications were found to be significantly inadequate among the women with a history of pregnancy complications in this study sample. The findings also revealed a considerable gap in their practice and management of CVD risk. These results underscore the urgent need to enhance the knowledge and awareness of women concerning the importance of early assessment, identification, and management of CVD risk in this high-risk population. Healthcare providers, who are often the first professionals to evaluate and educate women about potential future CVD risks (Roth et al., 2020), must possess adequate knowledge and confidence in applying their expertise (Greaves et al., 2020). The following section discusses the results of the healthcare providers' study on the knowledge and management of CVD risk in women with a history of complications during pregnancy.

Characteristics of the healthcare providers

Healthcare providers from various disciplines were recruited for this study, with the majority being general practitioners (44.3%). General practitioners play a critical role in identifying individuals at high risk, promoting healthy lifestyles, and implementing preventive measures across the population. In Australia, general practitioners are the frontline healthcare providers responsible for providing postnatal assessments and information to women during the first 6 weeks after delivery, particularly for those who have received antenatal care and labour services through the public system (Milroy & Frayne, 2022). The second-largest group of participants in this study comprised midwives. Midwives play a significant role in providing skilled, knowledgeable, respectful, and compassionate care for women. As the primary healthcare providers for women, midwives have the opportunity to promptly respond to, manage, and escalate situations by involving, collaborating with, and referring at-risk women to interdisciplinary teams (McEniery, 2021).

In this study, the majority of participants were female (69%), reflecting the female-dominated nature of midwifery. Additionally, women comprise around 50% of general practitioners and obstetricians in Australia (AHPRA, 2022; Australian Government Department of Health, 2017). Most participants had graduated from an Australian university (82.1%) and possessed over 10 years of work experience. A substantial portion of participants worked in both public and private hospitals, covering inpatient and outpatient settings.

Healthcare providers' knowledge of CVD risk factors in women

In this study, only 59.7% of participants exhibited good knowledge of CVD and its risk factors in women. Considering the complexity of CVD with multiple risk factors, it is crucial for healthcare providers to have a comprehensive understanding of these factors to effectively assess and manage CVD risk (Holthuis et al., 2021; Piepoli et al., 2016). To accurately assess and manage CVD risk, healthcare providers must also be aware of the target levels for each risk factor (Piepoli et al., 2016). Understanding these targets would enable healthcare providers to identify individuals who are at higher risk of CVD and initiate timely secondary prevention strategies to reduce the risk (Lloyd-Jones et al., 2010). Therefore, one of the objectives of this study was to assess the knowledge of CVD risk factors among healthcare providers as a first step toward identifying and managing CVD risk in women affected by pregnancy complications.

The study findings indicate a lack of sufficient knowledge among healthcare providers regarding risk factors for CVD. These results align with findings from other studies that have also reported inadequate awareness of CVD risk factors among healthcare providers. For example, a study conducted in Sri Lanka revealed that only 44.5% of physicians correctly identified the blood pressure targets for the general population as set by the AHA (Matthias et al., 2014). Similarly, a cross-sectional survey of primary care physicians in Croatia found that only 43.0% of physicians considered 120/80 mmHg or less as the optimal blood pressure for high-risk individuals (Reiner et al., 2010). In another study, only 57.7% of pharmacists were aware of the diagnostic cut-off point for hypertension in the general population (BP $\geq$ 140/90 mmHg), although the majority (97.6%) could classify hypertension as a CVD risk factor (Amadi et al., 2018). These findings highlight the need for increased education and training of healthcare providers regarding CVD risk factors to improve the management of CVD risk.

Although the participants in the current study had a higher level of knowledge about the cut-off point for blood pressure compared to other studies, the results still suggest significant knowledge gaps among healthcare providers regarding blood-pressure assessment and management. This is concerning because hypertension is a primary risk factor for the onset of CVD (Fuchs & Whelton, 2020), and effective treatments and health systems are available for diagnosis and management of high blood pressure (Patel et al., 2016). One of the major obstacles to blood-pressure control is the low level of knowledge and adherence to policies and guidelines among healthcare providers, which undermines the effective delivery of screening, diagnostic, preventive, and treatment programs (Patel et al., 2016). However, successful models of hypertension control in the US and Canada offer valuable lessons that suggest controlling hypertension is achievable by improving healthcare providers' knowledge and practices and monitoring the progress of blood pressure diagnosis and control among populations (Jaffe et al., 2013; McAlister et al., 2011). Hence, there is a pressing need to bridge the knowledge gaps among healthcare providers regarding blood-pressure assessment and management, given the significant health risks associated with uncontrolled hypertension. By building on successful models of hypertension control and improving healthcare providers' knowledge and practices, it is possible to achieve better diagnosis and control rates of high blood pressure and reduce the burden of CVD.

Additionally, the current study identified concerning knowledge gaps among healthcare providers regarding dyslipidaemia and its connection to CVD risk in women. These findings align with previous research by Amadi et al. (2018), indicating that only 13.1% of community pharmacists in their study were aware of the cut-off point for total cholesterol. These gaps in knowledge among healthcare providers are concerning, as dyslipidaemia is a modifiable risk factor for CVD, and effective management can prevent cardiovascular events (Amadi et al., 2018).

Therefore, efforts are needed to improve healthcare providers' knowledge and awareness of dyslipidaemia, its impact on CVD risk, and the recommended guidelines for lipid management in women. Yet the study conducted by Matthias et al. in Sri Lanka reported a relatively higher knowledge level among physicians (40.7%) regarding the normal level of LDL-C compared to the current study. However, in their study, only 21% of physicians were able to give the target at which treatment should commence for TG management, a finding that is similar to the results of the present study (Matthias et al., 2014). Similarly, a survey conducted in Croatia reported that only half of physicians knew that HDL-C < 1.2 mmol/L is a marker of increased CVD risk in women (Reiner et al., 2010).

The fact that a significant percentage of healthcare workers in the current study were not aware of the normal levels of HDL-C, LDL-C, and TG is concerning, indicating a lack of knowledge about these risk factors among various groups of healthcare providers. Although healthcare practitioners may be aware of the associations between lower HDL-C or higher LDL-C and TG with increased CVD risk, this knowledge alone, without knowing the cut-off values to initiate interventions, is not sufficient to manage the risk, resulting in these conditions remaining under-detected and under-treated (Matthias et al., 2014; Reiner et al., 2010). This is particularly concerning for high-risk individuals, including women with complications of pregnancy who are at childbearing ages and could benefit from early interventions and effective management of the risk (Vahedi et al., 2020). Efforts are needed to improve healthcare providers' knowledge and awareness of the normal levels of HDL-C, LDL-C, and TG and the recommended guidelines for their management in order to reduce the burden of CVD in the population, especially among high-risk groups.

In the current study, slightly over half of participants (50.6%) were not aware that antioxidant supplements may help prevent CVD among women. In contrast, the study in Sri Lanka found that the use of aspirin as an antioxidant compound was well-known among physicians who participated in the study, with over 80% knowing the correct dose and duration of aspirin for CVD prevention among higher-risk individuals (Matthias et al., 2014). Furthermore, a concerning aspect of the present study is that 39.3% of participants inaccurately believed that prescribing estrogen and progestin is recommended for preventing CHD in women. Incorrect information about specific treatments or management strategies from healthcare providers can lead to mistrust between patients and their healthcare providers (Gu et al., 2022; Huang et al., 2018). Trust is pivotal for an effective patient–physician relationship and is regarded as one of the primary factors influencing a patient's decision to choose and utilize various sources for accessing health-related information (Vega et al., 2011). Trust in healthcare providers has been associated with enhancements in patient–physician communication, adherence to treatments, and the maintenance of a healthy lifestyle (Huang et al., 2018).

Healthcare providers demonstrated a negative attitude or a lack of awareness towards CVD risk-reducing programs, a finding of concern that could influence the adoption of CVD prevention guidelines by clinicians and potentially impact outcomes in CVD prevention and management (Nieuwlaat et al., 2013). This result is consistent with prior research, suggesting that general practitioners tend to prioritise symptom-relieving drugs over preventive drugs and may experience uncertainty about prescribing preventive medicine (Hultberg & Rudebeck, 2012; Qadi et al., 2020; Virdee et al., 2013). Some healthcare providers have expressed concerns that prescribing medications for primary prevention may discourage patients from engaging in lifestyle modifications and may label healthy individuals with a diagnosis (Qadi et al., 2020; Virdee et al., 2013). Such negative attitudes among healthcare providers towards preventive measures are concerning and require close attention from curriculum developers and continuing education programs.

CVD is the leading cause of death in Australia and worldwide, and according to the WHO, over 75% of premature CVD cases are preventable. Addressing risk factors can help reduce the growing burden of CVD on both individuals and healthcare providers (Stewart et al., 2017). Utilising the recommendations of national and international guidelines for primary and secondary prevention of CVD is crucial to reducing mortality, morbidity, and burden of CVD globally (Qadi et al., 2019). Despite the existence of evidence-based recommendations and guidelines, the implementation of these guidelines remains suboptimal, particularly in middle- and low-income countries (Nieuwlaat et al., 2013). In Australia, general practitioners are crucial in implementing these guidelines, as they are responsible for the care of approximately 90% of the population (RACGP, 2018). However, a national cross-sectional survey of general practitioners in Australia identified a significant gap between evidence and practice in the management of individuals with CVD (Webster et al., 2009).

Webster et al. conducted a survey among 99 Australian general practitioners to determine the proportion of patients being screened, treated, and achieving targets based on current Australian CVD risk guidelines and overall or absolute CVD risk (Webster et al., 2009). According to their survey, blood pressure was not recorded for 13% of the sample, and antihypertensive medication was only prescribed to 8% of patients. Among patients who were already prescribed antihypertensive medication, only 59% were achieving target blood pressure. The survey also found that data on LDL-C levels were not available for 53% of patients who should have undergone lipid screening according to the guidelines, and only 41% of patients were prescribed a statin. Among patients already prescribed a statin, only 62% were achieving target LDL-C levels. Another study, based on data from several general practices in 4 Australian states and territories between 2015 and 2018, assessed the implications of the National Vascular Disease Prevention Alliance (NVDPA) guideline (Hespe et al., 2020). The study reported that 10.4% of the population had established CVD, 12.7% were clinically at high risk for CVD, and 45.2% were at intermediate-to-low risk. Among patients with established CVD, just over half (56.8%) had been prescribed the guideline-recommended treatments. Among patients at high risk of CVD, only 41.2% were prescribed recommended treatments for secondary prevention. Overall, the study found a considerable gap in implementing the guidelines by primary care providers (Hespe et al., 2020).

While the gap in guideline implementation and contributing factors vary between low-, middle-, and high-income countries, it is crucial for healthcare systems globally to address the lack of implementation of proven effective strategies (under-use) and inappropriate use of strategies with strong evidence against, or insufficient evidence for, their effectiveness and safety (over-use) (Nieuwlaat et al., 2013). Although a significant knowledge gap was noted in many aspects of cardiovascular health and risk factors among the healthcare providers in this study, some aspects showed a small gap in knowledge. For example, the majority of healthcare providers (80.4%) were aware of the positive association between family history of CHD and CVD risk. Similarly, in a cross-sectional study conducted in Nigeria among community pharmacists, 93.5% of participants were aware of the CVD risk associated with having a positive family history (Amadi et al., 2018). The slightly higher awareness of the association in the study by Amadi et al. compared to the present study could be due to the fact that only pharmacists participated in their study, whereas the current study was conducted among different groups of health professionals. In addition, 80.1% of participants in the present study knew that diabetes is a stronger risk factor for developing CHD in women than men, which is similar to the result reported by Amadi et al. where only 22.0% of community pharmacists were incorrect that men with diabetes have a higher risk of developing heart disease than women with diabetes (Amadi et al., 2018).

Additionally, the current study found that 76.6% of participants were aware of the recommendation that women should engage in at least 150 minutes of moderate physical activity per week to reduce the risk of CHD. This is a higher percentage than the study conducted by Matthias et al. (2014) in Sri Lanka, where only 58.5% of physicians were aware of this relationship. However, the fact that nearly one quarter of participants in the current study were still unaware of the recommended level of physical activity for cardiovascular health is a significant knowledge gap.

It is crucial for both the general public and healthcare providers to possess essential knowledge to mitigate the burden of CVD, which remains the leading cause of death. Additionally, a notable 75.3% of participants in the current study recognised the importance of regular monitoring of waist circumference and BMI in women at high risk of CHD. This level of awareness contrasts with findings from other studies indicating a knowledge gap among healthcare providers in this area. For example, Matthias et al. (2014) found that only 24.5% of physicians in Sri Lanka could identify the waist circumference cut-off specific for Asians. Similarly, in a survey conducted in Nigeria, only 25.6% of community pharmacists could identify the cut-off point for abdominal obesity in women (Amadi et al., 2018).

Healthcare providers' knowledge of CVD risk associated with complications of pregnancy

The results further indicated a significant lack of knowledge among healthcare providers regarding cardiovascular risk in women with complicated pregnancies, requiring attention, although the knowledge gap in some areas was relatively small. However, due to the scarcity of comparable research, it is challenging to draw direct comparisons between the results of this study and those of other studies. Currently, only a limited number of studies have explored the knowledge of healthcare professionals about CVD risk associated with various pregnancy complications, with a focus on individual complications of pregnancy (Gogineni et al., 2021; Roth et al., 2020; Wu et al., 2022). The findings from the present study underscore the necessity for healthcare providers to be educated about the potential CVD risks in women with a history of miscarriage and stillbirth, equipping them with the knowledge and skills to effectively manage these risks. This is crucial as these women constitute a high-risk population that necessitates prompt management of their CVD risk to prevent disease development.

Additionally, it is concerning that approximately 42% of participants either did not know or were unsure about the use of low-dose aspirin in women with a history of HDP to reduce their future risk of CHD. The use of low-dose aspirin is a well-established preventive measure for reducing the risk of cardiovascular events in individuals at high risk, including those with a history of HDP. Current guidelines recommend aspirin for primary and secondary prevention of CVD in high-risk individuals, and the use of low-dose aspirin has been endorsed by multiple professional organisations (Almalki et al., 2021; Eckel et al., 2014; Peters & Mutharasan, 2020). Women with a history of complications of pregnancy are considered a high-risk group and have been shown to benefit from low-dose aspirin as a preventive measure (Miller et al., 2019). Therefore, it is important for healthcare providers to have a clear understanding of the role of aspirin in preventing CVD in this population and to incorporate this knowledge into their clinical practice.

A significant proportion of healthcare workers in this study (85%) showed awareness of the link between gestational diabetes and future T2DM. However, a survey conducted by Schmitz et al. among practicing gynaecologists in Germany (n = 418) reported an even higher level of knowledge. In their study, 96% of the participating gynaecologists were aware that GDM was associated with an increased risk of developing T2DM in the mother (Schmitz et al., 2016).

Likewise, in the current study, a large proportion of participants (80.1%) knew that GDM increases the risk of future CHD in women. This result is similar to the finding of a study in the US, which reported that 87% of physicians practising in different specialities including internal medicine, family medicine, obstetrics, and cardiology were aware of the association between GDM and long-term CVD risk (Gogineni et al., 2021). Similarly, the results of an international online survey by Wu et al. showed that over 90% of healthcare providers who participated in the study were aware of the link between a positive history of hypertension and diabetes during pregnancy with atherosclerotic cardiovascular disease (ASCVD) (Wu et al., 2022).

The current study found that a high proportion of participants (86.1%) were aware of the increased risk of future hypertension in women with a history of gestational hypertension or pre-eclampsia. These findings are consistent with earlier studies that have reported similar results (Adekanle et al., 2015; Heidrich et al., 2013; Young et al., 2012). For example, a survey conducted in Germany among 500 obstetricians found that 87% of the clinicians were aware of the association between pre-eclampsia and the future risk of hypertension (Heidrich et al., 2013). Similarly, a survey in the US that recruited internists and obstetricians reported that most providers were aware of the association between pre-eclampsia and future risk of hypertension, with only 6% of obstetricians and gynaecologists and 17% of internists being unsure or incorrect about this association (Young et al., 2012).

Additionally, an Australian national survey found that 85% of healthcare providers were aware of the increased CVD risk associated with a history of pre-eclampsia and gestational hypertension (Roth et al., 2020). A study from a lower-to-middle-income country also yielded consistent results. Adekanle et al. conducted their research as part of a workshop at a teaching hospital in southwestern Nigeria. The majority of the participating healthcare professionals (87%) demonstrated knowledge about the association between pre-eclampsia and the risk of developing hypertension. Additionally, 63% were aware of the association between pre-eclampsia and coronary heart disease (CHD), while 69% were cognizant of the link between pre-eclampsia and future stroke (Adekanle et al., 2015).

Management of CVD risk in women with complications of pregnancy

Healthcare providers in this study exhibited an overall inadequate management of CVD risk in women with a history of pregnancy complications. This finding is troubling and consistent with previous research indicating a general lack of adherence to CVD guidelines among healthcare professionals. For example, a survey conducted by the Women's Heart Alliance (Bairey Merz et al., 2017) found that only 16% of primary care physicians and 22% of cardiologists implemented all eight of the American Heart Association's (AHA) recommendations for CVD risk assessment. These recommendations include discussing personal and family medical history (including history of hypertension, diabetes, high cholesterol, established heart disease, or previous stroke) as well as pregnancy complications that may further increase CVD risk (such as miscarriages, GDM, pre-eclampsia, or eclampsia). Other recommendations included asking about heart disease symptoms, smoking, diet, and physical activity habits, screening for depression among women with heart disease, conducting a physical examination that includes blood pressure, BMI, and waist circumference measurements, measuring cholesterol, TG, and sugar levels, calculating 10-year and lifetime heart-disease risk, and talking with women about their heart health (Bairey Merz et al., 2017).

However, a significant percentage of healthcare providers (90.5%) acknowledged that assessing, referring, or managing CVD risk in women with complications is part of their responsibility. Despite this recognition, their lack of action in assessing the risk of CVD in women with specific pregnancy complications is concerning, considering that identifying and assessing risk is the initial step in promoting health and preventing disease (Raingruber, 2014). Preventive measures, such as lifestyle modification, are essential in reducing the individual and societal burden of CVD (Geense et al., 2013). Healthcare providers, especially general practitioners who have frequent contact with patients, are capable of fulfilling this role and are perceived to be the most reliable formal source of information. By identifying patients at risk at an early stage, they can play a significant role in CVD prevention (Geense et al., 2013).

However, many healthcare providers fall short in providing the health promotion and preventive strategies recommended in different guidelines and policies (Geense et al., 2013). A number of reasons have been identified for the inadequate attention to risk assessment and preventive services in clinical settings. These include insufficient knowledge and skills among healthcare providers to carry out health promotion activities, concerns about patient adherence to prevention plans, conflicting guidelines and programs for health promotion, and lack of time (Bonner et al., 2013; Geense et al., 2013; Rubio-Valera et al., 2014).

To simplify CVD risk assessment in clinical practice, the NVDPA of Australia recommends using the absolute cardiovascular risk (ACVDR) score, which takes into account age, gender, smoking, systolic blood pressure, total cholesterol to HDL-C ratio, and diabetes (Nieuwlaat et al., 2013; O'Callaghan et al., 2014). The score calculates the individual's 5-year risk for developing CVD and categorises them as low risk (< 10%), moderate risk (10–15%), or high risk (> 15%). Patients with a high ACVDR score, or moderate risk with additional risk factors and without prior CVD, are recommended to receive lifestyle modification advice and be prescribed both lipid and blood-pressure-lowering therapy. Despite this, most Australians at high CVD risk do not receive the recommended combination therapy (Bonner et al., 2013; O'Callaghan et al., 2014).

However, despite the availability of these risk prediction tools, it is still challenging to identify women who are at high risk for CVD, particularly young women (Stuart et al., 2018). In 2013, the American College of Cardiology and the AHA endorsed the use of pooled cohort risk equations (PCEs) to predict the 10-year risk of a first hard ASCVD event, and since then, they have been integrated into clinical practice (Goff Jr et al., 2014). Different tools may be more appropriate for specific populations, and ongoing research is needed to refine risk assessment and identify individuals who could benefit from early interventions to prevent CVD. Although the PCEs have advanced the prediction of CVD risk by incorporating stroke as an endpoint and creating sex- and race/ethnicity-specific equations, they have received criticism for not including novel risk markers such as complications of pregnancy, which could add value to the tool in clinical practice (Cook & Ridker, 2016).

Complications of pregnancy are not currently included as a factor in existing cardiovascular risk prediction models; however, incorporating this factor may enhance the ability of these tools to better identify women at high risk for CVD later in life. Women with a history of pregnancy complications may benefit from early cardiovascular risk screening and tailored primary prevention programs (Hermes et al., 2013). Awareness of CVD risk and prevention goals can motivate women to adopt heart-healthy lifestyles (Hermes et al., 2013).

In the current study, only 43.8% of healthcare providers felt confident in assessing the risk of CVD in women with complications of pregnancy, which is consistent with the finding that most healthcare providers did not often assess the risk of CVD in these women. This lack of confidence may be attributed to the insufficient knowledge and skills of healthcare professionals in engaging in health promotion activities (Bonner et al., 2013; Geense et al., 2013; Rubio-Valera et al., 2014). The Women's Heart Alliance also reported that a low percentage of primary care physicians and cardiologists felt extremely well prepared to assess CVD risk in women, highlighting the importance of knowledge in developing confidence in this area (Greaves et al., 2020). To effectively assess CVD risk, healthcare providers need to have comprehensive knowledge about the latest guidelines and be confident in using various risk assessment tools (Greaves et al., 2020). A survey revealed that 12% of general practitioners did not use guidelines, with 28% citing lack of awareness as the reason (Dallongeville et al., 2012). Therefore, it is essential to widely disseminate high-quality clinical practice guidelines to healthcare providers to promote their implementation in practice.

Only 31% of the participants frequently discussed the risk of CVD with women who had a history of complications during pregnancy. Although there are no comparable studies to compare this finding with, existing research suggests that overall, CVD risk communication during patient visits is inadequate. For instance, the Women's Heart Alliance conducted a survey which found that only 7% of primary care physicians discussed CVD risk and risk factors with their high-risk patients in each visit, and only 35% discussed the risk with every new patient (Bairey Merz et al., 2017). Primary care physicians and cardiologists reported that this was because patients had more pressing health issues or because women did not clearly report their symptoms (Bairey Merz et al., 2017).

In this study, slightly over half of the participants (55.2%) took actions to mitigate the risk of CVD in women with a history of pregnancy complications. However, the specific actions taken by healthcare providers to reduce CVD risk in this high-risk group of women are not clearly defined. Qualitative studies may provide better insights into the measures that healthcare providers take to manage CVD risk in women with a history of pregnancy complications. Findings from other studies indicate a higher rate of engagement by healthcare providers in CVD risk reduction programs compared to the current study. For example, in a survey conducted by Young et al. (2012), 95% of internists and 70% of gynaecologists reported routinely counselling patients about CVD risk reduction. However, in the case of

HDP, only 5% of internists and 42% of gynaecologists included pre-eclampsia in the medical history assessment. Furthermore, only a subset of healthcare providers provided counselling to patients with a history of pre-eclampsia about their increased CVD risk. Specifically, only 9% of internists and 38% of gynaecologists counselled women with a history of pre-eclampsia about their increased CVD risk. In a survey conducted in China with the aim of exploring the knowledge and clinical practice of registered nurses about CVD prevention, fewer than 70% of registered nurses provided patients with any health education for the purpose of CVD prevention in their practice (Ding et al., 2017). The low engagement rate of healthcare providers in CVD risk reduction measures may be due to their focus on women with a history of complicated pregnancy.

Furthermore, only 44.6% of participants in the current study often referred women with a history of complicated pregnancy to an appropriate practitioner/specialist for a detailed assessment and management of their cardiovascular disease (CVD) risk. Although there are no comparable studies to compare this finding with, a cross-sectional survey of 111 general practitioners conducted in Queensland, Australia, in 2017 showed that 78% of general practitioners used the ACVDR score to assess their patients' CVD risk and refer their high-risk patients to appropriate practitioners, including dietitians (76%) and exercise physiologists (68%) (Greaves et al., 2020). The low referral rate in the current study may be partially related to poor knowledge among healthcare providers of the association between complications of pregnancy and future CVD risk, as well as their negative attitudes toward the effectiveness of CVD risk-reducing programs and treatments, as discussed earlier.

Conclusion of the chapter

The women's survey results revealed inadequate levels of knowledge and awareness regarding CVD risk, general risk factors, and those related to pregnancy complications among women with a history of pregnancy complications. Additionally, a significant gap in the practice and management of CVD risk among study participants was identified. These findings highlight the urgent need to enhance women's knowledge and awareness regarding the early assessment, identification, and management of CVD risk in this high-risk population. Healthcare providers, being the first professionals to evaluate and educate women about potential future CVD risks, need to possess adequate knowledge and confidence in applying their expertise. However, the healthcare providers' survey results also uncovered significant knowledge gaps regarding CVD risk factors, general risk factors, and those related to pregnancy complications. Moreover, a noticeable gap was observed in the practice and management of CVD risk by healthcare providers.

Given the critical role of healthcare providers in public health, improving their knowledge and attitudes towards CVD risk factors, especially sex-specific ones, is imperative. Providing healthcare providers with adequate education and training to identify high-risk population groups, offer counseling, and refer patients for further assessment and risk management is crucial. Enhancing healthcare providers' knowledge and attitudes towards CVD risk can ultimately lead to improved cardiovascular health outcomes for women with a history of pregnancy complications.

The following chapter serves as the conclusion of this thesis, where the study's strengths and limitations, key findings, implications, and future directions of the research are summarized and discussed.

Chapter Eight: Conclusion

Introduction to the chapter

This chapter presents the conclusion of the thesis and discusses the implications and recommendations of the study findings for women's health and healthcare providers' education, practice, policies, and future research. It commences with a review of key findings, followed by an assessment of the overall strengths and limitations of the study. Subsequently, it outlines the contribution of the current study to the literature and to women's health, providing recommendations for future policies in Australia to enhance cardiovascular health among women with a history of pregnancy complications.

Key findings

A notable proportion of women with a history of pregnancy complications in this study exhibited low to moderate knowledge regarding the connection between their obstetric history and the subsequent risk of CVD. This lack of awareness partially explains their limited participation in activities and initiatives aimed at reducing CVD risk, as demonstrated by the statistically significant association between their knowledge levels and engagement in preventive behaviors.

As knowledge of the risk of CVD is crucial for managing the risk (Yilmaz et al., 2018), the first step in addressing this issue should be to enhance women's knowledge regarding the relationship between pregnancy complications and the elevated risk of CVD. However, knowledge alone is not sufficient to motivate women to adopt CVD preventive behaviours. Other individual factors, such as their perception of personal risk and health beliefs, play a significant role in behaviour change and the adoption of healthier lifestyles, including a balanced diet, adequate physical activity, and regular risk monitoring (Gellert & Tille, 2015; Maharajan et al., 2016).

Understanding and perception of risk are fundamental drivers of behavioral change aimed at reducing the risk of CVD. Consequently, healthcare providers hold a pivotal position in enhancing women's, particularly those at high risk such as those with a history of pregnancy complications, knowledge, and motivation to embrace preventive behaviors and adopt healthier lifestyles. To accomplish this goal, healthcare providers must be equipped with sufficient knowledge and undergo appropriate training regarding CVD risk and its factors, particularly in women overall and among those with a history of pregnancy complications. Additionally, they should possess proficient skills in risk communication and patient education (Wu et al., 2022). They must also be more vigilant in their practice and maintain a positive attitude, motivation, and belief in the effectiveness of evidence-based practice guidelines. Healthcare providers should be proficient in delivering correct and timely information to women, enabling informed decision-making regarding risk management strategies (Shahmoradi et al., 2017; Uchmanowicz et al., 2021).

Despite this, healthcare providers in this study were found to possess a sub-optimal level of knowledge on the association between pregnancy complications and future CVD. They also reported insufficient practice and attitudes towards the assessment, prevention, and management of CVD risk among these high-risk women. The study surveys identified significant knowledge and practice gaps among women and healthcare providers regarding the increased risk of CVD associated with a complicated pregnancy. It was shown that CVD risk in this group of women was mismanaged by healthcare providers. The study findings highlight the need for education and support to increase awareness and knowledge of CVD risk among women as well as healthcare providers, and to improve their attitudes and practices towards managing CVD risk in this high-risk group of women.

This research was conducted with a solid conceptual framework rooted in three comprehensive literature reviews investigating the correlations between pregnancy complications and future cardiovascular disease (CVD) (Asgharvahedi et al., 2022; Asgharvahedi et al., 2019; Vahedi et al., 2020), alongside a robust theoretical framework connecting health knowledge and behaviour change. Kanter's theory of structural empowerment was also discussed as a potential framework to empower healthcare providers in assessing and managing CVD risk among women with a history of pregnancy complications.

The literature reviews emphasised that women who experience pregnancy complications, such as pregnancy loss, HDP, and GDM, have a higher risk of developing CVD later in life. Yet it is estimated that up to 80% of all cases of CVD, including heart disease and stroke, are preventable, and engaging in primary and secondary prevention activities can significantly reduce the risk of developing CVD (Parikh et al., 2021; Uchmanowicz et al., 2021). To minimise the burden of CVD and its associated risk factors, it is crucial to proactively manage modifiable CVD risk factors, such as high blood pressure, diabetes, obesity, and physical inactivity, through early identification and assessment of at-risk individuals. Effective strategies, such as lifestyle modifications and treatment methods tailored to the individual's risk should be implemented (Parikh et al., 2021)..

Strengths and limitations

This is the first study to investigate the knowledge and practices of both women and healthcare providers concerning various types of pregnancy complications, including HDP, GDM, and pregnancy loss. Other limited available studies have only focused on a single complication (Roth et al., 2020; Yu et al., 2022; Peters et al., 2017). The study findings make a significant contribution to existing research by providing a foundation for comprehensive and tailored interventions to enhance women's and healthcare providers' awareness and knowledge of the increased risk of CVD in women with pregnancy complications. As part of this study, three literature reviews were conducted to provide strong evidence on the relationship between various pregnancy complications and the risk of future CVD. The study emphasised the fundamental principles of health promotion and disease prevention to highlight the important role of knowledge and risk perception on individuals' behaviours.

This study not only focused on women with a history of pregnancy complications as a high-risk group, who bear ultimate responsibility for reducing their CVD risk but also encompassed healthcare providers, who play a crucial role in women's health promotion. To ensure comprehensive coverage of all areas relevant to the study objectives, two distinct survey packages were developed. The survey packages underwent face and content validation by women and healthcare providers involved in women's health services, which adds value to the survey. Additionally, the questionnaires were pilot tested, and the reliability of the survey packages was assessed. The outcomes indicated that the survey instruments had good readability, acceptability, and internal consistency, thereby reinforcing the study's rigor.

The study involved healthcare providers from various professions, including cardiologists, gynaecologists, obstetricians, general practitioners, and midwives. They were recruited from both public and private healthcare settings, encompassing both in-patient and out-patient facilities across three states. This diverse recruitment approach increased the representativeness of the study sample and enhanced the generalisability of the results. These strengths improve the external validity of the study's findings and render the recommendations applicable to a broader range of healthcare settings and provider populations.

Although the study has notable strengths, it is important to acknowledge some limitations. The study used a non-probability sampling method, which was susceptible to selection bias and may have affected the generalisability of the results (Pace, 2021). Despite its limitation, this method of sampling was chosen because the procedures used to recruit participants were convenient, time-efficient, and cost-effective compared to probability sampling. These factors were important given the time constraints inherent in a PhD study. In addition, the surveys relied on self-reported data, which may be subject to recall bias, potentially resulting in either overestimation or underestimation of the reported information (Wilson, 2016). There is a possibility that some participants may not have fully understood the questions, leading to potential invalid or unreliable responses. However, the researcher attempted to minimise this bias by rigorously testing the surveys for validity and reliability and conducting a pilot study before the main data collection.

Additionally, the cross-sectional design of the study precludes establishing causality between the level of knowledge and awareness of women and healthcare providers and their health behaviours and practice. Yet, this research design was deemed the most appropriate for the study objectives, as it facilitated the recruitment of participants from a large and heterogeneous study population. Moreover, the actual knowledge of the target population regarding CVD risk factors, including the risk factors associated with pregnancy complications, may be lower than what is reported in the study. Participants bias occurs when they search for the correct answers on the internet, leading to an overestimation of their knowledge. This may result in social desirability bias as participants may respond in a way to portray themselves as having high level of knowledge. Finally, in the women's study, the participants were predominantly from a higher socioeconomic background, and individuals who could not read and write in English were excluded from the study. This might imply that the actual knowledge level among a broader spectrum of women with a history of pregnancy complications could be lower than what was observed in this study. This assumption is based on the results of a previous research that showed women from lower socioeconomic and diverse cultural and linguistic backgrounds are more likely to have poor knowledge about CVD risk factors (Nutbeam & Lloyd, 2021).

Implications of the study findings

Despite significant advancements in the diagnosis and treatment of CVD, it remains the leading cause of mortality and morbidity among women globally, accounting for approximately 32% of female deaths (Virani et al., 2020; WHO, 2017). There are several female-specific risk factors for CVD, including complications of pregnancy, which have been demonstrated to be independent risk factors for the development of CVD in women (Arnott et al., 2020; Brown et al., 2013; Riise et al., 2019). There is ample evidence that women with a history of complications of pregnancy, such as GDM, HDP, and pregnancy loss, are at an increased risk of developing CVD later in life. Furthermore, CVD tends to occur at an earlier age in women with a history of these complications, increasing the individual and social burden associated with CVD (Asgharvahedi et al., 2022; Asgharvahedi et al., 2019; Vahedi et al., 2020). Thus, it is crucial to focus more on sex-specific clinical care and research to contribute to the prediction of CVD risk in women. A sex-specific approach to cardiovascular health management offers an opportunity to identify at-risk women, formulate tailored preventive guidelines, offer targeted education, and implement effective strategies to enhance their comprehension of associated risks more accurately. This approach can also encourage their participation in cardiovascular disease risk reduction behaviors (Arnott et al., 2020).

To tackle the cardiovascular disease burden in women, it is crucial that healthcare providers are well-versed in cardiovascular disease risk and its associated factors, particularly those linked to pregnancy complications. This knowledge equips them to offer appropriate information and guidance to women effectively. Furthermore, there is a need to improve communication between healthcare providers and women, particularly in terms of discussing individual risk factors, prevention strategies, and lifestyle modifications. This can be achieved using diverse and tailored educational strategies, including educations videos, pamphlets, and online resources, as well as through ongoing education and training for healthcare providers. Further research is needed to explore the effectiveness of interventions aimed at improving knowledge and awareness of CVD risk factors in both healthcare providers and women.

Based on the findings of the current study, it was observed that while women had an acceptable level of knowledge regarding some CVD risk factors, such as increased risk with older age, positive family history, and associations with high blood pressure, blood cholesterol, and BMI, their knowledge regarding other factors like miscarriage, stillbirth, HDP, and GDM was notably lower. Similarly, healthcare providers demonstrated good understanding of traditional CVD risk factors but had deficiencies in knowledge regarding precise cut-off points for specific criteria and awareness of increased CVD risk among women with a history of miscarriage and stillbirth, although they showed better knowledge regarding associations with HDP and GDM. Addressing these knowledge gaps is crucial for improving CVD risk assessment and management effectiveness.

The study findings revealed a deficiency in adequate CVD risk management by healthcare providers, with only 20.2% reporting effective practice in managing CVD risk in women with a history of pregnancy complications, who are at high risk for CVD. Although a statistically significant correlation was found between providers' knowledge and their CVD risk-management practices, the correlation was weak, suggesting that factors beyond knowledge may have influenced their risk-management behaviors. The reasons for this could be multifaceted and may include poor motivation, inadequate time, excessive work pressure, insufficient budget, or unhelpful health policies (Uchmanowicz et al., 2021).

One concerning finding from this study was that a significant proportion of healthcare providers did not believe in or were unsure about the effectiveness of available CVD risk-reducing programs. Such lack of knowledge or negative attitudes about the effectiveness of preventive measures can adversely affect the uptake of CVD prevention guidelines, leading to negative outcomes in CVD prevention and management (Nieuwlaat et al., 2013; Uchmanowicz et al., 2021). The associations between various pregnancy complications and CVD have important implications for delivering preventive strategies to lower CVD risk in affected women. Early diagnosis of these complications can help identify a woman's risk of CVD at a young age. Women of childbearing age who have had a pregnancy complication may benefit from counselling during and/or after pregnancy, as well as adopting healthy lifestyle changes, such as limiting inter-pregnancy weight gain (Oliver-Williams et al., 2022).

Implications and recommendations for clinical practice

The study highlighted a substantial lack of knowledge and adherence to recommended practices among women with a history of pregnancy complications and healthcare providers. More than 50% of the women surveyed reported not monitoring their blood pressure regularly, while only 25.8% had their blood sugar levels checked within the last year. Moreover, approximately 30% of participants did not undergo blood cholesterol testing in the last 12 months, and over a quarter were unsure of their cholesterol levels. These findings are alarming, considering that both American and European guidelines identify pregnancy complications as a significant risk factor for future CVD (Fossum et al., 2018). The Society of Obstetric Medicine of Australia and New Zealand Guideline for the Management of Hypertensive Disorders of Pregnancy recommend that women with a history of pre-eclampsia should have an annual blood-pressure check and regular assessment of other CVD risk factors such as serum lipids, and receive counselling on smoking cessation, achieving and maintaining a healthy weight, healthy eating, and physical activity (Hutchesson et al., 2018). These guidelines highlight the importance of ongoing monitoring and prevention strategies for women who have experienced pregnancy complications and are at increased risk for CVD.

Furthermore, the study's findings suggest that only about one third of healthcare providers assessed the risk of CVD in women with specific pregnancy complications or discussed their CVD risk with them. It is important to regularly monitor this high-risk group of women for future CVD and provide lifestyle interventions to reduce smoking and overweight and improve diet and physical activity. When necessary, targeted pharmacological treatment of important mediators, such as hypertension and diabetes mellitus, should also be considered (Riise et al., 2019). These interventions can help reduce the risk of CVD in women who have experienced pregnancy complications and improve their long-term health outcomes.

In a busy practice, gynaecologists and obstetricians may not have enough time to adequately discuss CVD risk among women who have experienced pregnancy complications that increase their risk of future CVD. They may prioritise discussing current and more immediate health issues rather than the long-term effects of pregnancy complications. General practitioners and midwives can play an essential role in this regard, spending more time with women to discuss their increased risk of CVD, answer their questions, and address their concerns.

Moreover, the study's findings highlight that less than half of healthcare providers (43.8%) feel confident in assessing the risk of CVD in women with pregnancy complications, which could reflect their inadequate knowledge about the risk factors of CVD associated with these complications. Therefore, it is essential to provide healthcare providers with training and education on the prevention, assessment, and management of CVD in women with a history of pregnancy complications. This can improve their confidence and ability to deliver effective preventive strategies to this high-risk group of women.

Another crucial issue is proper communication and referral of affected women across different healthcare professions. Effective collaboration between different healthcare providers is critical in ensuring good healthcare across a range of patient contexts (Watson et al., 2016). However, there is evidence to suggest that different disciplines, such as nursing/midwifery, medicine, and allied health, have separate guidelines, which can impact the ability of different healthcare providers to collaborate effectively (Watson et al., 2016).

One study reported that the division of healthcare between two healthcare provider from various professions could have played a role in the inadequate postpartum care received by women following GDM (Ehrenthal & Catov, 2013). Hence, appropriate communication and handover of women’s obstetric history across different types of healthcare providers is an essential component of the health system. This ensures that women receive adequate and coordinated care, reducing the risk of adverse outcomes, and improving their overall health and wellbeing. Therefore, this study makes the following recommendations:

- Education and training programs should be developed and implemented for healthcare providers to improve their knowledge and confidence in assessing and managing CVD risk in women with complications of pregnancy.
- Efforts should be made to increase public awareness and understanding about the potential long-term health impacts of complications of pregnancy, including increased risk of developing CVD later in life.
- Women who have experienced one or more types of pregnancy complications should be identified in a timely and efficient manner. Their risk for developing CVD should be comprehensively assessed, and interventions should be initiated to modify their risk factors and encourage lifestyle changes aimed at reducing their future CVD risk.

- Postpartum transitional clinics can play a crucial role in supporting women who have experienced a complicated pregnancy. These clinics provide an opportunity for a detailed discussion about the complications of pregnancy and their long-term health impact, including cardiovascular health. By offering this support, women can better understand the potential risks and take necessary steps to reduce their risk for developing CVD.
- Multidisciplinary, high-quality, and evidence-based clinical practice guidelines should be widely available to all healthcare providers to follow in their clinical practice. This will ensure that patients receive consistent and effective care, regardless of the healthcare provider they see. By utilising these guidelines, healthcare providers can make informed decisions about the best course of treatment for their patients and improve patient outcomes.
- Multidisciplinary approaches should be considered when developing CVD risk reduction programs, implementing behaviour change strategies, and delivering preventive services in primary care. By utilising a team-based approach, healthcare providers can provide comprehensive care that addresses all aspects of CVD risk, including medical, lifestyle, and social factors. This can lead to better patient outcomes and improved population health.
- An appropriate and clear referral system between different levels of healthcare providers is essential. This ensures that patients receive the appropriate level of care based on their individual needs and that healthcare providers can collaborate effectively to manage patient care. A clear referral system can also help to reduce unnecessary hospitalisations, ensure timely access to specialised care, and improve patient outcomes.

Implications and recommendations for education

Complications of pregnancy can provide insight into a woman's long-term cardiovascular risk and present an opportunity to engage in CVD prevention. However, there is a significant knowledge gap among both women and healthcare providers regarding the prolonged adverse effects of pregnancy complications on the cardiovascular system. These findings highlight the need for education and awareness efforts aimed at both patients and healthcare providers. By increasing knowledge and awareness, patients can be empowered to take steps to reduce their CVD risk, and healthcare providers can improve their ability to identify and manage CVD risk factors in this patient population.

Primary healthcare providers, including general practitioners and midwives, along with women's health specialists such as obstetricians, have a unique opportunity to liaise with women and their families during the postpartum phase of their lives. By sharing important, evidence-based information on women's health throughout this phase, healthcare providers can empower women to take action to improve their own future health and contribute to a healthier future for themselves, their families, and their communities. However, additional work is needed to better educate women about their risk of CVD so that they can become more active in their own care (O'Kelly et al., 2022).

Health education is an essential component of any health promotion program, and it can increase the likelihood of adopting healthy behaviours among individuals and society (Pueyo-Garrigues et al., 2019). Increasing knowledge and awareness of CVD risk factors and symptoms has been shown to improve patient engagement with healthy behaviours and medication adherence (O'Kelly et al., 2022). Therefore, healthcare providers should prioritise patient education and work to improve health literacy among their patient population. This can include providing educational materials, offering counselling sessions, and utilising technology to improve patient engagement and understanding of their own health.

The findings of this study also indicate a knowledge gap among healthcare providers regarding the implementation of preventive strategies in affected women. Therefore, it is essential to provide professional continuing education and in-service training on the significance of primary and secondary prevention of heart disease to first-line healthcare providers. This will equip them with the necessary knowledge, attitudes, and skills to assume this role within their clinical practices. Additionally, further education for women's health specialists, including obstetricians and gynaecologists, is necessary to recognise obstetric complications as 'red flags' for the risk of future CVD in women (Aslam et al., 2021).

To improve care and reduce the burden of CVD, all medical students and registrars should receive education regarding the importance of reproductive history-taking as part of their core educational curriculum. These educational programs should provide healthcare providers at all levels of practice with the necessary information and latest updates about sex-specific CVD risk factors, screening, and preventive strategies. As CVD is considered a national health priority, all healthcare providers should be knowledgeable about this disease to effectively reduce its burden.

In addition, the findings of this study indicate that a significant proportion of healthcare providers (90.5%) believe that it is their responsibility to assess, refer, or manage CVD risk in women with complications of pregnancy. While this is a promising finding, there is still a need for specific educational programs to assist healthcare providers in feeling more confident and motivated to engage in assessing and managing CVD in women. Such programs could focus on the latest guidelines and recommendations for the management of CVD risk in women with complications of pregnancy, as well as strategies for effective communication with patients and promoting healthy lifestyle changes. By improving healthcare provider knowledge and confidence in managing CVD risk, better outcomes can be achieved for women with a history of complications of pregnancy.

Moreover, women's cardiovascular health topics should be featured more prominently at professional society conferences so that all providers may feel better informed about the unique aspects of caring for women with CVD (O'Kelly et al., 2022). Such educational initiatives will not only improve knowledge and skills but also help to promote collaboration between different healthcare professionals and provide more comprehensive care for women with complications of pregnancy. Therefore, the following recommendations are made:

- Educational programs for both women and healthcare providers should be designed and implemented at an appropriate time to discuss the long-term health effects of complications of pregnancy, including the increased risk of CVD. This could include providing education to women during their antenatal and postpartum periods, as well as educating healthcare providers who care for women during these phases. It is important to ensure that the information is evidence-based and culturally appropriate, and that it is delivered in a manner that is accessible and understandable to all women and healthcare providers. By improving knowledge and awareness of CVD risk factors and symptoms, educational programs can help women to become more active in their own care and contribute to modifying their lifestyle and reducing their future CVD risk.
- Raising awareness about CVD as the leading cause of death in Australia and globally is important. Social media and other digital platforms can be powerful tools for disseminating information and engaging with communities. By using these platforms, healthcare organisations, public health agencies, and other stakeholders can educate the public about CVD risk factors, symptoms, and preventive measures. This can help to reduce the incidence of CVD and improve outcomes for individuals at risk. Additionally, community-based education programs and initiatives can be developed

to improve knowledge and awareness of CVD and its risk factors among various demographic groups, including women. By engaging with communities in this way, people can work together to reduce the burden of CVD and promote cardiovascular health for all.

- Comprehensive and specific education and in-service programs are necessary for all healthcare providers to stay up to date on the latest evidence-based practices and guidelines related to women's health. This is particularly important for providers who care for women during and after pregnancy, as they play a critical role in identifying and managing potential cardiovascular risk factors. These educational programs can include training on risk assessment, lifestyle interventions, and management of CVD risk factors such as hypertension, diabetes, and dyslipidaemia. Additionally, these programs can address the unique aspects of caring for women with CVD, including reproductive history-taking and the management of complications of pregnancy. By providing healthcare providers with the necessary knowledge, skills, and resources, we can improve the quality of care and outcomes for women at risk of CVD.
- Interprofessional education sessions should be provided to healthcare providers, including midwives, nurses, general practitioners, and healthcare specialists, to provide opportunities for them to learn with, from, and about each other. This can help them develop the necessary knowledge, skills, and attitudes required to support women's health effectively. These educational sessions can help bridge gaps in knowledge and promote collaboration and communication between different healthcare providers, leading to improved patient outcomes.

Implications and recommendations for policy makers

It is concerning that current guidelines and policies regarding the assessment and management of CVD risk in women with a history of complications of pregnancy are inadequate in both primary and acute care settings. This is especially alarming given the growing body of evidence indicating that complications of pregnancy are associated with an increased risk of CVD later in life. For example, guidelines recommend that women with a history of HDP undergo cardiovascular screening, but there is a lack of guidance on when to initiate this screening (Visseren et al., 2021). Studies have shown that blood pressure in these affected women increases within 5 years postpartum, indicating that screening should be done earlier rather than later. Improved guidelines and policies are needed to ensure that women with a history of complications of pregnancy receive appropriate screening and management to reduce their risk of CVD.

Healthcare providers must receive education about the significance of recognising and managing CVD risk factors in women who have a history of pregnancy complications. It is equally important to enhance awareness among these women about their heightened risk of developing CVD. Research has shown that healthcare providers who possess knowledge about the association between GDM and future diabetes are more likely to conduct further testing and interventions, emphasising the necessity of increasing awareness of CVD risk factors among both healthcare providers and women (Ehrenthal & Catov, 2013).

It should also be noted that current guidelines and recommendations for CVD risk assessment and management are primarily based on research conducted on male and older patient groups (Brown et al., 2018; Lowe et al., 2015). Therefore, it may not be appropriate to apply these guidelines to women in the early postpartum years who have experienced different types of pregnancy complications. There is a need for more specific and tailored recommendations for managing CVD risk in this population.

In conclusion, a comprehensive and national policy of follow-up and management strategies for women with different types of pregnancy complications is needed. Such policies should be based on well-designed studies and recommendations that consider the unique needs and risks of women in the early postpartum years. This would ensure that women receive appropriate screening, management, and support to reduce their risk of CVD and improve their long-term health outcomes. This study makes the following recommendations:

- Policy makers must prioritise the development, rigorous evaluation, and systematic deployment of strategies that address women's health, with a particular focus on complications of pregnancy. These strategies should aim to improve screening, assessment, management, and follow-up care for women who have experienced pregnancy complications, such as HDP, GDM, and pregnancy loss. Additionally, these strategies should be designed to address the unique needs and risks of women in the early postpartum years.
- By implementing evidence-based strategies for screening, assessment, management, and follow-up care for women who have experienced pregnancy complications, policymakers can reduce the burden of CVD in women and improve their long-term health outcomes. This would require collaboration between healthcare providers, researchers, and policymakers to develop evidence-based guidelines and policies that prioritise the health of women and their families.
- To ensure the development of comprehensive and effective policies for the assessment and management of CVD risk in women with a history of pregnancy complications, policymakers should work collaboratively with multidisciplinary groups of healthcare providers. This should include midwives, general practitioners, and specialists in areas such as obstetrics, cardiology, endocrinology, and public

health. These groups should be involved in the development, implementation, and evaluation of policies to facilitate discussion, referral, comprehensive education, and follow-up programs for women who have experienced different types of pregnancy complications. This would ensure that policies are evidence-based and consider the unique needs and perspectives of different healthcare providers and their patients.

Implications and recommendations for future research

Although the association between complications of pregnancy and future CVD risk has been well established, the pathophysiology of sex-specific CVD risk factors and their mechanistic links to future CVD remains unclear. A better understanding of the underlying pathophysiology could help inform the development of specific prevention strategies for improving heart health in women.

Currently, several CVD risk prediction models exist, such as the Framingham Risk Score, the Reynolds Risk Score, the SCORE equation, the PCEs, and the QRISK score. However, none of these models consider a history of complications of pregnancy as a variable for predicting individual cardiovascular risk. As a result, it is not clear how effective these tools are at predicting CVD risk among women who have experienced pregnancy complications. To improve cardiovascular risk prediction among affected women, it is important to consider a history of complications of pregnancy as a relevant risk factor. By including this variable in existing CVD risk prediction models, healthcare providers may be better able to identify women who are at high risk for CVD later in life. This, in turn, could provide an opportunity for early cardiovascular risk screening and the implementation of individualised primary prevention programs. Therefore, this study makes the following recommendations:

- Future research should focus on gaining a better understanding of the pathophysiology underlying miscarriage, stillbirth, HDP, and GDM, and how these conditions contribute to the development of CVD. This could help identify specific sex-specific risk factors and mechanistic links that may be relevant to the development of CVD in affected women.
- More research is needed to determine the most effective screening and management strategies for women with a history of pregnancy complications. This may involve evaluating the effectiveness of current screening tools and prevention programs, as well as developing new approaches that are tailored to the unique needs of affected women. Larger studies with long-term follow-up should be undertaken to determine whether including additional variables such as miscarriage/recurrent miscarriage, stillbirth, HDP, and GDM to the CVD risk prediction models could improve their accuracy in estimating CVD risk in women. This could help to identify women who are at higher risk of developing CVD and ensure that appropriate prevention and management strategies are implemented early.
- Further research is warranted to comprehensively examine healthcare providers' perceptions of the existing CVD prevention programs, as a favourable attitude is a crucial factor that facilitates the adoption and execution of CVD risk-mitigation policies and protocols.
- Research should be conducted to identify effective strategies for reducing CVD risk in women with complications of pregnancy and to evaluate the effectiveness of current interventions.

Conclusion of the chapter

In view of closing the knowledge gap and developing awareness in women and healthcare providers about the risk of CVD in women with a history of pregnancy complications, this chapter outlined the conclusion of the study and discussed implications of the study findings, as well as implications and recommendations for future clinical practice, education, policy, and research. The findings indicate a need for the development of educational and skill resources, as well as improvements to clinical practice and referral systems. Enhancing knowledge and awareness among both women with a history of pregnancy complications and healthcare providers may result in more timely and improved subsequent counseling, management, and enhancement of the CVD health of these high-risk women.

References

Aambø, A., & Klemsdal, T. O. (2017). Cardiovascular disease and diabetes in patients with African or Asian background. *Tidsskrift for den Norske Laegeforening: Tidsskrift for Praktisk Medicin, ny Raekke, 137*(22).

Abraham, C., & Sheeran, P. (2005). The health belief model. In M. Conner and P. Norman (Eds.), *Predicting Health Behaviour*. Open University Press.

Abraham, C., Kelly, M. P., West, R., & Michie, S. (2009). The UK National Institute for Health and Clinical Excellence public health guidance on behaviour change: a brief introduction. *Psychology, Health & Medicine, 14*(1), 1-8. https://doi.org/10.1080/13548500802537903

Abushaikha, L., Edwards, J. E., & Cesario, S. (2021). "Moms and babies first"-A historical overview of the Association of Women's Health Obstetric and Neonatal Nurses. *Nursing Outlook, 69*(6), 1049-1057. https://doi.org/10.1016/j.outlook.2021.05.012

Achhra, A. (2009). Health promotion in Australian general practice: A gap in GP training. *Australian Family Physician, 38*(8), 605.

Adekanle, D., Adeyemi, A., Olowookere, S., & Akinleye, C. (2015). Health workers' knowledge on future vascular disease risk in women with pre-eclampsia in south western Nigeria. *BMC research notes, 8*(1), 1-5. https://doi.org/10.1186/s13104-015-1553-6

Agarwal, S. K. (2012). Cardiovascular benefits of exercise. *International Journal of General Medicine, 5*, 541. https://doi.org/10.2147/IJGM.S30113

Aggarwal, N. R., Patel, H. N., Mehta, L. S., Sanghani, R. M., Lundberg, G. P., Lewis, S. J., Mendelson, M. A., Wood, M. J., Volgman, A. S., & Mieres, J. H. (2018). Sex differences in ischemic heart disease: advances, obstacles, and next steps. *Circulation: Cardiovascular Quality and Outcomes, 11*(2), e004437. https://doi.org/10.1161/CIRCOUTCOMES.117.004437

Ahmad, A., & Oparil, S. (2017). Hypertension in women: recent advances and lingering questions. *Hypertension, 70*(1), 19-26. https://doi.org/10.1161/HYPERTENSIONAHA.117.08317

Ahpra. (2022). *Registration data*. Medical Board Ahpra. https://www.medicalboard.gov.au/News/Statistics.aspx

Ajzen, I. (2005). *Attitudes, personality, and behavior*. McGraw-Hill Education (UK).

Ajzen, I. (2011). The theory of planned behaviour: reactions and reflections. *Psychology & Health, 26*(9), 1113-1127. https://doi.org/10.1080/08870446.2011.613995

Akinyelure, O. P., Jaeger, B. C., Moore, T. L., Hubbard, D., Oparil, S., Howard, V. J., Howard, G., Buie, J. N., Magwood, G. S., & Adams, R. J. (2021). Racial differences in blood pressure control following stroke: The REGARDS study. *Stroke, 52*(12), 3944-3952. https://doi.org/10.1161/STROKEAHA.120.033108

Aldridge, A. (2001). *Surveying the social world: Principles and practice in survey research*. McGraw-Hill Education (UK).

Alladin, A. A., & Harrison, M. (2012). Preeclampsia: systemic endothelial damage leading to increased activation of the blood coagulation cascade. *Journal of Biotech Research, 4*, 26-43.

Almalki, S., Alhossan, A., Alrumayyan, B., Alanazi, K., Gamea, S. B., Alesikri, M., Ahmad, A., & Alrabiah, Z. (2021). Aspirin prescribing pattern and guidelines-adherence evaluation for primary prevention of cardiovascular disease at a teaching hospital. *Saudi Pharmaceutical Journal, 29*(12), 1426-1431. https://doi.org/10.1016/j.jsps.2021.10.010

Altamimi, S., Alshoshan, F., Al Shaman, G., Tawfeeq, N., Alasmary, M., & Ahmed, A. E. (2016). Health promotion practices as perceived by primary health care professionals at the Ministry of National Guard Health Affairs, Saudi Arabia. *Qatar Medical Journal, 2016*(1), 4. https://doi.org/10.5339/qmj.2016.4

Amadi, C. E., Lawal, F. O., Mbakwem, A. C., Ajuluchukwu, J. N., & Oke, D. A. (2018). Knowledge of cardiovascular disease risk factors and practice of primary prevention of cardiovascular disease by Community Pharmacists in Nigeria: a cross-sectional study. *International Journal of Clinical Pharmacy, 40*(6), 1587-1595. https://doi.org/10.1007/s11096-018-0744-3

American College of Obstetricians and Gynecologists. (2013). Hypertension in pregnancy. Report of the American College of Obstetricians and Gynecologists' task force on hypertension in pregnancy. *Obstetrics and Gynecol, 122*(5), 1122-1131. https://doi.org/10.1097/01.AOG.0000437382.03963.88

American College of Obstetricians and Gynecologists. (2015). ACOG Committee Opinion No. 650: Physical activity and exercise during pregnancy and the postpartum period. *Obstetrics and Gynecology, 126*(6), e135–e142. https://doi.org/10.1097/AOG.0000000000001214

American Diabetes Association. (2020a). 2. Classification and diagnosis of diabetes: Standards of Medical Care in Diabetes—2020. *Diabetes Care, 43*(Supplement_1), S14-S31. https://doi.org/10.2337/dc20-S002

American Diabetes Association. (2020b). *Statistics About Diabetes*. American Diabetes Association. https://www.diabetes.org/about-us/statistics/about-diabetes

American Diabetes Association. (2022). Care in Diabetes—2022. *Diabetes Care, 45*, S17. https://doi.org/10.2337/dc22-S002

Anand, S. S., Hawkes, C., De Souza, R. J., Mente, A., Dehghan, M., Nugent, R., Zulyniak, M. A., Weis, T., Bernstein, A. M., & Krauss, R. M. (2015). Food consumption and its impact on cardiovascular disease: importance of solutions focused on the globalized food system: a report from the workshop convened by the World Heart Federation. *Journal of the American College of Cardiology, 66*(14), 1590-1614. https://doi.org/10.1016/j.jacc.2015.07.050

Appelman, Y., van Rijn, B. B., Monique, E., Boersma, E., & Peters, S. A. (2015). Sex differences in cardiovascular risk factors and disease prevention. *Atherosclerosis, 241*(1), 211-218. https://doi.org/10.1016/j.atherosclerosis.2015.01.027

Arnadottir, G. A., Geirsson, R. T., Arngrimsson, R., Jonsdottir, L. S., & Olafsson, Ö. (2005). Cardiovascular death in women who had hypertension in pregnancy: a case–control study. *BJOG: An International Journal of Obstetrics & Gynaecology, 112*(3), 286-292.

Arnott, C., Nelson, M., Ramirez, M. A., Hyett, J., Gale, M., Henry, A., Celermajer, D. S., Taylor, L., & Woodward, M. (2020). Maternal cardiovascular risk after hypertensive disorder of pregnancy. *Heart, 106*(24), 1927-1933. https://doi.org/10.1111/j.1471-0528.2004.00396.x

Asgharvahedi, F., Gholizadeh, L., & Siabani, S. (2019). The risk of cardiovascular disease in women with a history of miscarriage and/or stillbirth. *Health Care for Women International, 40*(10), 1117-1131. https://doi.org/10.1080/07399332.2019.1566332

Asgharvahedi, F., Gholizadeh, L., Orr, F., & Khajehei, M. (2022). Risk of developing CVD in women with a history of gestational diabetes. *Acta Scientific MEDICAL SCIENCES. (ISSN: 2582-0931)*, *6*(7).

Aslam, A., Perera, S., Watts, M., Kaye, D., Layland, J., Nicholls, S. J., Cameron, J., & Zaman, S. (2021). Previous pre-eclampsia, gestational diabetes and hypertension

place women at high cardiovascular risk: but do we ask? *Heart, Lung and Circulation, 30*(1), 154-157. https://doi.org/10.1016/j.hlc.2020.06.022
August, P., & Sibai, B. M. (2013). Preeclampsia: Clinical features and diagnosis. *UpToDate*. Retrieved April 17, 2015, from https://www.uptodate.com/contents/preeclampsia-clinical-features-and-diagnosis
Australian Bureau of Statistics. (2015). *National health survey: First results, 2014–15*. https://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/4364.0.55.0012014-15?OpenDocument
Australian Bureau of Statistics. (2018a). *Causes of Death, Australia, 2017*. https://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/3303.0Main+Features12017?OpenDocument
Australian Bureau of Statistics. (2018b). *High cholesterol*. Retrieved September 10, 2021. from https://www.abs.gov.au/statistics/health/health-conditions-and-risks/high-cholesterol/latest-release
Australian Bureau of Statistics. (2018c). *Hypertension and measured high blood pressure.* Retrieved 21 December, 2021, from https://www.abs.gov.au/statistics/health/health-conditions-and-risks/hypertension-and-measured-high-blood-pressure/latest-release
Australian Government Department of Health and Aged Care. (2021). *Smoking and tobacco and pregnancy*. Retrieved September 2, 2022, from https://www.health.gov.au/health-topics/smoking-and-tobacco/smoking-and-tobacco-throughout-life/smoking-and-tobacco-and-pregnancy
Australian Government Department of Health and Aged Care. (2022). *Australian Health System*. https://www.health.gov.au/about-us/the-australian-health-system
Australian Government Department of Health. (2017). *Midwives 2017 factsheet*. Health Work Force Data. Retrieved November 20, 2020, from http://hwd.health.gov.au
Australian Health Ministers' Advisory Council. (2012). *Clinical practice guidelines: antenatal care-module 1.* https://apo.org.au/organisation/80538
Australian Heart Association Presidential Advisory. (2017). Dietary fats and cardiovascular disease, . *Circulation, 135*, 00-00.
Australian Institute of Health and Welfare. (2012). *Australia's health 2012: In brief.*
Australian Institute of Health and Welfare. (2017). *Australian Health Expenditure – demographics and diseases: hospital admitted patient expenditure 2004-05 to 2012-13*.
Australian Institute of Health and Welfare. (2019a). *Australia's mothers and babies*. Retrieved September 2, 2021, from https://www.aihw.gov.au/getmedia/2a0c22a2-ba27-4ba0-ad47-ebbe51854cd6/aihw-per-100-in-brief.pdf.aspx?inline=true
Australian Institute of Health and Welfare. (2019b). *Cardiovascular disease in Australian women— a snapshot of national statistics*. https://www.aihw.gov.au/reports/heart-stroke-vascular-diseases/cardiovascular-disease-in-women-main
Australian Institute of Health and Welfare. (2019c). *Incidence of gestational diabetes in Australia*. Cat. no. CVD 85. Retrieved March 26, 2022, from https://www.aihw.gov.au/reports/diabetes/incidence-of-gestational-diabetes-in-australia
Australian Institute of Health and Welfare. (2019d). *The health of Australia's females*. Retrieved July 23, 2022, from https://www.aihw.gov.au/reports/men-women/female-health
Australian Institute of Health and Welfare. (2020a). *Aboriginal and Torres Strait Islander health performance framework 2020 summary report*. Retrieved December 20, 2022, from

https://www.aihw.gov.au/news-media/media-releases/2020/december/indigenous-health-performance-framework
Australian Institute of Health and Welfare. (2020b). *Cardiovascular disease*. Retrieved August 1, 2020, from https://www.aihw.gov.au/reports/heart-stroke-vascular-diseases/cardiovascular-health-compendium/contents/deaths-from-cardiovascular-disease
Australian Institute of Health and Welfare. (2021). *Heart, Stroke and Vascular disease-Australian facts.* Retrieved November 15, 2022, from https://www.aihw.gov.au/reports/heart-stroke-vascular-diseases/hsvd-facts/contents/risk-factors
Australian Institute of Health and Welfare. (2022a). *Insufficient physical activity*. Retrieved September 2, from https://www.aihw.gov.au/reports/australias-health/insufficient-physical-activity
Australian Institute of Health and Welfare. (2022b). *Insufficient physical activity*. Retrieved 10 October, from https://www.aihw.gov.au/reports/australias-health/insufficient-physical-activity
Australian Institute of Health and Welfare. (2022c). *Overweight and obesity*. https://www.aihw.gov.au/reports/australias-health/overweight-and-obesity
Australian Institute of Health and Welfare. (2022d). *Stillbirths and neonatal deaths in Australia*. Retrieved December 24, 2023, from https://www.aihw.gov.au/reports/mothers-babies/stillbirths-and-neonatal-deaths
Australian Institute of Health and Welfare. (2022e). *Diabetes: Australian facts*. https://www.aihw.gov.au/reports/diabetes/diabetes-australian-facts/contents/summary
Australian Nursing & Midwifery Federation. (2014). *National practice standards for nurses in general practice*. https://www.anmf.org.au/media/fwkozhdm/anmf_national_practice_standards_for_nurses_in_general_practice.pdf
Awad, A., & Al-Nafisi, H. (2014). Public knowledge of cardiovascular disease and its risk factor in Kuwait: a cross-sectional survey. *BMC Public Health, 14*(1131). https://doi.org/10.1186/1471-2458-14-1131
Aykas, F., Solak, Y., Erden, A., Bulut, K., Dogan, S., Sarli, B., Acmaz, G., Afsar, B., Siriopol, D., & Covic, A. (2015). Persistence of cardiovascular risk factors in women with previous preeclampsia. *Journal of Investigative Medicine, 63*(4), 641-645. https://doi.org/10.1097/JIM.0000000000000189
Azahar, N. M. Z. M., Krishnapillai, A. D. S., Zaini, N. H., & Yusoff, K. (2017). Risk perception of cardiovascular disease among individuals with hypertension in rural Malaysia. *Heart Asia, 9*(2), e010864. https://doi.org/10.1136/heartasia-2016-010864
Azeez, O., Kulkarni, A., Kuklina, E. V., Kim, S. Y., & Cox, S. (2019). Peer reviewed: hypertension and diabetes in non-pregnant women of reproductive age in the United States. *Preventing Chronic Disease, 16*. https://doi.org/10.5888/pcd16.190105
Baart, S. J., Dam, V., Scheres, L. J., Damen, J. A., Spijker, R., Schuit, E., Debray, T. P., Fauser, B. C., Boersma, E., & Moons, K. G. (2019). Cardiovascular risk prediction models for women in the general population: A systematic review. *PLOS One, 14*(1), e0210329. https://doi.org/10.1371/journal.pone.0210329
Babbie, E. R. (2020). *The practice of social research*. Cengage Learning.
Bairey Merz, C. N., Andersen, H., Sprague, E., Burns, A., Keida, M., Walsh, M. N., Greenberger, P., Campbell, S., Pollin, I., & McCullough, C. (2017). Knowledge, attitudes, and beliefs regarding cardiovascular disease in women: the Women's Heart Alliance. *Journal of the American College of Cardiology, 70*(2), 123-132. https://doi.org/10.1016/j.jacc.2017.05.024

Baker, C. (2017). Quantitative research designs: Experimental, quasi-experimental, and descriptive. Jones and Bartlett Learning.

Ballotari, P., Venturelli, F., Greci, M., Giorgi Rossi, P., & Manicardi, V. (2017). Sex differences in the effect of type 2 diabetes on major cardiovascular diseases: results from a population-based study in Italy. *International Journal of Endocrinology, 2017*. https://doi.org/10.1155/2017/6039356

Bandura, A. (1986). *Social foundations of thought and actions: A social cognitive theory*. Prentice-Hall.

Bandura, A. (2004). Health promotion by social cognitive means. *Health Education & Behavior, 31*(2), 143-164. https://doi.org/10.1177/1090198104263660

Banerjee, A., & Chaudhury, S. (2010). Statistics without tears: Populations and samples. *Industrial Psychiatry Journal, 19*(1), 60. https://doi.org/10.4103/0972-6748.77642

Banks, E., Joshy, G., Korda, R. J., Stavreski, B., Soga, K., Egger, S., Day, C., Clarke, N. E., Lewington, S., & Lopez, A. D. (2019). Tobacco smoking and risk of 36 cardiovascular disease subtypes: fatal and non-fatal outcomes in a large prospective Australian study. *BMC Medicine, 17*(1), 128. https://doi.org/10.1186/s12916-019-1351-4

Barley, E., & Lawson, V. (2016). Using health psychology to help patients: theories of behaviour change. *British Journal of Nursing, 25*(16), 924-927. https://doi.org/10.12968/bjon.2016.25.16.924

Bassily, E., Bell, C., Verma, S., Patel, N., & Patel, A. (2019). Significance of obstetrical history with future cardiovascular disease risk. *The American Journal of Medicine, 132*(5), 567-571. https://doi.org/10.1016/j.amjmed.2018.11.029

Bellamy, L., Casas, J., Hingorani, A., & Williams, D. (2008). Preeclampsia and risk of cardiovascular disease and cancer in later life: systematic review and meta-analysis. *Obstetric Anesthesia Digest, 28*(2), 80. https://doi.org/10.1097/01.aoa.0000319790.23890.2c

Benjamin, E. J., Muntner, P., Alonso, A., Bittencourt, M. S., Callaway, C. W., Carson, A. P., Chamberlain, A. M., Chang, A. R., Cheng, S., & Das, S. R. (2019). Heart disease and stroke statistics—2019 update: a report from the American Heart Association. *Circulation, 139*(10), e56-e528. https://doi.org/10.1161/CIR.0000000000000659

Bergman, H. E., Reeve, B. B., Moser, R. P., Scholl, S., & Klein, W. M. (2011). Development of a comprehensive heart disease knowledge questionnaire. *American Journal of Health Education, 42*(2), 74-87. https://doi.org/10.1080/19325037.2011.10599175

Berkman, N., DeWalt, D., Pignone, M., Sheridan, S. L., Lohr, K. N., Lux, L., Sutton, S., Swinson, T., & Arthur, J. (2004). Literacy and health outcomes: summary. AHRQ evidence report summaries.

Bernier, N. (2007). Health promotion program resilience and policy trajectories: A comparison of three provinces. In O'Neill, M., Pederson, A., Rootman, I., Dupéré, S. (Eds.), *Health Promotion in Canada: Critical Perspectives.* Canadian Scholars' Press.

Beussink-Nelson, L., Baldridge, A. S., Hibler, E., Bello, N. A., Epps, K., Cameron, K. A., Lloyd-Jones, D. M., Gooding, H. C., Catov, J. M., & Rich-Edwards, J. W. (2022). Knowledge and perception of cardiovascular disease risk in women of reproductive age. *American Journal of Preventive Cardiology, 11*, 100364. https://doi.org/10.1016/j.ajpc.2022.100364

Bhatnagar, A. (2017). Environmental determinants of cardiovascular disease. *Circulation Research, 121*(2), 162-180. https://doi.org/10.1161/CIRCRESAHA.117.306458

Bloom, B. S., Engelhart, M. D., Furst, E., Hill, W. H., & Krathwohl, D. R. (1956). Handbook I: cognitive domain. *New York: David McKay*.

Bloomfield, J., & Fisher, M. J. (2019). Quantitative research design. *Journal of the Australasian Rehabilitation Nurses Association, 22*(2), 27-30. https://doi.org/10.33235/jarna.22.2.27-30

Bokslag, A., Teunissen, P. W., Franssen, C., van Kesteren, F., Kamp, O., Ganzevoort, W., Paulus, W. J., & de Groot, C. J. (2017). Effect of early-onset preeclampsia on cardiovascular risk in the fifth decade of life. *American Journal of Obstetrics and Gynecology, 216*(5), 523. e521-523. e527. https://doi.org/10.1016/j.ajog.2017.02.015

Bolarinwa, O. A. (2015). Principles and methods of validity and reliability testing of questionnaires used in social and health science researches. *Nigerian Postgraduate Medical Journal, 22*(4), 195. https://doi.org/10.4103/1117-1936.173959

Bonner, C., Jansen, J., McKinn, S., Irwig, L., Doust, J., Glasziou, P., Hayen, A., & McCaffery, K. (2013). General practitioners' use of different cardiovascular risk assessment strategies: a qualitative study. *Medical Journal of Australia, 199*(7), 485-489. https://doi.org/10.5694/mja13.10133

Boo, S., Oh, H., Froelicher, E. S., & Suh, C. H. (2017). Knowledge and perception of cardiovascular disease risk among patients with rheumatoid arthritis. *PLOS One, 12*(4), e0176291. https://doi.org/10.1371/journal.pone.0176291

Bots, S. H., Peters, S. A., & Woodward, M. (2017). Sex differences in coronary heart disease and stroke mortality: a global assessment of the effect of ageing between 1980 and 2010. *BMJ Global Health, 2*(2), e000298. https://doi.org/10.1136/bmjgh-2017-000298

Brener, A., Lewnard, I., Mackinnon, J., Jones, C., Lohr, N., Konda, S., McIntosh, J., & Kulinski, J. (2020). Missed opportunities to prevent cardiovascular disease in women with prior preeclampsia. *BMC Women's Health, 20*(1), 1-8. https://doi.org/10.1186/s12905-020-01074-7

Brewer, N. T., Weinstein, N. D., Cuite, C. L., & Herrington, J. E. (2004). Risk perceptions and their relation to risk behavior. *Annals of Behavioral Medicine, 27*(2), 125-130. https://doi.org/10.1207/s15324796abm2702_7

Brooks, A., Buchanan, T., & Oakes, W. (2020). Smoke-free environments: current status and remaining challenges in Australia. *Public Health Research & Practice, 30*(3), e3032022. https://doi.org/10.17061/phrp3032022

Brown, M. A., Magee, L. A., Kenny, L. C., Karumanchi, S. A., McCarthy, F. P., Saito, S., Hall, D. R., Warren, C. E., Adoyi, G., & Ishaku, S. (2018). Hypertensive disorders of pregnancy: ISSHP classification, diagnosis, and management recommendations for international practice. *Hypertension, 72*(1), 24-43. https://doi.org/10.1161/HYPERTENSIONAHA.117.10803

Brown, M. C., Best, K. E., Pearce, M. S., Waugh, J., Robson, S. C., & Bell, R. (2013). Cardiovascular disease risk in women with pre-eclampsia: systematic review and meta-analysis. *European Journal of Epidemiology, 28*(1), 1-19. https://doi.org/10.1007/s10654-013-9762-6

Brunström, M., & Carlberg, B. (2016). Effect of antihypertensive treatment at different blood pressure levels in patients with diabetes mellitus: systematic review and meta-analyses. *BMJ, 352*. https://doi.org/10.1136/bmj.i717

Bucholz, E. M., Rodday, A. M., Kolor, K., Khoury, M. J., & de Ferranti, S. D. (2018). Prevalence and predictors of cholesterol screening, awareness, and statin treatment among US adults with familial hypercholesterolemia or other forms of severe dyslipidemia (1999–2014). *Circulation, 137*(21), 2218-2230. https://doi.org/10.1161/CIRCULATIONAHA.117.032321

Bukhari, S. Z., Hussain, W. M., Banjar, A., Almaimani, W. H., Karima, T. M., & Fatani, M. I. (2011). Hand hygiene compliance rate among healthcare professionals. *Saudi Med J, 32*(5), 515-519.

Burgess, A., & Feliu, K. (2019). Women's knowledge of cardiovascular risk after preeclampsia. *Nursing for Women's Health, 23*(5), 424-432. https://doi.org/10.1016/j.nwh.2019.07.001

Calderon-Margalit, R., Friedlander, Y., Yanetz, R., Deutsch, L., Manor, O., Harlap, S., & Paltiel, O. (2007). Late stillbirths and long-term mortality of mothers. *Obstetrics & Gynecology, 109*(6), 1301-1308. https://doi.org/10.1097/01.AOG.0000264548.10767.ea

Canti, I. C. T., Komlós, M., Martins-Costa, S. H., Ramos, J. G. L., Capp, E., & Corleta, H. v. E. (2010). Risk factors for cardiovascular disease ten years after preeclampsia. *Sao Paulo Medical Journal, 128*(1), 10-13. https://doi.org/10.1590/S1516-31802010000100003

Carbone, S., Canada, J. M., Billingsley, H. E., Siddiqui, M. S., Elagizi, A., & Lavie, C. J. (2019). Obesity paradox in cardiovascular disease: where do we stand? *Vascular Health and Risk Management, 15*, 89. https://doi.org/10.2147/VHRM.S168946

Carr, D. B., Utzschneider, K. M., Hull, R. L., Tong, J., Wallace, T. M., Kodama, K., Shofer, J. B., Heckbert, S. R., Boyko, E. J., & Fujimoto, W. Y. (2006). Gestational diabetes mellitus increases the risk of cardiovascular disease in women with a family history of type 2 diabetes. *Diabetes Care, 29*(9), 2078-2083. https://doi.org/10.2337/dc05-2482

Cavusoglu, L., & Demirbag-Kaplan, M. (2017). Health commodified, health communified: navigating digital consumptionscapes of well-being. *European Journal of Marketing, 51*(11/12), 2054-2079. https://doi.org/10.1108/EJM-01-2017-0015

Centers for Disease Control and Prevention. (2021). *Heart disease: It can happen at any age*. National Center for Chronic Disease Prevention and Health Promotion, Division for Heart Disease and Stroke Prevention. Retrieved October 10, 2022, from https://www.cdc.gov/heartdisease/any_age.htm

Chacko, M., Sarma, P. S., Harikrishnan, S., Zachariah, G., & Jeemon, P. (2020). Family history of cardiovascular disease and risk of premature coronary heart disease: A matched case-control study. *Wellcome Open Research, 5*. https://doi.org/10.12688/wellcomeopenres.15829.2; https://doi.org/10.12688/wellcomeopenres.15829.1

Champion, V. L., & Skinner, C. S. (2008). The health belief model. *Health Behavior and Health Education: Theory, Research, and Practice, 4*, 45-65.

Charach, R., Wolak, T., Shoham-Vardi, I., Sergienko, R., & Sheiner, E. (2016). Can slight glucose intolerance during pregnancy predict future maternal atherosclerotic morbidity? *Diabetic Medicine, 33*(7), 920-925. https://doi.org/10.1111/dme.13036

Chen, S.-N., Cheng, C.-C., Tsui, K.-H., Tang, P.-L., Chern, C.-u., Huang, W.-C., & Lin, L.-T. (2018). Hypertensive disorders of pregnancy and future heart failure risk: a nationwide population-based retrospective cohort study. *Pregnancy Hypertension, 13*, 110-115. https://doi.org/10.1016/j.preghy.2018.05.010

Chin, J. H., & Mansori, S. (2019). Theory of planned behaviour and health belief model: Females' intention on breast cancer screening. *Cogent Psychology, 6*(1), 1647927. https://doi.org/10.1080/23311908.2019.1647927

Chin, J., Morrow, D. G., Stine-morrow, E. A., Conner-Garcia, T., Graumlich, J. F., & Murray, M. D. (2011). The process-knowledge model of health literacy: Evidence from a componential analysis of two commonly used measures. *Journal of Health Communication, 16*, 222-241. https://doi.org/10.1080/10810730.2011.604702

Cho, G. J., Kim, H. Y., Park, J. H., Ahn, K.-H., Hong, S.-C., Kim, H.-J., Han, S. W., & Oh, M.-J. (2019). Prepregnancy factors are associated with development of hypertension later in life in women with pre-eclampsia. *Journal of Women's Health, 28*(7), 984-989. https://doi.org/10.1089/jwh.2018.7165

Cho, I. Y., Park, H. Y., Lee, K., Bae, W. K., Jung, S. Y., Ju, H. J., Song, J. K., & Han, J. S. (2017). Association between the awareness of dyslipidemia and health behavior for control of lipid levels among Korean adults with dyslipidemia. *Korean Journal of Family Medicine, 38*(2), 64. https://doi.org/10.4082/kjfm.2017.38.2.64

Cho, L., Davis, M., Elgendy, I., Epps, K., Lindley, K. J., Mehta, P. K., Michos, E. D., Minissian, M., Pepine, C., & Vaccarino, V. (2020). Summary of updated recommendations for primary prevention of cardiovascular disease in women: JACC state-of-the-art review. *Journal of the American College of Cardiology, 75*(20), 2602-2618. https://doi.org/10.1016/j.jacc.2020.03.060

Choudhury, M. J. H., Chowdhury, M. T. I., Nayeem, A., & Jahan, W. A. (2015). Modifiable and non-modifiable risk factors of stroke: A review update. *Journal of National Institute of Neurosciences Bangladesh, 1*(1), 22-26. https://doi.org/10.3329/jninb.v1i1.22944

Chow, C. K., Teo, K. K., Rangarajan, S., Islam, S., Gupta, R., Avezum, A., Bahonar, A., Chifamba, J., Dagenais, G., & Diaz, R. (2013). Prevalence, awareness, treatment, and control of hypertension in rural and urban communities in high-, middle-, and low-income countries. *Jama, 310*(9), 959-968. https://doi.org/10.1001/jama.2013.184182

Christian, A. H., Mochari, H. Y., & Mosca, L. J. (2005). Coronary heart disease in ethnically diverse women: risk perception and communication. *Mayo Clinic Proceedings. 80*(12), 1593–1599. https://doi.org/10.4065/80.12.1593

Claydon, L. S. (2015). Rigour in quantitative research. *Nursing Standard (Royal College of Nursing (Great Britain): 1987), 29(47),43-48.* https://doi.org/10.7748/ns.29.47.43.e8820

Clement, S., Ibrahim, S., Crichton, N., Wolf, M., & Rowlands, G. (2009). Complex interventions to improve the health of people with limited literacy: A systematic review. *Patient Education and Counseling, 75*(3), 340-351. https://doi.org/10.1016/j.pec.2009.01.008

Collins, K. M., Dantico, M., Shearer, N. B., & Mossman, K. L. (2004). Heart disease awareness among college students. *Journal of Community Health, 29*(5), 405-420. https://doi.org/10.1023/B:JOHE.0000038655.19448.b2

Collins, P., Webb, C., De Villiers, T., Stevenson, J., Panay, N., & Baber, R. (2016). Cardiovascular risk assessment in women–an update. *Climacteric, 19*(4), 329-336. https://doi.org/10.1080/13697137.2016.1198574

Commonwealth Department of Health and Aged Care. (2018). Good Clinical Practice (GCP) in Australia,. Australian Government. Retrieved 20 September, 2018, from https://www.australianclinicaltrials.gov.au/researchers/good-clinical-practice-gcp-australia

Connaway, L. S., & Powell, R. R. (2010). *Basic research methods for librarians*. ABC-CLIO.

Conner, M., & Norman, P. (2017). Health behaviour: Current issues and challenges. Psychology & Health, 32(8), 895-906. https://doi.org/10.1080/08870446.2017.1336240

Cook, N. R., & Ridker, P. M. (2016). Calibration of the pooled cohort equations for atherosclerotic cardiovascular disease: an update. *Annals of Internal Medicine, 165*(11), 786-794. https://doi.org/10.7326/M16-1739

Cook, N. R., Paynter, N. P., Eaton, C. B., Manson, J. E., Martin, L. W., Robinson, J. G., Rossouw, J. E., Wassertheil-Smoller, S., & Ridker, P. M. (2012). Comparison of the Framingham and Reynolds Risk scores for global cardiovascular risk prediction in the multiethnic Women's Health Initiative. *Circulation, 125*(14), 1748-1756. https://doi.org/10.1161/CIRCULATIONAHA.111.075929

Cope, D. G. (2014). Using electronic surveys in nursing research. *Oncology Nursing Forum, 41*(6), 681-682. https://doi.org/10.1188/14.ONF.681-682

Corcoy, R. (2019). Glucose screening in pregnancy to predict future cardiovascular risk. *Nature Reviews Endocrinology, 15*(7), 380-382. https://doi.org/10.1038/s41574-019-0216-4

Coulson, N. S., Ferguson, M. A., Henshaw, H., & Heffernan, E. (2016). Applying theories of health behaviour and change to hearing health research: Time for a new approach. *International Journal of Audiology, 55*(sup3), S99-S104. https://doi.org/10.3109/14992027.2016.1161851

Couper, M. P. (2017). New developments in survey data collection. *Annual Review of Sociology, 43*, 121-145. https://doi.org/10.1146/annurev-soc-060116-053613

Creswell, J. W. (2013). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage Publications.

Creswell, J. W., Hanson, W. E., Clark Plano, V. L., & Morales, A. (2007). Qualitative research designs: Selection and implementation. *The Counseling Psychologist, 35*(2), 236-264. https://doi.org/10.1177/0011000006287390

Critical Appraisal Skills Programme. (2016). *CASP Checklists*. CASP. Retrieved September 1, 2029, from https://casp-uk.net/casp-tools-checklists

Cunningham, F., Lenevo, K., Bloom, S., & Spong, C. (2014). *Williams bstetrics*. McGraw-Hill Education.

Cushman, M., Shay, C. M., Howard, V. J., Jiménez, M. C., Lewey, J., McSweeney, J. C., Newby, L. K., Poudel, R., Reynolds, H. R., & Rexrode, K. M. (2021). Ten-year differences in women's awareness related to coronary heart disease: Results of the 2019 American Heart Association National Survey: A special report from the American Heart Association. *Circulation, 143*(7), e239-e248. https://doi.org/10.1161/CIR.0000000000000907

Cusimano, M. C., Pudwell, J., Roddy, M., Cho, C.-K. J., & Smith, G. N. (2014). The maternal health clinic: An initiative for cardiovascular risk identification in women with pregnancy-related complications. *American Journal of Obstetrics and Gynecology, 210*(5), 438. e431-438. e439. https://doi.org/10.1016/j.ajog.2013.12.001

Dallongeville, J., Banegas, J. R., Tubach, F., Guallar, E., Borghi, C., Backer, G. D., Halcox, J. P., Massó-González, E. L., Perk, J., & Sazova, O. (2012). Survey of physicians' practices in the control of cardiovascular risk factors: The EURIKA study. *European Journal of Preventive Cardiology, 19*(3), 541-550. https://doi.org/10.1177/1741826711407705

Daly, B., Toulis, K. A., Thomas, N., Gokhale, K., Martin, J., Webber, J., Keerthy, D., Jolly, K., Saravanan, P., & Nirantharakumar, K. (2018). Increased risk of ischemic heart disease, hypertension, and type 2 diabetes in women with previous gestational diabetes mellitus, a target group in general practice for preventive interventions: A population-based cohort study. *PLOS Medicine, 15*(1). https://doi.org/10.1371/journal.pmed.1002488

Danaei, G., Ding, E. L., Mozaffarian, D., Taylor, B., Rehm, J., Murray, C. J., & Ezzati, M. (2009). The preventable causes of death in the United States: Comparative risk assessment of dietary, lifestyle, and metabolic risk factors. *PLOS Medicine, 6*(4), e1000058. https://doi.org/10.1371/journal.pmed.1000058

Daponte-Codina, A., Knox, E. C., Mateo-Rodriguez, I., Seims, A., Regitz-Zagrosek, V., Maas, A. H., White, A., Barnhoorn, F., & Rosell-Ortiz, F. (2022). Gender and social inequalities in awareness of coronary artery disease in European countries. *International Journal of Environmental Research and Public Health, 19*(3), 1388. https://doi.org/10.3390/ijerph19031388

Darwin, C. (2017). Building a learning organization. *Knowledge Solutions, 57*. https://doi.org/10.1007/978-981-10-0983-9_11

Davidson, C. (2003). *Social science research in New Zealand: Many paths to understanding*. Pearson Education New Zealand.

de Jong, M., Woodward, M., & Peters, S. A. (2020). Diabetes, glycated hemoglobin, and the risk of myocardial infarction in women and men: A prospective cohort study of the UK Biobank. *Diabetes Care, 43*(9), 2050-2059. https://doi.org/10.2337/dc19-2363

Dennison, D., & Golaszewski, T. (2002). The activated health education model: Refinement and implications for school health education. *Journal of School Health, 72*(1), 23-26. https://doi.org/10.1111/j.1746-1561.2002.tb06507.x

Di Cianni, G., Lacaria, E., Lencioni, C., & Resi, V. (2018). Preventing type 2 diabetes and cardiovascular disease in women with gestational diabetes–The evidence and potential strategies. *Diabetes Research and Clinical Practice, 145*, 184-192. https://doi.org/10.1016/j.diabres.2018.04.021

Di Giosia, P., Passacquale, G., Petrarca, M., Giorgini, P., Marra, A. M., & Ferro, A. (2017). Gender differences in cardiovascular prophylaxis: Focus on antiplatelet treatment. *Pharmacological Research, 119*, 36-47. https://doi.org/10.1016/j.phrs.2017.01.025

Diabetes Australia. (2020). *Gestational Diabetes*. Retrieved March 15, 2022, from https://www.diabetesaustralia.com.au/gestational-diabetes

Diamanti, A., Papadakis, S., Schoretsaniti, S., Rovina, N., Vivilaki, V., Gratziou, C., & Katsaounou, P. A. (2019). Smoking cessation in pregnancy: An update for maternity care practitioners. *Tobacco Induced Diseases, 17*. https://doi.org/10.18332/tid/109906

Díaz-Gutiérrez, J., Ruiz-Canela, M., Gea, A., Fernández-Montero, A., & Martínez-González, M. Á. (2018). Association between a healthy lifestyle score and the risk of cardiovascular disease in the SUN cohort. *Revista Española de Cardiología (English Edition), 71*(12), 1001-1009. https://doi.org/10.1016/j.rec.2017.10.038

Ding, S., Deng, Y., Lu, S., Lamb, K. V., Zhang, Y., & Wu, Y. (2017). Knowledge and practice in cardiovascular disease prevention among hospital registered nurses: a cross-sectional study. *Journal of Clinical Nursing, 26*(21-22), 3318-3327. https://doi.org/10.1111/jocn.13678

Dombrowski, S. U., Ford, G. A., Morgenstern, L. B., Withe, M., Sniehotta, F. F., & Mackintosh, J. E. (2015). Are there differrences between US and UK adults in stroke preparedness? Evidence from parallel population-based community surveys. *Stroke, 46*, 3220-3225. https://doi.org/10.1161/STROKEAHA.115.009997

Duff, E. (20019). A structural equation model of empowerment factors affecting nurse practitioners competence. *Nurse education in practice*, *38*, 145-152. https://doi.org/10.1016/j.nepr.2019.06.002

Dugas, C., & Slane, V. H. (2022). Miscarriage. In *StatPearls [Internet]*. StatPearls Publishing.

Echouffo-Tcheugui, J. B., Guan, J., Retnakaran, R., & Shah, B. R. (2021). Gestational diabetes and incident heart failure: a cohort study. *Diabetes Care, 44*(10), 2346-2352. https://doi.org/10.2337/dc21-0552

Eckel, R. H., Jakicic, J. M., Ard, J. D., de Jesus, J. M., Miller, N. H., Hubbard, V. S., Lee, I.-M., Lichtenstein, A. H., Loria, C. M., & Millen, B. E. (2014). 2013 AHA/ACC guideline on lifestyle management to reduce cardiovascular risk: A report of the

American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *Journal of the American College of Cardiology, 63*(25 Part B), 2960-2984. https://doi.org/10.1016/j.jacc.2013.11.003

Edwards, S., Birks, M., Chapman, Y., & Yates, K. (2016). Miscarriage in Australia: The geographical inequity of healthcare services. *Australasian Emergency Nursing Journal, 19*(2), 106-111. https://doi.org/10.1016/j.aenj.2016.02.001

Ehrenthal, D. B., & Catov, J. M. (2013). Importance of engaging obstetrician/gynecologists in cardiovascular disease prevention. *Current Opinion in Cardiology, 28*(5), 547. https://doi.org/10.1097/HCO.0b013e328364298e

Ehrenthal, D. B., Rogers, S., Goldstein, N. D., Edwards, D. G., & Weintraub, W. S. (2015). Cardiovascular risk factors one year after a hypertensive disorder of pregnancy. *Journal of Women's Health, 24*(1), 23-29. https://doi.org/10.1089/jwh.2014.4811

Einarson, T. R., Acs, A., Ludwig, C., & Panton, U. H. (2018). Prevalence of cardiovascular disease in type 2 diabetes: A systematic literature review of scientific evidence from across the world in 2007–2017. *Cardiovascular Diabetology, 17*(1), 1-19. https://doi.org/10.1186/s12933-018-0728-6

El Khoudary, S. R., Aggarwal, B., Beckie, T. M., Hodis, H. N., Johnson, A. E., Langer, R. D., Limacher, M. C., Manson, J. E., Stefanick, M. L., & Allison, M. A. (2020). Menopause transition and cardiovascular disease risk: Implications for timing of early prevention: A scientific statement from the American Heart Association. *Circulation, 142*(25), e506-e532. https://doi.org/10.1161/CIR.0000000000000912

Eldredge, J. D., Weagel, E. F., & Kroth, P. J. (2014). Defining and identifying members of a research study population: CTSA-affiliated faculty members. *Hypothesis: The Newsletter of the Research Section of MLA, 26*(1), 5.

Etchegary, C., Taylor, L., Mahoney, K., Parfrey, O., & Hall, A. (2021). Changing health-related behaviours 5: On interventions to change physician behaviours. In *Clinical Epidemiology* (pp. 613-630). Springer. https://doi.org/10.1007/978-1-0716-1138-8_33

Fabiyi, C. A., Reid, L. D., & Mistry, K. B. (2019). Postpartum health care use after gestational diabetes and hypertensive disorders of pregnancy. *Journal of Women's Health, 28*(8), 1116-1123. https://doi.org/10.1089/jwh.2018.7198

Facca, T. A., Mastroianni-Kirsztajn, G., Sabino, A. R. P., Passos, M. T., Dos Santos, L. F., Famá, E. A. B., Nishida, S. K., & Sass, N. (2018). Pregnancy as an early stress test for cardiovascular and kidney disease diagnosis. *Pregnancy Hypertension, 12*, 169-173. https://doi.org/10.1016/j.preghy.2017.11.008

Fadhil, A., Matteotti, C., Armellin, G., Villafiorita, A., & Betti, D. (2016). *CoachMe: A platform for promoting healthy lifestyle.* Proceedings of the 18th International Conference on Human-Computer Interaction with Mobile Devices and Services Adjunct.

Fang, J., Luncheon, C., Ayala, C., Odom, E., & Loustalot, F. (2019). Awareness of heart attack symptoms and response among adults—United States, 2008, 2014, and 2017. *Morbidity and Mortality Weekly Report, 68*(5), 101. https://doi.org/10.15585/mmwr.mm6805a2

Fernandez, M. E., Ruiter, R. A., Markham, C. M., & Kok, G. (2019). Intervention mapping: Theory- and evidence-based health promotion program planning: Perspective and examples. *Frontiers in Public Health, 7*, 209. https://doi.org/10.3389/fpubh.2019.00209

Ferranti, E. P., Jones, E. J., & Hernandez, T. L. (2016). Pregnancy reveals evolving risk for cardiometabolic disease in women. *Journal of Obstetric, Gynecologic & Neonatal Nursing, 45*(3), 413-425. https://doi.org/10.1016/j.jogn.2016.02.004

Ferrer, R. A., & Klein, W. M. (2015). Risk perceptions and health behavior. *Current Opinion in Psychology, 5*, 85-89. https://doi.org/10.1016/j.copsyc.2015.03.012

Firestone, R., Rowe, C. J., Modi, S. N., & Sievers, D. (2017). The effectiveness of social marketing in global health: A systematic review. *Health Policy and Planning, 32*(1), 110-124. https://doi.org/10.1093/heapol/czw088

Fitzner, K., & Heckinger, E. (2010). Sample size calculation and power analysis: A quick review. *The Diabetes Educators, 36*, 701-707. https://doi.org/10.1177/0145721710380791

Flack, J. M., & Adekola, B. (2020). Blood pressure and the new ACC/AHA hypertension guidelines. *Trends in Cardiovascular Medicine, 30*(3), 160-164. https://doi.org/10.1016/j.tcm.2019.05.003

Fletcher, G. F., Landolfo, C., Niebauer, J., Ozemek, C., Arena, R., & Lavie, C. J. (2018). Promoting physical activity and exercise: JACC health promotion series. *Journal of the American College of Cardiology, 72*(14), 1622-1639. https://doi.org/10.1016/j.jacc.2018.08.2141

Fossum, S., Halvorsen, S., Vikanes, Å. V., Roseboom, T. J., Ariansen, I., & Næss, Ø. (2018). Cardiovascular risk profile at the age of 40–45 in women with previous hyperemesis gravidarum or hypertensive disorders in pregnancy: A population-based study. *Pregnancy Hypertension, 12*, 129-135. https://doi.org/10.1016/j.preghy.2018.04.013

Foxcroft, C., & Roodt, G. (2005). *An introduction to psychological assessment in the South African context*. Oxford University Press, USA.

Fretts, R., & Lockwood, C. (2015). Fetal demise and stillbirth: Incidence, etiology and prevention.

Fry, D., & Zask, A. (2017). Applying the Ottawa Charter to inform health promotion programme design. *Health Promotion International, 32*(5), 901-912. https://doi.org/10.1093/heapro/daw022

Fuchs, F. D., & Whelton, P. K. (2020). High blood pressure and cardiovascular disease. *Hypertension, 75*(2), 285-292. https://doi.org/10.1161/HYPERTENSIONAHA.119.14240

Funai, E. F., Friedlander, Y., Paltiel, O., Tiram, E., Xue, X., Deutsch, L., & Harlap, S. (2005). Long-term mortality after preeclampsia. *Epidemiology, 16*(2), 206-215. https://doi.org/10.1097/01.ede.0000152912.02042.cd

Gallucci, G., Tartarone, A., Lerose, R., Lalinga, A. V., & Capobianco, A. M. (2020). Cardiovascular risk of smoking and benefits of smoking cessation. *Journal of Thoracic Disease, 12*(7), 3866. https://doi.org/10.21037/jtd.2020.02.47

Gao, Z., Chen, Z., Sun, A., & Deng, X. (2019). Gender differences in cardiovascular disease. *Medicine in Novel Technology and Devices, 4*(100025). https://doi.org/10.1016/j.medntd.2019.100025

Garcia, M., Mulvagh, S. L., Bairey Merz, C. N., Buring, J. E., & Manson, J. E. (2016). Cardiovascular disease in women: Clinical perspectives. *Circulation Research, 118*(8), 1273-1293. https://doi.org/10.1161/CIRCRESAHA.116.307547

Garcia, T. A., Fairlie, A. M., Litt, D. M., Waldron, K. A., & Lewis, M. A. (2018). Perceived vulnerability moderates the relations between the use of protective behavioral strategies and alcohol use and consequences among high risk young adults. *Addictive Behaviors, 81*, 150-156. https://doi.org/10.1016/j.addbeh.2018.02.001

Garg, N., Muduli, S. K., Kapoor, A., Tewari, S., Kumar, S., Khanna, R., & Goel, P. K. (2017). Comparison of different cardiovascular risk score calculators for cardiovascular risk prediction and guideline recommended statin uses. *Indian Heart Journal, 69*(4), 458-463. https://doi.org/10.1016/j.ihj.2017.01.015

Garovic, V. D., Bailey, K. R., Boerwinkle, E., Hunt, S. C., Weder, A. B., Curb, D., Mosley Jr, T. H., Wiste, H. J., & Turner, S. T. (2010). Hypertension in pregnancy as a risk factor for cardiovascular disease later in life. *Journal of Hypertension, 28*(4), 826. https://doi.org/10.1097/HJH.0b013e328335c29a

Gastrich, M. D., Zinonos, S., Bachmann, G., Cosgrove, N. M., Cabrera, J., Cheng, J. Q., & Kostis, J. B. (2020). Preeclamptic women are at significantly higher risk of future cardiovascular outcomes over a 15-year period. *Journal of Women's Health, 29*(1), 74-83. https://doi.org/10.1089/jwh.2019.7671

Geense, W. W., Van De Glind, I. M., Visscher, T. L., & Van Achterberg, T. (2013). Barriers, facilitators and attitudes influencing health promotion activities in general practice: An explorative pilot study. *BMC Family Practice, 14*(1), 1-10. https://doi.org/10.1186/1471-2296-14-20

Geldsetzer, P., Manne-Goehler, J., Marcus, M.-E., Ebert, C., Zhumadilov, Z., Wesseh, C. S., Tsabedze, L., Supiyev, A., Sturua, L., & Bahendeka, S. K. (2019). The state of hypertension care in 44 low-income and middle-income countries: A cross-sectional study of nationally representative individual-level data from 1.1 million adults. *The Lancet, 394*(10199), 652-662. https://doi.org/10.1016/S0140-6736(19)30955-9

Gellert, P., & Tille, F. (2015). What do we know so far? The role of health knowledge within theories of health literacy. *European Health Psychologist, 17*(6), 266-274.

Gerdts, E., Okin, P. M., De Simone, G., Cramariuc, D., Wachtell, K., Boman, K., & Devereux, R. B. (2008). Gender differences in left ventricular structure and function during antihypertensive treatment: The Losartan Intervention for Endpoint Reduction in Hypertension Study. *Hypertension, 51*(4), 1109-1114. https://doi.org/10.1161/HYPERTENSIONAHA.107.107474

Gholizadeh, L., Davidson, P., Salamonson, Y., & Worrall-Carter, L. (2010). Theoretical considerations in reducing risk for cardiovascular disease: Implications for nursing practice. *Journal of Clinical Nursing, 19*(15-16), 2137-2145. https://doi.org/10.1111/j.1365-2702.2009.03189.x

Gilbert, S., Laschinger, H. K., & Leiter, M. (2010). The mediating effect of burnout on the relationship between structural empowerment and organizational citizenship behaviours. *Journal of Nursing Management, 18*(3), 339-348. https://doi.org/10.1111/j.1365-2834.2010.01074.x

Gladstone, R. A., Pudwell, J., Nerenberg, K. A., Grover, S. A., & Smith, G. N. (2019). Cardiovascular risk assessment and follow-up of women after hypertensive disorders of pregnancy: A Prospective Cohort Study. *Journal of Obstetrics and Gynaecology Canada, 41*(8), 1157-1167. e1151. https://doi.org/10.1016/j.jogc.2018.10.024

Glantz, K., Rimer, B., & Viswanath, K. (2008). The scope of health behavior and health education. In *Health behavior and health education: theory, research, and practice* (4th ed., pp.3-22). Jossey-Bass.

Glasow, P. A. (2005). Fundamentals of survey research methodology. MITRE.

Goff Jr, D. C., Lloyd-Jones, D. M., Bennett, G., Coady, S., D'agostino, R. B., Gibbons, R., Greenland, P., Lackland, D. T., Levy, D., & O'Donnell, C. J. (2014). 2013 ACC/AHA guideline on the assessment of cardiovascular risk: A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *Circulation, 129*(25_suppl_2), S49-S73. https://doi.org/10.1161/01.cir.0000437741.48606.98

Gogineni, V. S. M., Manfrini, D., Aroda, S. H., Zhang, Y., Nelson, D. S., Egerman, R., & Park, K. (2021). Variations in awareness of association between adverse pregnancy outcomes and cardiovascular risk by specialty. *Cardiology and Therapy, 10*(2), 577-592. https://doi.org/10.1007/s40119-021-00220-y

Gogtay, N. J. (2010). Principles of sample size calculation. *Indian Journal of Ophthalmology, 58*(6), 517. https://doi.org/10.4103/0301-4738.71692

Gomathy, E., Akurati, L., & Radhika, K. (2018). Early onset and late onset preeclampsia-maternal and perinatal outcomes in a rural teritiary health center. *International Journal of Reproduction, Contraception, Obstetrics and Gynecology, 7*(6), 2266-2270. https://doi.org/10.18203/2320-1770.ijrcog20182333

Gooding, H. C., Brown, C. A., Liu, J., Revette, A. C., Stamoulis, C., & de Ferranti, S. D. (2019). Will teens go red? Low cardiovascular disease awareness among young women. *Journal of the American Heart Association, 8*(6), e011195. https://doi.org/10.1161/JAHA.118.011195

Gore, T. D., & Bracken, C. C. (2005). Testing the theoretical design of a health risk message: Reexamining the major tenets of the extended parallel process model. *Health Education & Behavior, 32*(1), 27-41. https://doi.org/10.1177/1090198104266901

Gorgui, J., Gorshkov, M., Khan, N., & Daskalopoulou, S. S. (2014). Hypertension as a risk factor for ischemic stroke in women. *Canadian Journal of Cardiology, 30*(7), 774-782. https://doi.org/10.1016/j.cjca.2014.01.007

Goueslard, K., Cottenet, J., Mariet, A.-S., Giroud, M., Cottin, Y., Petit, J.-M., & Quantin, C. (2016). Early cardiovascular events in women with a history of gestational diabetes mellitus. *Cardiovascular Diabetology, 15*(1), 15. https://doi.org/10.1186/s12933-016-0338-0

Govender, R. D., Al-Shamsi, S., Soteriades, E. S., & Regmi, D. (2019). Incidence and risk factors for recurrent cardiovascular disease in middle-eastern adults: A retrospective study. *BMC Cardiovascular Disorders, 19*(1), 1-7. https://doi.org/10.1186/s12872-019-1231-z

Grandi, S. M., Filion, K. B., Yoon, S., Ayele, H. T., Doyle, C. M., Hutcheon, J. A., Smith, G. N., Gore, G. C., Ray, J. G., & Nerenberg, K. (2019). Cardiovascular disease-related morbidity and mortality in women with a history of pregnancy complications: Systematic review and meta-analysis. *Circulation, 139*(8), 1069-1079. https://doi.org/10.1161/CIRCULATIONAHA.118.036748

Grandi, S. M., Reynier, P., Platt, R. W., Basso, O., & Filion, K. B. (2018). The timing of onset of hypertensive disorders in pregnancy and the risk of incident hypertension and cardiovascular disease. *International Journal of Cardiology, 270*, 273-275. https://doi.org/10.1016/j.ijcard.2018.06.059

Grandi, S. M., Vallée-Pouliot, K., Reynier, P., Eberg, M., Platt, R. W., Arel, R., Basso, O., & Filion, K. B. (2017). Hypertensive disorders in pregnancy and the risk of subsequent cardiovascular disease. *Paediatric and Perinatal Epidemiology, 31*(5), 412-421. https://doi.org/10.1111/ppe.12388

Greaves, K., Smith, A., Agostino, J., Kunarajah, K., Stanton, T., & Korda, R. (2020). Cross-sectional survey describing general practitioners' absolute cardiovascular disease risk assessment practices and their relationship to knowledge, attitudes and beliefs about cardiovascular disease risk in Queensland, Australia. *BMJ Open, 10*(8), e033859. https://doi.org/10.1136/bmjopen-2019-033859

Green, J. B. (2021). Cardiovascular consequences of gestational diabetes. *Circulation*, *143*(10), 988–990. https://doi.org/10.1161/CIRCULATIONAHA.120.052995

Greenhalgh, E., Scollo, M. M., & Winstanley, M. H. (2022). *Tobacco in Australia: Facts and issues*. Cancer Council Victoria. www.tobaccoinaustralia.org.au

Gross, D. P. (2012). Knowledge translation and behaviour change: patients, providers, and populations. *Physiotherapy Canada, 64*(3), 221. https://doi.org/10.3138/ptc.64.3.ge1

Gruszin, S., Hetzel, D., & Glover, J. (2012). *Advocacy and action in public health: lessons from Australia over the 20th century.* Australian National Preventive Health Agency.

Gulati, M. (2017). Improving the cardiovascular health of women in the nation: moving beyond the bikini boundaries. *Circulation, 135*(6), 495-498. https://doi.org/10.1161/CIRCULATIONAHA.116.025303

Guthrie, J., Mancino, L., & Lin, C. T. J. (2015). Nudging consumers toward better food choices: Policy approaches to changing food consumption behaviors. *Psychology & Marketing, 32*(5), 501-511. https://doi.org/10.1002/mar.20795

Haines, A., Horton, R., & Bhutta, Z. (2007). Primary health care comes of age. Looking forward to the 30th anniversary of Alma-Ata: call for papers. *The Lancet, 370*(9591), 911-913. https://doi.org/10.1016/S0140-6736(07)61423-8

Harreiter, J., Dovjak, G., & Kautzky-Willer, A. (2014). Gestational diabetes mellitus and cardiovascular risk after pregnancy. *Women's Health, 10*(1), 91-108. https://doi.org/10.2217/WHE.13.69

Haug, E. B., Horn, J., Markovitz, A. R., Fraser, A., Klykken, B., Dalen, H., Vatten, L. J., Romundstad, P. R., Rich-Edwards, J. W., & Åsvold, B. O. (2019). Association of conventional cardiovascular risk factors with cardiovascular disease after hypertensive disorders of pregnancy: Analysis of the Nord-Trøndelag Health Study. *JAMA Cardiology, 4*(7), 628-635. https://doi.org/10.1001/jamacardio.2019.1746

Hauspurg, A., Countouris, M. E., & Catov, J. M. (2019). Hypertensive disorders of pregnancy and future maternal health: How can the evidence guide postpartum management? *Current Hypertension Reports, 21*(12), 1-10. https://doi.org/10.1007/s11906-019-0999-7

Hauspurg, A., Ying, W., Hubel, C. A., Michos, E. D., & Ouyang, P. (2018). Adverse pregnancy outcomes and future maternal cardiovascular disease. *Clinical Cardiology, 41*(2), 239-246. https://doi.org/10.1002/clc.22887

Hawton, K., Houston, K., Malmbergand, A., & Simkin, S. (2003). Psychological autopsy interviews in suicide research: The reactions of informants. *Archives of Suicide Research, 7*(1), 73-82. https://doi.org/10.1080/13811110301566

Hedayatnia, M., Asadi, Z., Zare-Feyzabadi, R., Yaghooti-Khorasani, M., Ghazizadeh, H., Ghaffarian-Zirak, R., Nosrati-Tirkani, A., Mohammadi-Bajgiran, M., Rohban, M., & Sadabadi, F. (2020). Dyslipidemia and cardiovascular disease risk among the MASHAD study population. *Lipids in Health and Disease, 19*(1), 1-11. https://doi.org/10.1186/s12944-020-01204-y

Hedlin, H., Weitlauf, J., Crandall, C. J., Nassir, R., Cauley, J. A., Garcia, L., Brunner, R., Robinson, J., Stefanick, M. L., & Robbins, J. (2019). Development of a comprehensive health-risk prediction tool for postmenopausal women. *Menopause, 26*(12), 1385-1394. https://doi.org/10.1097/GME.0000000000001411

Heidrich, M.-B., Wenzel, D., von Kaisenberg, C. S., Schippert, C., & von Versen-Höynck, F. M. (2013). Preeclampsia and long-term risk of cardiovascular disease: What do obstetrician-gynecologists know? *BMC Pregnancy and Childbirth, 13*(61), 1-6. https://doi.org/10.1186/1471-2393-13-61

Hermes, W., Tamsma, J. T., Grootendorst, D. C., Franx, A., van der Post, J., Van Pampus, M. G., Bloemenkamp, K. W., Porath, M., Mol, B. W., & De Groot, C. J. (2013). Cardiovascular risk estimation in women with a history of hypertensive pregnancy disorders at term: A longitudinal follow-up study. *BMC Pregnancy and Childbirth, 13*(1), 126. https://doi.org/10.1186/1471-2393-13-126

Hespe, C. M., Campain, A., Webster, R., Patel, A., Rychetnik, L., Harris, M. F., & Peiris, D. P. (2020). Implementing cardiovascular disease preventive care guidelines in general practice: An opportunity missed. *Med J Aust, 213*(7), 327-328. https://doi.org/10.5694/mja2.50756

Hill, M. F., & Bordoni, B. (2022). Hyperlipidemia. In *StatPearls [Internet]*. StatPearls Publishing.
Hoare, E., Stavreski, B., Kingwell, B. A., & Jennings, G. L. (2017). Australian adults' behaviours, knowledge and perceptions of risk factors for heart disease: A cross-sectional study. *Preventive Medicine Reports, 8*, 204-209. https://doi.org/10.1016/j.pmedr.2017.10.007
Holthuis, E. I., Visseren, F. L., Bots, M. L., Peters, S. A., & group, U.-S. s. (2021). Risk factor clusters and cardiovascular disease in high risk patients: The UCC-SMART Study. *Global Heart, 16*(1). https://doi.org/10.5334/gh.897
Honigberg, M. C., Zekavat, S. M., Aragam, K., Klarin, D., Bhatt, D. L., Scott, N. S., Peloso, G. M., & Natarajan, P. (2019). Long-term cardiovascular risk in women with hypertension during pregnancy. *Journal of the American College of Cardiology, 74*(22), 2743-2754. https://doi.org/10.1016/j.jacc.2019.09.052
Horn, J., Tanz, L. J., Stuart, J. J., Markovitz, A. R., Skurnik, G., Rimm, E. B., Missmer, S. A., & Rich-Edwards, J. W. (2019). Early or late pregnancy loss and development of clinical cardiovascular disease risk factors: A prospective cohort study. *BJOG: An International Journal of Obstetrics & Gynaecology, 126*(1), 33-42. https://doi.org/10.1111/1471-0528.15452
Hsu, C. L., & Sheu, W. H. H. (2018). History of gestational diabetes and future cardiovascular disease: What have we learned? *Journal of Diabetes Investigation, 9*(6), 1258. https://doi.org/10.1111/jdi.12874
Huang, E. C.-H., Pu, C., Chou, Y.-J., & Huang, N. (2018). Public trust in physicians—health care commodification as a possible deteriorating factor: Cross-sectional analysis of 23 countries. *INQUIRY: The Journal of Health Care Organization, Provision, and Financing, 55*, 0046958018759174. https://doi.org/10.1177/0046958018759174
Huck, S. W., Cormier, W. H., & Bounds, W. G. (2012). *Reading statistics and research* (Vol. 566). Pearson Boston.
Huebschmann, A. G., Huxley, R. R., Kohrt, W. M., Zeitler, P., Regensteiner, J. G., & Reusch, J. E. (2019). Sex differences in the burden of type 2 diabetes and cardiovascular risk across the life course. *Diabetologia, 62*(10), 1761-1772. https://doi.org/10.1007/s00125-019-4939-5
Hug, L., You, D., Blencowe, H., Mishra, A., Wang, Z., Fix, M. J., Wakefield, J., Moran, A. C., Gaigbe-Togbe, V., & Suzuki, E. (2022). Global, regional, and national estimates and trends in stillbirths from 2000 to 2019: A systematic assessment. *Obstetrical & Gynecological Survey, 77*(2), 83-85. https://doi.org/10.1097/01.ogx.0000816512.11007.84
Hultberg, J., & Rudebeck, C. E. (2012). Clinical gaze in risk-factor haze: Swedish GPs' perceptions of prescribing cardiovascular preventive drugs. *International Journal of Family Medicine, 2012,* 612572. https://doi.org/10.1155/2012/612572
Huma, S., Tariq, R., Amin, F., & Mahmood, K. T. (2012). Modifiable and non-modifiable predisposing risk factors of myocardial infarction-A review. *Journal of Pharmaceutical Sciences and Research, 4*(1), 1649.
Humphries, K., Izadnegadar, M., Sedlak, T., Saw, J., Johnston, N., Schenck-Gustafsson, K., Shah, R., Regitz-Zagrosek, V., Grewal, J., & Vaccarino, V. (2017). Sex differences in cardiovascular disease–impact on care and outcomes. *Frontiers in Neuroendocrinology, 46*, 46. https://doi.org/10.1016/j.yfrne.2017.04.001
Hutchesson, M., Shrewsbury, V., Park, F., Callister, R., & Collins, C. (2018). Are women with a recent diagnosis of pre-eclampsia aware of their cardiovascular disease risk? A cross-sectional survey. *Australian and New Zealand Journal of Obstetrics and Gynaecology, 58*(6), E27-E28. https://doi.org/10.1111/ajo.12900

Huxley, R. R., Peters, S. A., Mishra, G. D., & Woodward, M. (2015). Risk of all-cause mortality and vascular events in women versus men with type 1 diabetes: a systematic review and meta-analysis. *The Lancet Diabetes & Endocrinology, 3*(3), 198-206. https://doi.org/10.1016/S2213-8587(14)70248-7

Hvidtjørn, D., Wu, C., Schendel, D., Thorlund Parner, E., & Brink Henriksen, T. (2016). Mortality in mothers after perinatal loss: a population-based follow-up study. *BJOG: An International Journal of Obstetrics & Gynaecology, 123*(3), 393-398. https://doi.org/10.1111/1471-0528.13268

Hyun, K. K., Redfern, J., Patel, A., Peiris, D., Brieger, D., Sullivan, D., Harris, M., Usherwood, T., MacMahon, S., & Lyford, M. (2017). Gender inequalities in cardiovascular risk factor assessment and management in primary healthcare. *Heart, 103*(7), 492-498. https://doi.org/10.1136/heartjnl-2016-310216

Iancu, M. A., Baltă, M. D., Stănescu, A. M. A., Ticărău, A., Nicolescu, O., Olariu, C. M., Diaconu, C. C., & Matei, D. (2020). The role of the general practitioner in monitoring pregnant women with hypertension. *Romanian Journal of Medical Practice, 15*(2), 71. https://doi.org/10.37897/RJMP.2020.2.5

Ibekwe, R. (2015). Modifiable risk factors of hypertension and socio demographic profile in Oghara, Delta state; Prevalence and correlates. *Annals of Medical and Health Sciences Research, 5*(1), 71-77. https://doi.org/10.4103/2141-9248.149793

In, J. (2017). Introduction of a pilot study. *Korean Journal of Anesthesiology, 70*(6), 601-605. https://doi.org/10.4097/kjae.2017.70.6.601

International Diabetes Federation. (2020). *Gestational diabetes*. Retrieved August 26, 2020, from https://www.idf.org/our-activities/care-prevention/gdm

Irgens, H. U., Roberts, J. M., Reisæter, L., Irgens, L. M., & Lie, R. T. (2001). Long term mortality of mothers and fathers after pre-eclampsia: Population based cohort study *BMJ, 323*(7323), 1213-1217. https://doi.org/10.1136/bmj.323.7323.1213

Isiadinso, I., & Wenger, N. K. (2017). Do we need a different approach to assess cardiovascular risk in women. *US Cardiology Review, 11*, 5-9. https://doi.org/10.15420/usc.2016:8:2

Ittaman, S. V., VanWormer, J. J., & Rezkalla, S. H. (2014). The role of aspirin in the prevention of cardiovascular disease. *Clinical Medicine & Research, 12*(3-4), 147-154. https://doi.org/10.3121/cmr.2013.1197

Jackson, E. (2018). Cardiovascular risk of smoking and benefits of smoking cessation. *UpToDate*. Retrieved from https://www.uptodate.com/contents/cardiovascular-risk-of-smoking-and-benefits-of-smoking-cessation

Janz, N. (1988). The Health Belief Model in understanding cardiovascular risk factor reduction behaviors. *Cardio-vascular Nursing, 24*(6), 39.

Janz, N. K., & Becker, M. H. (1984). The health belief model: A decade later. *Health Education Quarterly, 11*(1), 1-47. https://doi.org/10.1177/109019818401100101

Jernberg, T., Hasvold, P., Henriksson, M., Hjelm, H., Thuresson, M., & Janzon, M. (2015). Cardiovascular risk in post-myocardial infarction patients: Nationwide real world data demonstrate the importance of a long-term perspective. *European Heart Journal, 36*(19), 1163-1170. https://doi.org/10.1093/eurheartj/ehu505

Ji, H., Kim, A., Ebinger, J. E., Niiranen, T. J., Claggett, B. L., Merz, C. N. B., & Cheng, S. (2020). Sex differences in blood pressure trajectories over the life course. *JAMA Cardiology, 5*(3), 255-262. https://doi.org/10.1001/jamacardio.2019.5306

Johansson, S., Rosengren, A., Young, K., & Jennings, E. (2017). Mortality and morbidity trends after the first year in survivors of acute myocardial infarction: A systematic review. *BMC Cardiovascular Disorders, 17*(1), 53. https://doi.org/10.1186/s12872-017-0482-9

John, H., Treharne, G. J., Hale, E. D., Panoulas, V. F., Carroll, D., & Kitas, G. D. (2009). Development and initial validation of a heart disease knowledge questionnaire for people with rheumatoid arthritis. *Patient Education and Counseling, 77*(1), 136-143. https://doi.org/10.1016/j.pec.2009.03.014

Johnson, M., & Welch, A. J. (2011). *Research methods in nursing and midwifery: Pathways to evidence-based practice*. Oxford University Press.

Kanter, R. M. (1993). *Men and women of the corporation*. Basic Books.

Karimi-Shahanjarini, A., Shakibazadeh, E., Rashidian, A., Hajimiri, K., Glenton, C., Noyes, J., Lewin, S., Laurant, M., & Colvin, C. J. (2019). Barriers and facilitators to the implementation of doctor-nurse substitution strategies in primary care: A qualitative evidence synthesis. *Cochrane Database of Systematic Reviews, 4*(4). https://doi.org/10.1002/14651858.CD010412.pub2

Kaul, P., Savu, A., Nerenberg, K., Donovan, L., Chik, C., Ryan, E., & Johnson, J. (2015). Impact of gestational diabetes mellitus and high maternal weight on the development of diabetes, hypertension and cardiovascular disease: A population-level analysis. *Diabetic Medicine, 32*(2), 164-173. https://doi.org/10.1111/dme.12635

Kayser, L., Karnoe, A., Duminski, E., Somekh, D., & Vera-Muñoz, C. (2019). A new understanding of health related empowerment in the context of an active and healthy ageing. *BMC Health Services Research, 19*(1), 242. https://doi.org/10.1186/s12913-019-4082-5

Keleher, H., & Parker, R. (2013). Health promotion by primary care nurses in Australian general practice. *Collegian, 20*(4), 215-221. https://doi.org/10.1016/j.colegn.2012.09.001

Kelly, B. B., & Fuster, V. (2010). *Promoting cardiovascular health in the developing world: A critical challenge to achieve global health*. National Academies Press.

Kelly, M. P., & Barker, M. (2016). Why is changing health-related behaviour so difficult? *Public Health, 136*, 109-116. https://doi.org/10.1016/j.puhe.2016.03.030

Khan, S., & Ali, S. A. (2017). Exploratory study into awareness of heart disease and health care seeking behavior among Emirati women (UAE)-Cross sectional descriptive study. *BMC Women's Health, 17*(1), 1-10. https://doi.org/10.1186/s12905-017-0445-4

Kharazmi, E., Dossus, L., Rohrmann, S., & Kaaks, R. (2011). Pregnancy loss and risk of cardiovascular disease: A prospective population-based cohort study (EPIC-Heidelberg). *Heart, 97*(1), 49-54. https://doi.org/10.1136/hrt.2010.202226

Kharazmi, E., Fallah, M., & Luoto, R. (2010). Miscarriage and risk of cardiovascular disease. *Acta Obstetricia et Gynecologica Scandinavica, 89*(2), 284-288. https://doi.org/10.3109/00016340903380758

Khosla, K., Heimberger, S., Nieman, K. M., Tung, A., Shahul, S., Staff, A. C., & Rana, S. (2021). Long-term cardiovascular disease risk in women after hypertensive disorders of pregnancy: Recent advances in hypertension. *Hypertension, 78*(4), 927-935. https://doi.org/10.1161/HYPERTENSIONAHA.121.16506

Kim, H.-J., Kim, H. Y., Kim, H.-L., Park, S. M., Cho, D.-H., Kim, M., Yoon, H. J., Byun, Y. S., Park, S. M., & Shin, M.-S. (2022). Awareness of cardiovascular disease among Korean women: Results from a nationwide survey. *Preventive Medicine Reports, 26*, 101698. https://doi.org/10.1016/j.pmedr.2022.101698

Kim, S. J., Kwon, O. D., Lee, E.-J., Ock, S. M., & Kim, K.-S. (2021). Impact of a family history of cardiovascular disease on prevalence, awareness, treatment, control of dyslipidemia, and healthy behaviors: Findings from the Korea National Health and

Nutrition Examination Survey. *PLOS One, 16*(7), e0254907. https://doi.org/10.1371/journal.pone.0254907

Kim, S. J., Kwon, O., & Kim, K.-S. (2021). Prevalence, awareness, treatment, and control of dyslipidemia among diabetes mellitus patients and predictors of optimal dyslipidemia control: Results from the Korea National Health and Nutrition Examination Survey. *Lipids in Health and Disease, 20*(1), 1-10. https://doi.org/10.1186/s12944-021-01455-3

Kirsten, W. (2001). *Health promotion: An international phenomenon.* American University. http://www.american.edu/academic.depts/cas/health/iihp/archives/pubsiihpchinawolf.html

Kitagawa, Y., Teramoto, T., & Daida, H. (2012). Adherence to preferable behavior for lipid control by high risk dyslipidemic Japanese patients under pravastatin treatment: The APPROACH-J study. *Journal of Atherosclerosis and Thrombosis*, 12682. https://doi.org/10.5551/jat.12682

Klisić, A., Kavarić, N., Bjelaković, B., Jovanović, M., Zvrko, E., Stanišić, V., Ninić, A., & Šćepanović, A. (2018). Cardiovascular risk assessed by reynolds risk score in relation to waist circumference in apparently healthy middle-aged population in Montenegro. *Acta Clinica Croatica, 57*(1), 22-30. https://doi.org/10.20471/acc.2018.57.01.03

Kodogo, V., Azibani, F., & Sliwa, K. (2019). Role of pregnancy hormones and hormonal interaction on the maternal cardiovascular system: A literature review. *Clinical Research in Cardiology*, 1-16. https://doi.org/10.1007/s00392-019-01441-x

Korczak, D. J., Cleverley, K., Birken, C. S., Pignatiello, T., Mahmud, F. H., & McCrindle, B. W. (2021). Cardiovascular disease risk factors among children and adolescents with depression. *Frontiers in Psychiatry, 12*, 702737. https://doi.org/10.3389/fpsyt.2021.702737

Koszowski, B., Rosenberry, Z. R., Yi, D., Stewart, S., & Pickworth, W. B. (2017). Smoking behavior and smoke constituents from cigarillos and little cigars. *Tobacco Regulatory Science, 3*(2), 31-40. https://doi.org/10.18001/TRS.3.2(Suppl1).4

Kozup, J., & Hogarth, J. M. (2008). Financial literacy, public policy, and consumers' self-protection—More questions, fewer answers. *Journal of Consumer Affairs, 42*(2), 127-136. https://doi.org/10.1111/j.1745-6606.2008.00101.x

Kumar, S., & Preetha, G. (2012). Health promotion: An effective tool for global health. *Indian Journal of Community Medicine: Official Publication of Indian Association of Preventive & Social Medicine, 37*(1), 5. https://doi.org/10.4103/0970-0218.94009

Kunst, A. E., Bos, V., Lahelma, E., Bartley, M., Lissau, I., Regidor, E., Mielck, A., Cardano, M., Dalstra, J. A., & Geurts, J. J. (2005). Trends in socioeconomic inequalities in self-assessed health in 10 European countries. *International Journal of Epidemiology, 34*(2), 295-305. https://doi.org/10.1093/ije/dyh342

Kwame, A., & Petrucka, P. M. (2021). A literature-based study of patient-centered care and communication in nurse-patient interactions: Barriers, facilitators, and the way forward. *BMC Nursing, 20*(1), 1-10. https://doi.org/10.1186/s12912-021-00684-2

Kyriacou, H., Al-Mohammad, A., Muehlschlegel, C., Foster-Davies, L., Bruco, M. E. F., Legard, C., Fisher, G., Simmons-Jones, F., & Oliver-Williams, C. (2022). The risk of cardiovascular disease after miscarriage, stillbirth, and induced abortion: A systematic review and meta-analysis. *European Heart Journal Open, 2*(5), oeac065. https://doi.org/10.1093/ehjopen/oeac065

Laher, S. (2016). Ostinato rigore: Establishing methodological rigour in quantitative research. *South African Journal of Psychology, 46*(3), 316-327. https://doi.org/10.1177/0081246316649121

Lahey, R., & Khan, S. S. (2018). Trends in obesity and risk of cardiovascular disease. *Current Epidemiology Reports, 5*(3), 243-251. https://doi.org/10.1007/s40471-018-0160-1

Lange, S., Probst, C., Rehm, J., & Popova, S. (2018). National, regional, and global prevalence of smoking during pregnancy in the general population: A systematic review and meta-analysis. *The Lancet Global Health, 6*(7), e769-e776. https://doi.org/10.1016/S2214-109X(18)30223-7

Larsson, S. C., Wallin, A., Håkansson, N., Stackelberg, O., Bäck, M., & Wolk, A. (2018). Type 1 and type 2 diabetes mellitus and incidence of seven cardiovascular disease. *International Journal of Cardiology, 262*, 66-70. https://doi.org/10.1016/j.ijcard.2018.03.099

Last, A. R., Ference, J. D., & Menzel, E. R. (2017). Hyperlipidemia: drugs for cardiovascular risk reduction in adults. *American family physician, 95*(2), 78-87.

Latham, G. P., & Locke, E. A. (2007). New developments in and directions for goal-setting research. *European Psychologist, 12*(4), 290-300. https://doi.org/10.1027/1016-9040.12.4.290

Laverack, G. (2017). The challenge of behaviour change and health promotion. *Challenges, 8*(2), 25. https://doi.org/10.3390/challe8020025

Leavy, P. (2022). *Research design: Quantitative, qualitative, mixed methods, arts-based, and community-based participatory research approaches*. Guilford Publications.

Lee, C. M. Y., Mnatzaganian, G., Woodward, M., Chow, C. K., Sitas, F., Robinson, S., & Huxley, R. R. (2019). Sex disparities in the management of coronary heart disease in general practices in Australia. *Heart, 105*(24), 1898-1904. https://doi.org/10.1136/heartjnl-2019-315134

Lee, S. M., Shivakumar, M., Park, J. W., Jung, Y. M., Choe, E. K., Kwak, S. H., Oh, S., Park, J. S., Jun, J. K., & Kim, D. (2022). Long-term cardiovascular outcomes of gestational diabetes mellitus: A prospective UK Biobank study. *Cardiovascular Diabetology, 21*(1), 1-14. https://doi.org/10.1186/s12933-022-01663-w

Leening, M. J., Ferket, B. S., Steyerberg, E. W., Kavousi, M., Deckers, J. W., Nieboer, D., Heeringa, J., Portegies, M. L., Hofman, A., & Ikram, M. A. (2014). Sex differences in lifetime risk and first manifestation of cardiovascular disease: Prospective population based cohort study. *BMJ, 349*, g5992. https://doi.org/10.1136/bmj.g5992

Leon, A. C., Davis, L. L., & Kraemer, H. C. (2011). The role and interpretation of pilot studies in clinical research. *Journal of Psychiatric Research, 45*(5), 626-629. https://doi.org/10.1016/j.jpsychires.2010.10.008

Leon, L. J., McCarthy, F. P., Direk, K., Gonzalez-Izquierdo, A., Prieto-Merino, D., Casas, J. P., & Chappell, L. (2019). Preeclampsia and cardiovascular disease in a large UK pregnancy cohort of linked electronic health records: A CALIBER study. *Circulation, 140*(13), 1050-1060. https://doi.org/10.1161/CIRCULATIONAHA.118.038080

Li, S., Peng, Y., Wang, X., Qian, Y., Xiang, P., Wade, S. W., Guo, H., Lopez, J. A. G., Herzog, C. A., & Handelsman, Y. (2019). Cardiovascular events and death after myocardial infarction or ischemic stroke in an older Medicare population. *Clinical Cardiology, 42*(3), 391-399. https://doi.org/10.1002/clc.23160

Liang, C., Chung, H.-F., Dobson, A. J., & Mishra, G. D. (2022). Infertility, miscarriage, stillbirth, and the risk of stroke among women: A systematic review and meta-analysis. *Stroke, 53*(2), 328–337. https://doi.org/10.1161/STROKEAHA.121.036271

Lin, S. X., Gebbie, K. M., Fullilove, R. E., & Arons, R. R. (2004). Do nurse practitioners make a difference in provision of health counseling in hospital outpatient departments? *Journal of the American Academy of Nurse Practitioners, 16*(10), 462-466. https://doi.org/10.1111/j.1745-7599.2004.tb00425.x

Lin, Y.-S., Tang, C.-H., Yang, C.-Y. C., Wu, L.-S., Hung, S.-T., Hwa, H.-L., & Chu, P.-H. (2011). Effect of pre-eclampsia–eclampsia on major cardiovascular events among peripartum women in Taiwan. *The American Journal of Cardiology, 107*(2), 325-330. https://doi.org/10.1016/j.amjcard.2010.08.073

Lind, J. M., Hennessy, A., & McLean, M. (2014). Cardiovascular disease in women: The significance of hypertension and gestational diabetes during pregnancy. *Current Opinion in Cardiology, 29*(5), 447-453. https://doi.org/10.1097/HCO.0000000000000094

Lloyd-Jones, D. M. (2010). Cardiovascular risk prediction: Basic concepts, current status, and future directions. *Circulation, 121*(15), 1768-1777. https://doi.org/10.1161/CIRCULATIONAHA.109.849166

Lloyd-Jones, D. M., Braun, L. T., Ndumele, C. E., Smith, S. C., Sperling, L. S., Virani, S. S., & Blumenthal, R. S. (2019). Use of risk assessment tools to guide decision-making in the primary prevention of atherosclerotic cardiovascular disease: A special report from the American Heart Association and American College of Cardiology. *Journal of the American College of Cardiology, 73*(24), 3153-3167. https://doi.org/10.1016/j.jacc.2018.11.005

Lloyd-Jones, D. M., Hong, Y., Labarthe, D., Mozaffarian, D., Appel, L. J., Van Horn, L., Greenlund, K., Daniels, S., Nichol, G., & Tomaselli, G. F. (2010). Defining and setting national goals for cardiovascular health promotion and disease reduction. *Circulation, 121*(4), 586-613. https://doi.org/10.1161/CIRCULATIONAHA.109.192703

LoBiondo-Wood, G., & Haber, J. (2017). *Nursing research-e-book: methods and critical appraisal for evidence-based practice*. Elsevier Health Sciences.

Lönnberg, L., Ekblom-Bak, E., & Damberg, M. (2019). Improved unhealthy lifestyle habits in patients with high cardiovascular risk: results from a structured lifestyle programme in primary care. *Upsala Journal of Medical Sciences, 124*(2), 94-104. https://doi.org/10.1080/03009734.2019.1602088

Lowe, S. A., Bowyer, L., Lust, K., McMahon, L. P., Morton, M., North, R. A., Paech, M., & Said, J. M. (2015). SOMANZ guidelines for the management of hypertensive disorders of pregnancy 2014. *Australian and New Zealand Journal of Obstetrics and Gynaecology, 55*(5), e1-e29. https://doi.org/10.1111/ajo.12399; https://doi.org/10.1111/ajo.12253

Lowhorn, G. L. (2007). *Qualitative and quantitative research: How to choose the best design* [Conference Session]. Academic Business World International Conference. Nashville, Tennessee.

Luoto, R., Kharazmi, E., Whitley, E., Raitanen, J., Gissler, M., & Hemminki, E. (2008). Systolic hypertension in pregnancy and cardiovascular mortality: A 44-year follow-up study. *Hypertension in Pregnancy, 27*(1), 87-94. https://doi.org/10.1080/10641950701826810

Luszczynska, A., & Schwarzer, R. (2015). Social cognitive theory. *Fac Health Sci Publ*, 225-251.

Lv, X., Niu, H., Qu, Y., Li, M., Li, L., Ma, X., Jiang, S., Gao, C., Wang, R., & Zhang, P. (2018). Awareness, treatment and control of hypertension among hypertensive patients aged 18 to 59 years old in the northeast of China. *Scientific Reports, 8*(1), 1-10. https://doi.org/10.1038/s41598-018-34923-5

Lykke, J. A., Langhoff-Roos, J., Sibai, B. M., Funai, E. F., Triche, E. W., & Paidas, M. J. (2009). Hypertensive pregnancy disorders and subsequent cardiovascular morbidity and type 2 diabetes mellitus in the mother. *Hypertension, 53*(6), 944-951. https://doi.org/10.1161/HYPERTENSIONAHA.109.130765

Maas, A. H., & Appelman, Y. E. (2010). Gender differences in coronary heart disease. *Netherlands Heart Journal, 18*(12), 598-603. https://doi.org/10.1007/s12471-010-0841-y

MacDonald, S. E., Walker, M., Ramshaw, H., Godwin, M., Chen, X.-k., & Smith, G. (2007). Hypertensive disorders of pregnancy and long-term risk of hypertension: What do Ontario prenatal care providers know and what do they communicate? *Journal of Obstetrics and Gynaecology Canada, 29*(9), 705-710. https://doi.org/10.1016/S1701-2163(16)32601-9

Madonna, R., Balistreri, C. R., De Rosa, S., Muscoli, S., Selvaggio, S., Selvaggio, G., Ferdinandy, P., & De Caterina, R. (2019). Impact of sex differences and diabetes on coronary atherosclerosis and ischemic heart disease. *Journal of Clinical Medicine, 8*(1), 98. https://doi.org/10.3390/jcm8010098

Magnani, J. W., Mujahid, M. S., Aronow, H. D., Cené, C. W., Dickson, V. V., Havranek, E., Morgenstern, L. B., Paasche-Orlow, M. K., Pollak, A., & Willey, J. Z. (2018). Health literacy and cardiovascular disease: Fundamental relevance to primary and secondary prevention: A scientific statement from the American Heart Association. *Circulation, 138*(2), e48-e74. https://doi.org/10.1161/CIR.0000000000000579

Maharajan, M., Rajiah, K., Num, S. K., Ngu, W., Ying, S. L. H., Yan, Y., & Lin, Y. S. (2016). Influence of perceived risk on willingness to pay for diagnosis of cardiovascular disease. *Value in Health, 19*(7), A870. https://doi.org/10.1016/j.jval.2016.08.381

Mahendru, A. A., & Morris, E. (2013). Cardiovascular disease in menopause: Does the obstetric history have any bearing? *Menopause International, 19*(3), 115-120. https://doi.org/10.1177/1754045313495675

Maino, A., Siegerink, B., Algra, A., Martinelli, I., Peyvandi, F., & Rosendaal, F. R. (2016). Pregnancy loss and risk of ischaemic stroke and myocardial infarction. *British Journal of Haematology, 174*(2), 302-309. https://doi.org/10.1111/bjh.14043

Mandviwala, T., Khalid, U., & Deswal, A. (2016). Obesity and cardiovascular disease: A risk factor or a risk marker? *Current Atherosclerosis Reports, 18*(5), 21. https://doi.org/10.1007/s11883-016-0575-4

Mankuta, D., Elami-Suzin, M., Elhayani, A., & Vinker, S. (2010). Lipid profile in consecutive pregnancies. *Lipids in Health and Disease, 9*(1), 58. https://doi.org/10.1186/1476-511X-9-58

Männistö, T., Mendola, P., Vääräsmäki, M., Järvelin, M.-R., Hartikainen, A.-L., Pouta, A., & Suvanto, E. (2013). Elevated blood pressure in pregnancy and subsequent chronic disease risk-clinical perspective. *Circulation, 127*(6), 681-690. https://doi.org/10.1161/CIRCULATIONAHA.112.128751

Manrique-Acevedo, C., Chinnakotla, B., Padilla, J., Martinez-Lemus, L. A., & Gozal, D. (2020). Obesity and cardiovascular disease in women. *International Journal of Obesity, 44*(6), 1210-1226. https://doi.org/10.1038/s41366-020-0548-0

Markovitz, A. R., Stuart, J. J., Horn, J., Williams, P. L., Rimm, E. B., Missmer, S. A., Tanz, L. J., Haug, E. B., Fraser, A., & Timpka, S. (2019). Does pregnancy complication history improve cardiovascular disease risk prediction? Findings from the HUNT study in Norway. *European Heart Journal, 40*(14), 1113-1120. https://doi.org/10.1093/eurheartj/ehy863

Marmot, M., Allen, J., Bell, R., Bloomer, E., & Goldblatt, P. (2012). WHO European review of social determinants of health and the health divide. *The Lancet, 380*(9846), 1011-1029. https://doi.org/10.1016/S0140-6736(12)61228-8

Marren, A. (2018). Recurrent pregnancy loss: A summary of international evidence-based guidelines and practice. *Australian journal of general practice, 47*(7), 432-436. https://doi.org/10.31128/AJGP-01-18-4459

Massimo, F., Piepoli, A., & Hoes, S. (2016). European guidelines on cardiovascular disease prevention in clinical practice. *Eur Heart J, 37*(29), 2315-2381.

Matheny, M., McPheeters, M. L., Glasser, A., Mercaldo, N., Weaver, R. B., Jerome, R. N., Walden, R., McKoy, J. N., Pritchett, J., & Tsai, C. (2011). *Systematic review of cardiovascular disease risk assessment tools*. Agency for Healthcare Research and Quality (US).

Matthews, K. A., El Khoudary, S. R., Brooks, M. M., Derby, C. A., Harlow, S. D., Barinas-Mitchell, E. J., & Thurston, R. C. (2017). Lipid changes around the final menstrual period predict carotid subclinical disease in postmenopausal women. *Stroke, 48*(1), 70-76. https://doi.org/10.1161/STROKEAHA.116.014743

Matthias, A. T., Lokunarangoda, N. C., & Ekanayaka, R. (2014). Knowledge assessment regarding secondary prevention of coronary heart disease-a multi centre survey. *BMC Medical Education, 14*(1), 1-8. https://doi.org/10.1186/1472-6920-14-113

Maxwell, J. A. (2012). *Qualitative research design: An interactive approach* (Vol. 41). Sage Publications.

McKenzie, J. F., Dennis, D., Auld, M. E., Lysoby, L., Doyle, E., Muenzen, P. M., Caro, C. M., & Kusorgbor-Narh, C. S. (2016). Health education specialist practice analysis 2015 (HESPA 2015) process and outcomes. *Health Education & Behavior, 43*(3), 286-295. https://doi.org/10.1177/1090198116639258

McKenzie-Sampson, S., Paradis, G., Healy-Profitós, J., St-Pierre, F., & Auger, N. (2018). Gestational diabetes and risk of cardiovascular disease up to 25 years after pregnancy: a retrospective cohort study. *Acta Diabetologica, 55*(4), 315-322. https://doi.org/10.1007/s00592-017-1099-2

Miller, E. C., Boehme, A. K., Chung, N. T., Wang, S. S., Lacey, J. V., Lakshminarayan, K., Zhong, C., Woo, D., Bello, N. A., & Wapner, R. (2019). Aspirin reduces long-term stroke risk in women with prior hypertensive disorders of pregnancy. *Neurology, 92*(4), e305-e316. https://doi.org/10.1212/WNL.0000000000006815

Milroy, T., & Frayne, J. (2022). Postnatal care: The general practitioner visit. *Australian Journal of General Practice, 51*(3), 105-110. https://doi.org/10.31128/AJGP-02-21-5835

Mirzaei, M., Mirzaei, M., Bagheri, B., & Dehghani, A. (2020). Awareness, treatment, and control of hypertension and related factors in adult Iranian population. *BMC Public Health, 20*(1), 1-10. https://doi.org/10.1186/s12889-020-08831-1

Mohammadnezhad, M., Mangum, T., May, W., Lucas, J. J., & Ailson, S. (2016). Common modifiable and non-modifiable risk factors of cardiovascular disease (CVD) among Pacific countries. *World Journal of Cardiovascular Surgery, 6*(11), 153. https://doi.org/10.4236/wjcs.2016.611022

Möller-Leimkühler, A. M. (2022). Gender differences in cardiovascular disease and comorbid depression. *Dialogues in Clinical Neuroscience*, *9*(1), 71–83. https://doi.org/10.31887/DCNS.2007.9.1/ammoeller

Monsuez, J.-J., Pham, T., Karam, N., Amar, L., Chicheportiche-Ayache, C., Menasché, P., Desnos, M., Dardel, P., & Weill, I. (2017). Awareness of individual cardiovascular risk factors and self-perception of cardiovascular risk in women. *The American Journal of the Medical Sciences, 354*(3), 240-245. https://doi.org/10.1016/j.amjms.2017.05.008

Moonesinghe, R., Yang, Q., Zhang, Z., & Khoury, M. J. (2019). Prevalence and cardiovascular health impact of family history of premature heart disease in the united states: analysis of the National Health and Nutrition Examination Survey, 2007–2014. *Journal of the American Heart Association, 8*(14), e012364. https://doi.org/10.1161/JAHA.119.012364

Moreno-Peral, P., Conejo-Cerón, S., Fernández, A., Berenguera, A., Martínez-Andrés, M., Pons-Vigués, M., Motrico, E., Rodríguez-Martín, B., Bellón, J. A., & Rubio-Valera, M. (2015). Primary care patients' perspectives of barriers and enablers of primary prevention and health promotion—a meta-ethnographic synthesis. *PLOS One, 10*(5), e0125004. https://doi.org/10.1371/journal.pone.0125004

Mortensen, M. B., & Nordestgaard, B. G. (2020). Elevated LDL cholesterol and increased risk of myocardial infarction and atherosclerotic cardiovascular disease in individuals aged 70–100 years: A contemporary primary prevention cohort. *The Lancet, 396*(10263), 1644-1652. https://doi.org/10.1016/S0140-6736(20)32233-9

Mosca, L., Benjamin, E. J., Berra, K., Bezanson, J. L., Dolor, R. J., Lloyd-Jones, D. M., Newby, L. K., Pina, I. L., Roger, V. L., & Shaw, L. J. (2011a). Effectiveness-based guidelines for the prevention of cardiovascular disease in women—2011 update: A guideline from the American Heart Association. *Circulation, 123*(11), 1243-1262. https://doi.org/10.1161/CIR.0b013e31820faaf8

Mosca, L., Benjamin, E. J., Berra, K., Bezanson, J. L., Dolor, R. J., Lloyd-Jones, D. M., Newby, L. K., Pina, I. L., Roger, V. L., & Shaw, L. J. (2011b). Effectiveness-based guidelines for the prevention of cardiovascular disease in women—2011 update: A guideline from the American Heart Association. *Journal of the American College of Cardiology, 57*(12), 1404-1423. https://doi.org/10.1016/j.jacc.2011.02.005

Mosca, L., Jones, W. K., King, K. B., Ouyang, P., Redberg, R. F., & Hill, M. N. (2000). Awareness, perception, and knowledge of heart disease risk and prevention among women in the United States. *Archives of Family Medicine, 9*(6), 506. https://doi.org/10.1001/archfami.9.6.506

Motamed, N., Rabiee, B., Perumal, D., Poustchi, H., Miresmail, S. J. H., Farahani, B., Maadi, M., Saeedian, F. S., Ajdarkosh, H., & Khonsari, M. R. (2017). Comparison of cardiovascular risk assessment tools and their guidelines in evaluation of 10-year CVD risk and preventive recommendations: A population based study. *International Journal of Cardiology, 228*, 52-57. https://doi.org/10.1016/j.ijcard.2016.11.048

Mozaffarian, D., Benjamin, E. J., Go, A. S., Arnett, D. K., Blaha, M. J., Cushman, M., Després, J.-P., Fullerton, H. J., Howard, V. J., Huffman, M. D., Judd, S. E., Kissela, B. M., Lackland, D. T., Lichtman, J. H., Lisabeth, L. D., Liu, S., Mackey, R. H., Matchar, D. B., McGuire, D. K., Heart, American Heart Association Statistics Committee, & Stroke Statistics Subcommittee. (2015). *Heart disease and stroke statistics – at-a-glance.* American Heart Association. https://doi.org/10.1161/CIR.0000000000000152

Mozaffarian, D., Benjamin, E. J., Go, A. S., Arnett, D. K., Blaha, M. J., Cushman, M., Das, S. R., De Ferranti, S., Després, J.-P., & Fullerton, H. J. (2016). Heart disease and stroke statistics—2016 update: A report from the American Heart Association. *Circulation, 133*(4), e38-e360. https://doi.org/10.1161/CIR.0000000000000350

Mozaffarian, D., Benjamin, E. J., Go, A. S., Arnett, D. K., Blaha, M. J., Cushman, M., de Ferranti, S., Després, J.-P., Fullerton, H. J., & Howard, V. J. (2015). American heart association statistics committee and stroke statistics subcommittee. Heart disease and stroke statistics–2015 update: a report from the American Heart Association. *Circulation, 131*(4), e29-e322. https://doi.org/10.1161/CIR.0000000000000366

Muehlschlegel, C., Kyriacou, H., Al-Mohammad, A., Foster-Davies, L. A., Simmons-Jones, F., & Oliver-Williams, C. (2020). The risk of cardiovascular disease in women after miscarriage, stillbirth, and therapeutic abortion: A protocol for a systematic review and meta-analysis. *Systematic Reviews, 9*(1), 1-8. https://doi.org/10.1186/s13643-020-01444-0

Muijs, D. (2010). *Doing quantitative research in education with SPSS*. Sage. https://doi.org/10.4135/9781849203241

Mukattash, T. L., Shara, M., Jarab, A. S., Al-Azzam, S. I., Almaaytah, A., & Al Hamarneh, Y. N. (2012). Public knowledge and awareness of cardiovascular disease and its risk factors: A cross-sectional study of 1000 Jordanians. *International Journal of Pharmacy Practice, 20*(6), 367-376. https://doi.org/10.1111/j.2042-7174.2012.00208.x

Muncan, B. (2018). Cardiovascular disease in racial/ethnic minority populations: illness burden and overview of community-based interventions. *Public Health Reviews, 39*(1), 1-11. https://doi.org/10.1186/s40985-018-0109-4

Murray-Johnson, L., Witte, K., Patel, D., Orrego, V., Zuckerman, C., Maxfield, A. M., & Thimons, E. D. (2004). Using the extended parallel process model to prevent noise-induced hearing loss among coal miners in Appalachia. *Health Education & Behavior, 31*(6), 741-755. https://doi.org/10.1177/1090198104263396

Muto, H., Yamamoto, R., Ishii, K., Kakubari, R., Takaoka, S., Mabuchi, A., & Mitsuda, N. (2016). Risk assessment of hypertensive disorders in pregnancy with maternal characteristics in early gestation: A single-center cohort study. *Taiwanese Journal of Obstetrics and Gynecology, 55*(3), 341-345. https://doi.org/10.1016/j.tjog.2016.04.009

Naghavi, M., Wang, H., Lozano, R., Davis, A., Liang, X., & Zhou, M. (2015). GBD 2013 Mortality and Causes of Death Collaborators. Global, regional, and national age-sex specific all-cause and cause-specific mortality for 240 causes of death, 1990-2013: A systematic analysis for the Global Burden of Disease Study 2013. *Lancet, 385*(9963), 117-171. https://doi.org/10.1016/S0140-6736(14)61682-2

Najafipour, H., Afshari, M., & Rostamzadeh, F. (2018). Prevalence of multiple coronary artery disease risk factors in Kerman: a population-based study in Southeast Iran. *Iranian Journal of Medical Sciences, 43*(2), 140.

Nardi, P. M. (2018). *Doing survey research: A guide to quantitative methods*. Routledge. https://doi.org/10.4324/9781315172231

National Health and Medical Research Council. (2018). *National Statement on Ethical Conduct in Human Research (NHMRC)*. https://www.nhmrc.gov.au/about-us/publications/national-statement-ethical-conduct-human-research-2007-updated-2018

National Vascular Disease Prevention Alliance. (2012). Guidelines for the management of absolute cardiovascular disease risk. National Stroke Foundation. https://informme.org.au/media/cuzjrcgz/absolutecvd_gl_webready.pdf

Newman, J. D., Schwartzbard, A. Z., Weintraub, H. S., Goldberg, I. J., & Berger, J. S. (2017). Primary prevention of cardiovascular disease in diabetes mellitus. *Journal of the American College of Cardiology, 70*(7), 883-893. https://doi.org/10.1016/j.jacc.2017.07.001

Nichols, M., Peterson, K., Herbert, J., Alston, L., & Allender, S. (2016). *Australian Heart Disease Statistics 2015*. National Heart Foundation of Australia.

Nieuwlaat, R., Schwalm, J.-D., Khatib, R., & Yusuf, S. (2013). Why are we failing to implement effective therapies in cardiovascular disease? *European Heart Journal, 34*(17), 1262-1269. https://doi.org/10.1093/eurheartj/ehs481

Nijdam, M.-E., Timmerman, M. R., Franx, A., Bruinse, H. W., Numans, M. E., Grobbee, D. E., & Bots, M. L. (2009). Cardiovascular risk factor assessment after pre-eclampsia in

primary care. *BMC Family Practice, 10*(1), 77. https://doi.org/10.1186/1471-2296-10-77
Norris, C. M., Yip, C. Y., Nerenberg, K. A., Clavel, M. A., Pacheco, C., Foulds, H. J., Hardy, M., Gonsalves, C. A., Jaffer, S., & Parry, M. (2020). State of the science in women's cardiovascular disease: a Canadian perspective on the influence of sex and gender. *Journal of the American Heart Association, 9*(4), e015634. https://doi.org/10.1161/JAHA.119.015634
NSW Health. (2019). *NSW Mothers and Babies 2018*. Retrieved 17 September 2022 http://www.health.nsw.gov.au/hsnsw/Pages/
Nutbeam, D. (2000). Health literacy as a public health goal: A challenge for contemporary health education and communication strategies into the 21st century. *Health Promotion International, 15*(3), 259-267. https://doi.org/10.1093/heapro/15.3.259
Nutbeam, D., & Lloyd, J. E. (2021). Understanding and responding to health literacy as a social determinant of health. *Annu Rev Public Health, 42*(1), 159-173. https://doi.org/10.1146/annurev-publhealth-090419-102529
O'Byrne, D. (1998). The power of partnership in health promotion. *Global Health Promotion, 5*(3/4), 7. https://doi.org/10.1177/102538239800500304
O'Callaghan, C. J., Rong, P., & Goh, M. Y. (2014). National guidelines for the management of absolute cardiovascular disease risk. *The Medical Journal of Australia, 200*(8), 454-456. https://doi.org/10.5694/mja13.11162
O'Kelly, A. C., Michos, E. D., Shufelt, C. L., Vermunt, J. V., Minissian, M. B., Quesada, O., Smith, G. N., Rich-Edwards, J. W., Garovic, V. D., & El Khoudary, S. R. (2022). Pregnancy and reproductive risk factors for cardiovascular disease in women. *Circulation Research, 130*(4), 652-672. https://doi.org/10.1161/CIRCRESAHA.121.319895
O'Neil, A., Scovelle, A. J., Milner, A. J., & Kavanagh, A. (2018). Gender/sex as a social determinant of cardiovascular risk. *Circulation, 137*(8), 854-864. https://doi.org/10.1161/CIRCULATIONAHA.117.028595
Oikonomou, P., Tsonis, O., Paxinos, A., Gkrozou, F., Korantzopoulos, P., & Paschopoulos, M. (2020). Preeclampsia and long-term coronary artery disease: How to minimize the odds? *European Journal of Obstetrics & Gynecology and Reproductive Biology, 255*, 253-258. https://doi.org/10.1016/j.ejogrb.2020.10.061
Oliver-Williams, C. T., Heydon, E. E., Smith, G. C., & Wood, A. M. (2013). Miscarriage and future maternal cardiovascular disease: A systematic review and meta-analysis. *Heart, 99*(22), 1636-1644. https://doi.org/10.1136/heartjnl-2012-303237
Oliver-Williams, C., Stevens, D., Payne, R. A., Wilkinson, I. B., Smith, G., & Wood, A. (2022). Association between hypertensive disorders of pregnancy and later risk of cardiovascular outcomes. *BMC Medicine, 20*(1), 1-11. https://doi.org/10.1186/s12916-021-02218-8
Oluwatayo, J. A. (2012). Validity and reliability issues in educational research. *Journal of Educational and Social Research, 2*(2), 391-400.
Onwere, C., Vakharia, H. N., Dutta, R., & Datta, S. T. (2014). *Crash Course Obstetrics and Gynaecology*. Elsevier Health Sciences.
Ortega, F. B., Lavie, C. J., & Blair, S. N. (2016). Obesity and cardiovascular disease. *Circulation Research, 118*(11), 1752-1770. https://doi.org/10.1161/CIRCRESAHA.115.306883
Osibogun, O., Ogunmoroti, O., & Michos, E. D. (2020). Polycystic ovary syndrome and cardiometabolic risk: opportunities for cardiovascular disease prevention. *Trends in Cardiovascular Medicine, 30*(7), 399-404. https://doi.org/10.1016/j.tcm.2019.08.010

Pace, D. S. (2021). Probability and non-probability sampling-an entry point for undergraduate researchers. *International Journal of Quantitative and Qualitative Research Methods, 9*(2), 1-15.

Pallazola, V. A., Davis, D. M., Whelton, S. P., Cardoso, R., Latina, J. M., Michos, E. D., Sarkar, S., Blumenthal, R. S., Arnett, D. K., & Stone, N. J. (2019). A clinician's guide to healthy eating for cardiovascular disease prevention. *Mayo Clinic Proceedings: Innovations, Quality & Outcomes, 3*(3), 251-267. https://doi.org/10.1016/j.mayocpiqo.2019.05.001

Parikh, N. I., Gonzalez, J. M., Anderson, C. A., Judd, S. E., Rexrode, K. M., Hlatky, M. A., Gunderson, E. P., Stuart, J. J., Vaidya, D., & American Heart Association Council on Epidemiology and Prevention; Council on Arteriosclerosis, Thrombosis and Vascular Biology; Council on Cardiovascular and Stroke Nursing; and the Stroke Council (2021). Adverse pregnancy outcomes and cardiovascular disease risk: Unique opportunities for cardiovascular disease prevention in women: A scientific statement from the American Heart Association. *Circulation, 143*(18), e902-e916. https://doi.org/10.1161/CIR.0000000000000961

Parikh, N. I., Jeppson, R. P., Berger, J. S., Eaton, C. B., Kroenke, C. H., LeBlanc, E. S., Lewis, C. E., Loucks, E. B., Parker, D. R., & Rillamas-Sun, E. (2016). Reproductive risk factors and coronary heart disease in the Women's Health Initiative Observational Study. *Circulation, 133*(22), 2149-2158. https://doi.org/10.1161/CIRCULATIONAHA.115.017854

Parikh, N. I., Norberg, M., Ingelsson, E., Cnattingius, S., Vasan, R. S., Domellöf, M., Jansson, J. H., & Edstedt Bonamy, A.-K. (2017). Association of pregnancy complications and characteristics with future risk of elevated blood pressure: the Västerbotten Intervention Program. *Hypertension, 69*(3), 475-483. https://doi.org/10.1161/HYPERTENSIONAHA.116.08121

Parker, D. R., Lu, B., Sands-Lincoln, M., Kroenke, C. H., Lee, C. C., O'Sullivan, M., Park, H. L., Parikh, N., Schenken, R. S., & Eaton, C. B. (2014). Risk of cardiovascular disease among postmenopausal women with prior pregnancy loss: The women's health initiative. *The Annals of Family Medicine, 12*(4), 302-309. https://doi.org/10.1370/afm.1668

Patel, P., Ordunez, P., DiPette, D., Escobar, M. C., Hassell, T., Wyss, F., Hennis, A., Asma, S., Angell, S., Treatment, S. H., & Network, P. (2016). Improved blood pressure control to reduce cardiovascular disease morbidity and mortality: The standardized hypertension treatment and prevention project. *The Journal of Clinical Hypertension, 18*(12), 1284-1294. https://doi.org/10.1111/jch.12861

Patey, A. M., Fontaine, G., Francis, J. J., McCleary, N., Presseau, J., & Grimshaw, J. M. (2022). Health care professional behaviour: Health impact, prevalence of evidence-based behaviours, correlates and interventions. *Psychology & Health*, 1-29. https://doi.org/10.1080/08870446.2022.2100887

Peckham, S., Hann, A., & Boyce, T. (2011). Health promotion and ill-health prevention: The role of general practice. *Quality in Primary Care, 19*(5), 317-323.

Peltzer, K., & Pengpid, S. (2018). Prevalence, risk awareness and health beliefs of behavioural risk factors for cardiovascular disease among university students in nine ASEAN countries. *BMC Public Health, 18*(1), 1-9. https://doi.org/10.1186/s12889-018-5142-1

Pennbrant, S., Lyckhage, E. D., & Nilsson, M. S. (2014). Prerequisites for person-centered care–As described by community care nurses. *Clinical Nursing Studies, 3*(1), 5. https://doi.org/10.5430/cns.v3n1p5

Perera, M. J., Reina, S. A., Elfassy, T., Potter, J. E., Sotres Alvarez, D., Simon, M. A., Isasi, C. R., Stuebe, A. M., Schneiderman, N., & Llabre, M. M. (2019). Gestational diabetes and cardiovascular risk factors and disease in US Hispanics/Latinas in the Hispanic Community Health Study/Study of Latinos (HCHS/SOL). *Women & Health, 59*(5), 481-495. https://doi.org/10.1080/03630242.2018.1500415

Peters, A. T., & Mutharasan, R. K. (2020). Aspirin for prevention of cardiovascular disease. *JAMA, 323*(7), 676-676. https://doi.org/10.1001/jama.2019.18425

Peters, S. A., & Woodward, M. (2018). Women's reproductive factors and incident cardiovascular disease in the UK Biobank. *Heart, 104*(13), 1069-1075. https://doi.org/10.1136/heartjnl-2017-312289

Peters, S. A., Huxley, R. R., & Woodward, M. (2014). Diabetes as risk factor for incident coronary heart disease in women compared with men: A systematic review and meta-analysis of 64 cohorts including 858,507 individuals and 28,203 coronary events. *Diabetologia, 57*(8), 1542-1551. https://doi.org/10.1007/s00125-014-3260-6

Peters, S. A., Wang, X., Lam, T.-H., Kim, H. C., Ho, S., Ninomiya, T., Knuiman, M., Vaartjes, I., Bots, M. L., & Woodward, M. (2018). Clustering of risk factors and the risk of incident cardiovascular disease in Asian and Caucasian populations: Results from the Asia Pacific Cohort Studies Collaboration. *BMJ Open, 8*(3), e019335. https://doi.org/10.1136/bmjopen-2017-019335

Peters, S. A., Yang, L., Guo, Y., Chen, Y., Bian, Z., Tian, X., Chang, L., Zhang, S., Liu, J., & Wang, T. (2017). Pregnancy, pregnancy loss, and the risk of cardiovascular disease in Chinese women: Findings from the China Kadoorie Biobank. *BMC Medicine, 15*(1), 1-10. https://doi.org/10.1186/s12916-017-0912-7

Piepoli, M. F., Hoes, A. W., Agewall, S., Albus, C., Brotons, C., Catapano, A. L., Cooney, M.-T., Corra, U., Cosyns, B., & Deaton, C. (2016). 2016 European Guidelines on cardiovascular disease prevention in clinical practice. *Kardiologia Polska (Polish Heart Journal), 74*(9), 821-936. https://doi.org/10.5603/KP.2016.0120

Pillay, M. (2005). *Knowledge, Attitude and Practices (KAP) survey*, Stellenbosch: Stellenbosch University.

Pirie, K., Peto, R., Reeves, G. K., Green, J., Beral, V., & Collaborators, M. W. S. (2013). The 21st century hazards of smoking and benefits of stopping: A prospective study of one million women in the UK. *The Lancet, 381*(9861), 133-141. https://doi.org/10.1016/S0140-6736(12)61720-6

Pirillo, A., Casula, M., Olmastroni, E., Norata, G. D., & Catapano, A. L. (2021). Global epidemiology of dyslipidaemias. *Nature Reviews Cardiology, 18*(10), 689-700. https://doi.org/10.1038/s41569-021-00541-4

Ponto, J. (2015). Understanding and evaluating survey research. *Journal of the Advanced Practitioner in Oncology, 6*(2), 168. https://doi.org/10.6004/jadpro.2015.6.2.9

Porter, G., Blashki, G., & Grills, N. (2014). General practice and public health: Who is my patient? *Australian Family Physician, 43*(7), 483-486.

Powell-Wiley, T. M., Poirier, P., Burke, L. E., Després, J.-P., Gordon-Larsen, P., Lavie, C. J., Lear, S. A., Ndumele, C. E., Neeland, I. J., & Sanders, P. (2021). Obesity and cardiovascular disease: A scientific statement from the American Heart Association. *Circulation, 143*(21), e984-e1010. https://doi.org/10.1161/CIR.0000000000000973

Poznyak, A. V., Sadykhov, N. K., Kartuesov, A. G., Borisov, E. E., Melnichenko, A. A., Grechko, A. V., & Orekhov, A. N. (2022). Hypertension as a risk factor for atherosclerosis: Cardiovascular risk assessment. *Frontiers in Cardiovascular Medicine, 9*. https://doi.org/10.3389/fcvm.2022.959285

Prabakaran, S., Schwartz, A., & Lundberg, G. (2021). Cardiovascular risk in menopausal women and our evolving understanding of menopausal hormone therapy: Risks,

benefits, and current guidelines for use. *Therapeutic Advances in Endocrinology and Metabolism, 12*, 20420188211013917. https://doi.org/10.1177/20420188211013917
Prevention, H. D. a. S. (2016). *High Blood Pressure Fact Sheet*.
Pueyo-Garrigues, M., Whitehead, D., Pardavila-Belio, M. I., Canga-Armayor, A., Pueyo-Garrigues, S., & Canga-Armayor, N. (2019). Health education: A Rogerian concept analysis. *International Journal of Nursing Studies, 94*, 131-138. https://doi.org/10.1016/j.ijnurstu.2019.03.005
Qadi, O., Lufumpa, N., Adderley, N., Bem, D., Marshall, T., & Kokab, F. (2020). Patients' and health professionals' attitudes and perceptions towards the initiation of preventive drugs for primary prevention of cardiovascular disease: A systematic review of qualitative studies. *BJGP Open, 4*(5). https://doi.org/10.3399/bjgpopen20X101087
Qadi, O., Marshall, T., Adderley, N., & Bem, D. (2019). Patients' and health professionals' attitudes and perceptions towards the initiation of preventive drugs for primary prevention of cardiovascular disease: Protocol for a systematic review of qualitative studies. *BMJ Open, 9*(4), e025587. https://doi.org/10.1136/bmjopen-2018-025587
Raingruber, B. (2014). Health education, health promotion, and health: What do these definitions have to do with nursing. *Contemporary Health Promotion in Nursing Practice*, 1-24.
Ramachandran, H. J., Wu, V. X., Kowitlawakul, Y., & Wang, W. (2016). Awareness, knowledge and healthy lifestyle behaviors related to coronary heart disease among women: An integrative review. *Heart & Lung, 45*(3), 173-185. https://doi.org/10.1016/j.hrtlng.2016.02.004
Ramezani Tehrani, F., Naz, M. S. G., Yarandi, R. B., & Behboudi-Gandevani, S. (2021). The impact of diagnostic criteria for gestational diabetes mellitus on adverse maternal outcomes: a systematic review and meta-analysis. *Journal of Clinical Medicine, 10*(4), 666. https://doi.org/10.3390/jcm10040666
Ranthe, M. F., Andersen, E. A. W., Wohlfahrt, J., Bundgaard, H., Melbye, M., & Boyd, H. A. (2013). Pregnancy loss and later risk of atherosclerotic disease. *Circulation, 127*(17), 1775-1782. https://doi.org/10.1161/CIRCULATIONAHA.112.000285
Ranthe, M., & Boyd, H. (2015). Miscarriage and cardiovascular disease. *Heart (British Cardiac Society), 101*(24), 1933-1934. https://doi.org/10.1136/heartjnl-2015-308383
Rathore, V., Singh, N., Mahat, R. K., Kocak, M., Fidan, K., Ayazoglu, T., Aydin Karahan, Y., Onk, D., Akar, E., & Yolcu, A. (2018). Risk factors for acute myocardial infarction: A review. *EJMI, 2*(1), 1-7. https://doi.org/10.14744/ejmi.2018.76486
Reiner, Ž., Sonicki, Z., & Tedeschi-Reiner, E. (2010). Physicians' perception, knowledge and awareness of cardiovascular risk factors and adherence to prevention guidelines: The PERCRO-DOC survey. *Atherosclerosis, 213*(2), 598-603. https://doi.org/10.1016/j.atherosclerosis.2010.09.014
Retnakaran, R., & Shah, B. R. (2017). Role of type 2 diabetes in determining retinal, renal, and cardiovascular outcomes in women with previous gestational diabetes mellitus. *Diabetes Care, 40*(1), 101-108. https://doi.org/10.2337/dc16-1400
Riaz, M., Lewis, S., Naughton, F., & Ussher, M. (2018). Predictors of smoking cessation during pregnancy: A systematic review and meta-analysis. *Addiction, 113*(4), 610-622. https://doi.org/10.1111/add.14135
Rice, S., Winter, S. R., Doherty, S., & Milner, M. (2017). Advantages and disadvantages of using internet-based survey methods in aviation-related research. *Journal of Aviation Technology and Engineering, 7*(1), 5. https://doi.org/10.7771/2159-6670.1160
Rich-Edwards, J. W., Fraser, A., Lawlor, D. A., & Catov, J. M. (2014). Pregnancy characteristics and women's future cardiovascular health: An underused opportunity

to improve women's health? *Epidemiologic Reviews, 36*(1), 57-70. https://doi.org/10.1093/epirev/mxt006

Ridker, P. M., Buring, J. E., Rifai, N., & Cook, N. R. (2007). Development and validation of improved algorithms for the assessment of global cardiovascular risk in women: The Reynolds Risk Score. *JAMA, 297*(6), 611-619. https://doi.org/10.1001/jama.297.6.611

Riise, H. K. R., Sulo, G., Tell, G. S., Igland, J., Egeland, G., Nygard, O., Selmer, R., Iversen, A.-C., & Daltveit, A. K. (2019). Hypertensive pregnancy disorders increase the risk of maternal cardiovascular disease after adjustment for cardiovascular risk factors. *International Journal of Cardiology, 282*, 81-87. https://doi.org/10.1016/j.ijcard.2019.01.097

Riise, H. K. R., Sulo, G., Tell, G. S., Igland, J., Nygård, O., Iversen, A. C., & Daltveit, A. K. (2018). Association between gestational hypertension and risk of cardiovascular disease among 617 589 Norwegian women. *Journal of the American Heart Association, 7*(10), e008337. https://doi.org/10.1161/JAHA.117.008337

Rimer, B. K., & Glanz, K. (2005). *Theory at a glance: A guide for health promotion practice*. National Cancer Institute. https://cancercontrol.cancer.gov/sites/default/files/2020-06/theory.pdf

Roffi, M., Radovanovic, D., Erne, P., Urban, P., Windecker, S., Eberli, F. R., & Investigator, A. P. (2013). Gender-related mortality trends among diabetic patients with ST-segment elevation myocardial infarction: Insights from a nationwide registry 1997–2010. *European Heart Journal: Acute Cardiovascular Care, 2*(4), 342-349. https://doi.org/10.1177/2048872613490382

Rørholm Pedersen, L., Frestad, D., Mide Michelsen, M., Dam Mygind, N., Rasmusen, H., Elena Suhrs, H., & Prescott, E. (2016). Risk factors for myocardial infarction in women and men: A review of the current literature. *Current Pharmaceutical Design, 22*(25), 3835-3852. https://doi.org/10.2174/1381612822666160309115318

Roth, H., Homer, C. S., Arnott, C., Roberts, L., Brown, M., & Henry, A. (2020). Assessing knowledge of health care providers concerning cardiovascular risk after hypertensive disorders of pregnancy: An Australian national survey. *BMC Pregnancy and Childbirth, 20*(1), 1-9. https://doi.org/10.1186/s12884-020-03418-5

Rowley, J. (2014). Designing and using research questionnaires. *Management Research Review*. https://doi.org/10.1108/MRR-02-2013-0027

Royal Australian College of General Practitioners. (2018). *General practice: health of the nation 2018*. https://www.racgp.org.au/download/Documents/Publications/Health-of-the-National-2018-Report.pdf

Rubio-Valera, M., Pons-Vigués, M., Martínez-Andrés, M., Moreno-Peral, P., Berenguera, A., & Fernández, A. (2014). Barriers and facilitators for the implementation of primary prevention and health promotion activities in primary care: A synthesis through meta-ethnography. *PLOS One, 9*(2), e89554. https://doi.org/10.1371/journal.pone.0089554

Rudd, R. E. (2007). Health literacy skills of US adults. *American Journal of Health Behavior, 31*(1), S8-S18. https://doi.org/10.5993/AJHB.31.s1.3

Russo, L. M., Whitcomb, B. W., Freeman, J. R., Mumford, S. L., Sjaarda, L. A., Perkins, N. J., Schliep, K. C., Grewal, J., Silver, R. M., & Schisterman, E. F. (2020). Physical activity and incidence of subclinical and clinical pregnancy loss: A secondary analysis in the effects of aspirin in gestation and reproduction randomized trial. *Fertility and Sterility, 113*(3), 601-608. e601. https://doi.org/10.1016/j.fertnstert.2019.10.027

Sacks, F. M., Lichtenstein, A. H., Wu, J. H., Appel, L. J., Creager, M. A., Kris-Etherton, P. M., Miller, M., Rimm, E. B., Rudel, L. L., & Robinson, J. G. (2017). Dietary fats and cardiovascular disease: a presidential advisory from the American Heart Association. *Circulation, 136*(3), e1-e23. https://doi.org/10.1161/CIR.0000000000000510

Saeed, A., Kampangkaew, J., & Nambi, V. (2017). Prevention of cardiovascular disease in women. *Methodist DeBakey Cardiovascular Journal, 13*(4), 185. https://doi.org/10.14797/mdcj-13-4-185

Saeedi, P., Petersohn, I., Salpea, P., Malanda, B., Karuranga, S., Unwin, N., Colagiuri, S., Guariguata, L., Motala, A. A., & Ogurtsova, K. (2019). Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas. *Diabetes Research and Clinical Practice, 157*, 107843. https://doi.org/10.1016/j.diabres.2019.107843

Sallam, T., & Watson, K. E. (2013). Predictors of cardiovascular risk in women. *Women's Health, 9*(5), 491-498. https://doi.org/10.2217/WHE.13.44

Sattar, N., Rawshani, A., Franzén, S., Rawshani, A., Svensson, A.-M., Rosengren, A., McGuire, D. K., Eliasson, B., & Gudbjörnsdottir, S. (2019). Age at diagnosis of type 2 diabetes mellitus and associations with cardiovascular and mortality risks: findings from the Swedish National Diabetes Registry. *Circulation, 139*(19), 2228-2237. https://doi.org/10.1161/CIRCULATIONAHA.118.037885

Sava, R. I., March, K. L., & Pepine, C. J. (2018). Hypertension in pregnancy: Taking cues from pathophysiology for clinical practice. *Clinical Cardiology, 41*(2), 220-227. https://doi.org/10.1002/clc.22892

Schmidt, A. M. (2019). Diabetes mellitus and cardiovascular disease: Emerging therapeutic approaches. *Arteriosclerosis, Thrombosis, and Vascular Biology, 39*(4), 558-568. https://doi.org/10.1161/ATVBAHA.119.310961

Schmitz, S., Groten, T., Schleussner, E., Battefeld, W., Hillemanns, P., Schippert, C., & von Versen-Höynck, F. (2016). Gestational diabetes mellitus: an evaluation of gynecologists' knowledge of guidelines and counseling behavior. *Archives of gynecology and obstetrics, 294*(6), 1209-1217. https://doi.org/10.1007/s00404-016-4161-3

Schuster, D. P., & Powers, W. J. (2005). *Translational and experimental clinical research*. Lippincott Williams & Wilkins.

Selvarajah, S., Kaur, G., Haniff, J., Cheong, K. C., Hiong, T. G., van der Graaf, Y., & Bots, M. L. (2014). Comparison of the Framingham Risk Score, SCORE and WHO/ISH cardiovascular risk prediction models in an Asian population. *International Journal of Cardiology, 176*(1), 211-218. https://doi.org/10.1016/j.ijcard.2014.07.066

Shadish, W. R., Cook, T. D., & Campbell, D. T. (2002). *Experimental and quasi-experimental designs for generalized causal inference/William R. Shedish, Thomas D. Cook, Donald T. Campbell*. Boston: Houghton Mifflin.

Shah, T., Palaskas, N., & Ahmed, A. (2016). An update on gender disparities in coronary heart disease care. *Current Atherosclerosis Reports, 18*(5), 28. https://doi.org/10.1007/s11883-016-0574-5

Shahmoradi, L., Safadari, R., & Jimma, W. (2017). Knowledge management implementation and the tools utilized in health care for evidence-based decision making: a systematic review. *Ethiopian journal of health sciences, 27*(5), 541-558. https://doi.org/10.4314/ejhs.v27i5.13

Sharma, M. (2021). *Theoretical foundations of health education and health promotion*. Jones & Bartlett Learning.

Sharma, M., & Branscum, P. W. (2020). *Introduction to community and public health*. John Wiley & Sons.

Shin, J.-Y. (2019). Trends in the prevalence and management of diabetes in Korea: 2007-2017. *Epidemiology and Health, 41*. https://doi.org/10.4178/epih.e2019029

Shostrom, D. C., Sun, Y., Oleson, J. J., Snetselaar, L. G., & Bao, W. (2017). History of gestational diabetes mellitus in relation to cardiovascular disease and cardiovascular

risk factors in US women. *Frontiers in Endocrinology, 8*, 144. https://doi.org/10.3389/fendo.2017.00144
Siedlecki, S. L., Butler, R. S., & Burchill, C. N. (2015). Survey design research: A tool for answering nursing research questions. *Clinical Nurse Specialist, 29*(4), E1-E8. https://doi.org/10.1097/NUR.0000000000000134
Simons-Morton, B., McLeroy, K., & Wendel, M. (2012). *Behavior theory in health promotion practice and research*. Jones & Bartlett Publishers.
Siontis, G. C., Tzoulaki, I., Siontis, K. C., & Ioannidis, J. P. (2012). Comparisons of established risk prediction models for cardiovascular disease: Systematic review. *BMJ, 344*. https://doi.org/10.1136/bmj.e3318
Skjaerven, R., Wilcox, A. J., Klungsøyr, K., Irgens, L. M., Vikse, B. E., Vatten, L. J., & Lie, R. T. (2012). Cardiovascular mortality after pre-eclampsia in one child mothers: Prospective, population based cohort study. *BMJ, 345*, e7677. https://doi.org/10.1136/bmj.e7677
Smith, G. C., Pell, J. P., & Walsh, D. (2001). Pregnancy complications and maternal risk of ischaemic heart disease: A retrospective cohort study of 129 290 births. *The Lancet, 357*(9273), 2002-2006. https://doi.org/10.1016/S0140-6736(00)05112-6
Smith, G. C., Pell, J. P., & Walsh, D. (2003). Spontaneous loss of early pregnancy and risk of ischaemic heart disease in later life: retrospective cohort study. *BMJ, 326*(7386), 423-424. https://doi.org/10.1136/bmj.326.7386.423
Smith, M. M., Hicks, V. L., & Heyward, V. H. (1991). Coronary heart disease knowledge test: Developing a valid and reliable tool. *The Nurse Practitioner, 16*(4), 28-42. https://doi.org/10.1097/00006205-199104000-00006
Sousa, V. D., Driessnack, M., & Mendes, I. A. C. (2007). An overview of research designs relevant to nursing: Part 1: Quantitative research designs. *Revista Latino-americana de Enfermagem, 15*(3), 502-507. https://doi.org/10.1590/S0104-11692007000300022
Spehr, K., & Curnow, R. (2011). *Are your objectives really about behaviour change? Or are they really about knowledge & attitudes?* Retrieved November 2019, from www.communitychange.com.au
Steptoe, A., Wardle, J., Cui, W., Bellisle, F., Zotti, A.-M., Baranyai, R., & Sanderman, R. (2002). Trends in smoking, diet, physical exercise, and attitudes toward health in European university students from 13 countries, 1990–2000. *Preventive Medicine, 35*(2), 97-104. https://doi.org/10.1006/pmed.2002.1048
Stewart, D. W., Adams, C. E., Cano, M. A., Correa-Fernández, V., Li, Y., Waters, A. J., Wetter, D. W., & Vidrine, J. I. (2013). Associations between health literacy and established predictors of smoking cessation. *American Journal of Public Health, 103*(7), e43-e49. https://doi.org/10.2105/AJPH.2012.301062
Stewart, J., Manmathan, G., & Wilkinson, P. (2017). Primary prevention of cardiovascular disease: A review of contemporary guidance and literature. *JRSM Cardiovascular Disease, 6*, 2048004016687211. https://doi.org/10.1177/2048004016687211
Straub, D., Boudreau, M.-C., & Gefen, D. (2004). Validation guidelines for IS positivist research. *Communications of the Association for Information Systems, 13*(1), 24. https://doi.org/10.17705/1CAIS.01324
Strumpf, E., Lang, A., Austin, N., Derksen, S. A., Bolton, J. M., Brownell, M. D., Chateau, D., Gregory, P., & Heaman, M. I. (2021). Prevalence and clinical, social, and health care predictors of miscarriage. *BMC pregnancy and childbirth, 21*(1), 1-9. https://doi.org/10.1186/s12884-021-03682-z
Stuart, J. J., Tanz, L. J., Cook, N. R., Spiegelman, D., Missmer, S. A., Rimm, E. B., Rexrode, K. M., Mukamal, K. J., & Rich-Edwards, J. W. (2018). Hypertensive disorders of

pregnancy and 10-year cardiovascular risk prediction. *Journal of the American College of Cardiology, 72*(11), 1252-1263. https://doi.org/10.1016/j.jacc.2018.05.077
Sugiura-Ogasawara, M. (2015). Recurrent pregnancy loss and obesity. *Best Practice & Research Clinical Obstetrics & Gynaecology, 29*(4), 489-497. https://doi.org/10.1016/j.bpobgyn.2014.12.001
Suka, M., Odajima, T., Okamoto, M., Sumitani, M., Igarashi, A., Ishikawa, H., Kusama, M., Yamamoto, M., Nakayama, T., & Sugimori, H. (2015). Relationship between health literacy, health information access, health behavior, and health status in Japanese people. *Patient Education and Counseling, 98*(5), 660-668. https://doi.org/10.1016/j.pec.2015.02.013
Sun, J., Kim, G. R., Lee, S. J., & Kim, H. C. (2021). Gestational diabetes mellitus and the role of intercurrent type 2 diabetes on long-term risk of cardiovascular events. *Scientific Reports, 11*(1), 1-9. https://doi.org/10.1038/s41598-021-99993-4
Taber, K. S. (2018). The use of Cronbach's alpha when developing and reporting research instruments in science education. *Research in science education, 48, 1273-1296.* https://doi.org/10.1007/s11165-016-9602-2
Taherdoost, H. (2016). Validity and reliability of the research instrument; how to test the validation of a questionnaire/survey in a research. *How to test the validation of a questionnaire/survey in a research (August 10, 2016)*. https://doi.org/10.2139/ssrn.3205040
Täufer Cederlöf, E., Lundgren, M., Lindahl, B., & Christersson, C. (2022). Pregnancy complications and risk of cardiovascular disease later in life: A nationwide cohort study. *Journal of the American Heart Association, 11*(2), e023079. https://doi.org/10.1161/JAHA.121.023079
Tedesco, L. M. R., Di Giuseppe, G., Napolitano, F., & Angelillo, I. F. (2015). Cardiovascular disease and women: Knowledge, attitudes, and behavior in the general population in Italy. *BioMed Research International, 2015*. https://doi.org/10.1155/2015/324692
Thacker, L. R. (2020). What is the big deal about populations in research? *Progress in Transplantation (Aliso Viejo, Calif.)*, *30*(1), 3. https://doi.org/10.1177/1526924819893795
Thanavaro, J. L., Thanavaro, S., & Delicath, T. (2010). Coronary heart disease knowledge tool for women. *Journal of the American Association of Nurse Practitioners, 22*(2), 62-69. https://doi.org/10.1111/j.1745-7599.2009.00476.x
Theilen, L. H., Meeks, H., Fraser, A., Esplin, M. S., Smith, K. R., & Varner, M. W. (2018). Long-term mortality risk and life expectancy following recurrent hypertensive disease of pregnancy. *American Journal of Obstetrics and Gynecology, 219*(1), 107. e101-107. e106. https://doi.org/10.1016/j.ajog.2018.04.002
Thompson, L. E., & Daugherty, S. L. (2017). Gender disparities in cardiovascular disease prevention. *Heart (British Cardiac Society), 103*(7), 479–480. https://doi.org/10.1136/heartjnl-2016-310788
Tian, D., & Meng, J. (2019). Exercise for prevention and relief of cardiovascular disease: Prognoses, mechanisms, and approaches. *Oxidative Medicine and Cellular Longevity, 2019*. https://doi.org/10.1155/2019/3756750
Tobias, D. K., Stuart, J. J., Li, S., Chavarro, J., Rimm, E. B., Rich-Edwards, J., Hu, F. B., Manson, J. E., & Zhang, C. (2017). Association of history of gestational diabetes with long-term cardiovascular disease risk in a large prospective cohort of US women. *JAMA Internal Medicine, 177*(12), 1735-1742. https://doi.org/10.1001/jamainternmed.2017.2790
Tones, K. (2000). Evaluating health promotion: A tale of three errors. *Patient Education and Counseling, 39*(2-3), 227-236. https://doi.org/10.1016/S0738-3991(99)00035-X

Tooher, J., Thornton, C., Makris, A., Ogle, R., Korda, A., & Hennessy, A. (2017). All hypertensive disorders of pregnancy increase the risk of future cardiovascular disease. *Hypertension, 70*(4), 798-803. https://doi.org/10.1161/HYPERTENSIONAHA.117.09246

Tovar, E., & Clark, M. C. (2015). Knowledge and health beliefs related to heart disease risk among adults with type 2 diabetes. *Journal of the American Association of Nurse Practitioners, 27*(6), 321-327. https://doi.org/10.1002/2327-6924.12172

Tran, D.-M. T., Dingley, C., & Arenas, R. (2020). Perception and beliefs regarding cardiovascular risk factors and lifestyle modifications among high risk college students. *Canadian Journal of Nursing Research*, 0844562119899310. https://doi.org/10.1177/0844562119899310

Traylor, J., Chandrasekaran, S., Limaye, M., Srinivas, S., & Durnwald, C. P. (2016). Risk perception of future cardiovascular disease in women diagnosed with a hypertensive disorder of pregnancy. *The Journal of Maternal-Fetal & Neonatal Medicine, 29*(13), 2067-2072. https://doi.org/10.3109/14767058.2015.1081591

Tsao, C. W., Aday, A. W., Almarzooq, Z. I., Alonso, A., Beaton, A. Z., Bittencourt, M. S., Boehme, A. K., Buxton, A. E., Carson, A. P., & Commodore-Mensah, Y. (2022). Heart disease and stroke statistics—2022 update: A report from the American Heart Association. *Circulation, 145*(8), e153-e639. https://doi.org/10.1161/CIR.0000000000001052

Tsulukidze, M., Reardon, D., & Craver, C. (2022). Elevated cardiovascular disease risk in low-income women with a history of pregnancy loss. *Open Heart, 9*(1), e002035. https://doi.org/10.1136/openhrt-2022-002035

Tulandi, T., & Al-Fozan, H. (2016). Spontaneous abortion: Risk factors, etiology, clinical manifestations, and diagnostic evaluation. *UpToDate*. Retieved 15 October, 2019.

Uchmanowicz, I., Hoes, A., Perk, J., McKee, G., Svavarsdóttir, M. H., Czerwińska-Jelonkiewicz, K., Janssen, A., Oleksiak, A., Dendale, P., & Graham, I. M. (2021). Optimising implementation of European guidelines on cardiovascular disease prevention in clinical practice: What is needed? *European Journal of Preventive Cardiology, 28*(4), 426-431. https://doi.org/10.1177/2047487320926776

Umesawa, M., & Kobashi, G. (2017). Epidemiology of hypertensive disorders in pregnancy: Prevalence, risk factors, predictors and prognosis. *Hypertension Research, 40*(3), 213-220. https://doi.org/10.1038/hr.2016.126

Unger, T., Borghi, C., Charchar, F., Khan, N., Poulter, N., Prabhakaran, D., & Schlaich, M. (2020). International Society of Hypertension Global Hypertension Practice Guidelines. *AHA Journal, 75*, 1334–1357. https://doi.org/10.1161/HYPERTENSIONAHA.120.15026

Upendrababu, V., & Gowda, S. N. (2020). World Journal Of Advance Health Care Research. *World, 4*(2).

Vahedi, F. A., Gholizadeh, L., & Heydari, M. (2020). Hypertensive disorders of pregnancy and risk of future cardiovascular disease in women. *Nursing for Women's Health*. https://doi.org/10.1016/j.nwh.2020.02.001

Valdiviezo, C., Garovic, V. D., & Ouyang, P. (2012). Preeclampsia and hypertensive disease in pregnancy: Their contributions to cardiovascular risk. *Clinical Cardiology, 35*(3), 160-165. https://doi.org/10.1002/clc.21965

Valerio, L., Peters, R. J., Zwinderman, A. H., & Pinto-Sietsma, S. J. (2016). Association of family history with cardiovascular disease in hypertensive individuals in a multiethnic population. *Journal of the American Heart Association, 5*(12), e004260. https://doi.org/10.1161/JAHA.116.004260

Valencia, E. (2020). Acquiescence, instructor's gender bias and validity of student evaluation of teaching. *Assessment & Evaluation in Higher Education, 45(4), 483-495.* https://doi.org/10.1080/02602938.2019.1666085

Van Achterberg, T., Huisman-de Waal, G. G., Ketelaar, N. A., Oostendorp, R. A., Jacobs, J. E., & Wollersheim, H. C. (2011). How to promote healthy behaviours in patients? An overview of evidence for behaviour change techniques. *Health promotion international, 26*(2), 148-162. https://doi.org/10.1093/heapro/daq050

van der Heide, I., Wang, J., Droomers, M., Spreeuwenberg, P., Rademakers, J., & Uiters, E. (2013). The relationship between health, education, and health literacy: Results from the Dutch Adult Literacy and Life Skills Survey. *Journal of Health Communication, 18*(sup1), 172-184. https://doi.org/10.1080/10810730.2013.825668

van der Pligt, J. (2001). Vulnerability and perceived susceptibility. *International Encyclopedia of the Social and Behavioral Sciences, 2001*, 16333-16335. https://doi.org/10.1016/B0-08-043076-7/03807-9

Varì, R., Scazzocchio, B., D'Amore, A., Giovannini, C., Gessani, S., & Masella, R. (2016). Gender-related differences in lifestyle may affect health status. *Annali dell'Istituto Superiore di Sanita, 52*(2), 158-166.

Varleta, P., Acevedo, M., Casas-Cordero, C., Berríos, A., & Navarrete, C. (2020). Low cardiovascular disease awareness in Chilean women: Insights from the ESCI project. *Global Heart, 15*(1). https://doi.org/10.5334/gh.534

Veerbeek, J. H., Hermes, W., Breimer, A. Y., van Rijn, B. B., Koenen, S. V., Mol, B. W., Franx, A., de Groot, C. J., & Koster, M. P. (2015). Cardiovascular disease risk factors after early-onset preeclampsia, late-onset preeclampsia, and pregnancy-induced hypertension-novelty and significance. *Hypertension, 65*(3), 600-606. https://doi.org/10.1161/HYPERTENSIONAHA.114.04850

Viana Pinto, P., Rei, M., Machado, A. P., & Montenegro, N. (2014). Preeclampsia and future cardiovascular risk: Are women and general practitioners aware of this relationship? The experience from a Portuguese centre. *Obstetrics and Gynecology International, 2014*. https://doi.org/10.1155/2014/531539

Victor Chang Cardiac Research Institute. (2022). *High Cholesterol*. Retrieved December 20, 2023, from https://www.victorchang.edu.au/high-cholesterol

Vinayagam, D., Leslie, K., Khalil, A., & Thilaganathan, B. (2015). Preeclampsia-What is to blame? The placenta, maternal cardiovascular system or both? *World Journal of Obstetrics and Gynecology, 4*(4), 77-85. https://doi.org/10.5317/wjog.v4.i4.77

Virani, S. S., Benjamin, E. J., Alonso, A., Bittencourt, M. S., Callaway, C. W., Carson, A. P., Chamberlain, A. M., & Chang, A. R. (2020). Heart disease and stroke statistics-2020 update: A report from the American Heart Association. *Circulation, 141*(10), e139-e596. https://doi.org/10.1161/CIR.0000000000000757

Virdee, S. K., Greenfield, S. M., Fletcher, K., McManus, R. J., Hobbs, F. R., & Mant, J. (2013). Would primary health care professionals prescribe a polypill to manage cardiovascular risk? A qualitative interview study. *BMJ Open, 3*(3), e002498. https://doi.org/10.1136/bmjopen-2012-002498

Von Wagner, Knight, Steptoe, & Wardle. (2007). Functional health literacy and health-promoting behaviour in a national sample of British adults. *Journal of Epidemiology & Community Health, 61*(12), 1086-1090. https://doi.org/10.1136/jech.2006.053967

Voogdt-Pruis, H. R., Beusmans, G. H., Gorgels, A. P., Kester, A. D., & Van Ree, J. W. (2010). Effectiveness of nurse-delivered cardiovascular risk management in primary care: A randomised trial. *Br J Gen Pract, 60*(570), 40-46. https://doi.org/10.3399/bjgp10X482095

Wagner, J., Lacey, K., Chyun, D., & Abbott, G. (2005). Development of a questionnaire to measure heart disease risk knowledge in people with diabetes: The Heart Disease Fact Questionnaire. *Patient Education and Counseling, 58*(1), 82-87. https://doi.org/10.1016/j.pec.2004.07.004

Wagner, M. M., Bhattacharya, S., Visser, J., Hannaford, P. C., & Bloemenkamp, K. W. (2015). Association between miscarriage and cardiovascular disease in a Scottish cohort. *Heart, 101*(24), 1954-1960. https://doi.org/10.1136/heartjnl-2015-307563

Wang, W., Xie, X., Yuan, T., Wang, Y., Zhao, F., Zhou, Z., & Zhang, H. (2021). Epidemiological trends of maternal hypertensive disorders of pregnancy at the global, regional, and national levels: A population-based study. *BMC Pregnancy and Childbirth, 21*(1), 1-10. https://doi.org/10.1186/s12884-021-03809-2

Wang, X., Dalmeijer, G. W., Den Ruijter, H. M., Anderson, T. J., Britton, A. R., Dekker, J., Engström, G., Evans, G. W., De Graaf, J., & Grobbee, D. E. (2017). Clustering of cardiovascular risk factors and carotid intima-media thickness: The USE-IMT study. *PLOS One, 12*(3), e0173393. https://doi.org/10.1371/journal.pone.0173393

Wang, Y.-X., Mínguez-Alarcón, L., Gaskins, A. J., Wang, L., Ding, M., Missmer, S. A., Rich-Edwards, J. W., Manson, J. E., & Chavarro, J. E. (2022). Pregnancy loss and risk of cardiovascular disease: The Nurses' Health Study II. *European Heart Journal, 43*(3), 190-199. https://doi.org/10.1093/eurheartj/ehab737

Watanabe, K., Kimura, C., Iwasaki, A., Mori, T., Matsushita, H., Shinohara, K., Wakatsuki, A., Gosho, M., & Miyano, I. (2015). Pregnancy-induced hypertension is associated with an increase in the prevalence of cardiovascular disease risk factors in Japanese women. *Menopause, 22*(6), 656-659. https://doi.org/10.1097/GME.0000000000000361

Watson, B. M., Heatley, M. L., Gallois, C., & Kruske, S. (2016). The importance of effective communication in interprofessional practice: Perspectives of maternity clinicians. *Health Communication, 31*(4), 400-407. https://doi.org/10.1080/10410236.2014.960992

Webster, R. J., Heeley, E. L., Peiris, D. P., Bayram, C., Cass, A., & Patel, A. A. (2009). Gaps in cardiovascular disease risk management in Australian general practice. *Medical Journal of Australia, 191*(6), 324-329. https://doi.org/10.5694/j.1326-5377.2009.tb02816.x

Wenger, N. (2017). Tailoring cardiovascular risk assessment and prevention for women: One size does not fit all. *Global Cardiology Science & Practice, 2017*(1). https://doi.org/10.21542/gcsp.2017.1

Wenger, N. K. (2013). Prevention of cardiovascular disease in women: Highlights for the clinician of the 2011 American Heart Association Guidelines. *Advances in Chronic Kidney Disease, 20*(5), 419-422. https://doi.org/10.1053/j.ackd.2013.02.006

Wenger, N. K. (2019). Female-friendly focus: 2019 ACC/AHA Guideline on the Primary Prevention of Cardiovascular Disease. *Clinical Cardiology, 42*(8), 706. https://doi.org/10.1002/clc.23218

Wenger, N. K., Arnold, A., Bairey Merz, C. N., Cooper-DeHoff, R. M., Ferdinand, K. C., Fleg, J. L., Gulati, M., Isiadinso, I., Itchhaporia, D., & Light-McGroary, K. (2018). Hypertension across a woman's life cycle. *Journal of the American College of Cardiology, 71*(16), 1797-1813. https://doi.org/10.1016/j.jacc.2018.02.033

Whitehead, D. (2006). Health promotion in the practice setting: findings from a review of clinical issues. *Worldviews on Evidence-Based Nursing, 3*(4), 165-184. https://doi.org/10.1111/j.1741-6787.2006.00068.x

Wikström, A. K., Haglund, B., Olovsson, M., & Lindeberg, S. N. (2005). The risk of maternal ischaemic heart disease after gestational hypertensive disease. *BJOG: An*

International Journal of Obstetrics & Gynaecology, 112(11), 1486-1491. https://doi.org/10.1111/j.1471-0528.2005.00733.x

Wilkins-Haug, L., Celi, A., Thomas, A., Frolkis, J., & Seely, E. W. (2015). Recognition by women's health care providers of long-term cardiovascular disease risk after preeclampsia. *Obstetrics & Gynecology, 125*(6), 1287-1292. https://doi.org/10.1097/AOG.0000000000000856

Willcox, S. (2015). *Chronic diseases in Australia: Blueprint for preventive action*. Australian Health Policy Collaboration.

Williams, B., Mancia, G., Spiering, W., Agabiti Rosei, E., Azizi, M., Burnier, M., Clement, D., Coca, A., De Simone, G., & Dominiczak, A. (2018). Practice guidelines for the management of arterial hypertension of the European Society of Hypertension and the European Society of Cardiology: ESH/ESC Task Force for the Management of Arterial Hypertension. *J Hypertens, 36*(12), 2284-2309. https://doi.org/10.1097/HJH.0000000000001961

Wilson, P. W., & Douglas, P. S. (2015). Epidemiology of coronary heart disease. UpToDate. Retrieved 13 November 2019.

Wilson, V. (2016). Research methods: Sampling. *Evidence Based Library and Information Practice, 11*(1 (S)), 69-71. https://doi.org/10.18438/B8333V

Woodward, M. (2019). Cardiovascular disease and the female disadvantage. *International Journal of Environmental Research and Public Health, 16*(7), 1165. https://doi.org/10.3390/ijerph16071165

World Health Organization. (2012). *Health education: Theoretical concepts, effective strategies and core competencies: A foundation document to guide capacity development of health educators.*Retrieved *20 November 2019*.

World Health Organization. (2014). *Global forum on chronic disease prevention and control*. Retrieved 01 October 2020. https://apps.who.int/mediacentre/news/releases/2004/pr76/en/index.html

World Health Organization. (2016). Ottawa Charter for Health Promotion. *World Health Organization*. Regional Office for Europe.

World Health Organization. (2017). Cardiovascular disease (CVDs) fact sheet. Retrieved 7 September 2019. https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds)

World Health Organization. (2018). Prevention of recurrences of myocardial infarction and stroke study: the PREMISE programme: country projects. Retrieved 20 December 2018. https://www.who.int/home/news-room/fact-sheets/myocardial infarction

World Health Organization. (2021a). *Cardiovascular disease (CVD)*. Retrieved 20 December, 2022, from https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds)

World Health Organization. (2021b). *Obesity and overweight*. https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight

World Health Organization. (2021c). *Diabetes*. https://www.who.int/news-room/fact-sheets/detail/diabetes

World Health Organization. (2022). *Physical activity*. Retrieved 23 July, 2022, from https://www.who.int/news-room/fact-sheets/detail/physical-activity

World Heart Federation. (2017). *Women and CVD-Facts and tips*. Retrieved 12 September, 2022, from https://www.world-heart-federation.org/resources/women-cvd-facts-tips

World Medical Association. (2013). World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. Jama,310(20),2191-2194.

Wright, J. D. (2015). International encyclopedia of the social & behavioral sciences. from https://www.elsevier.com/books/international-encyclopedia-of-the-social-and-behavioral-sciences/wright/978-0-08-097086-8

Wu, C.-Y., Hu, H.-Y., Chou, Y.-J., Huang, N., Chou, Y.-C., & Li, C.-P. (2015). High blood pressure and all-cause and cardiovascular disease mortalities in community-dwelling older adults. *Medicine, 94*(47). https://doi.org/10.1097/MD.0000000000002160

Wu, P., Mamas, M. A., & Gulati, M. (2019). Pregnancy as a predictor of maternal cardiovascular disease: The era of cardioobstetrics. *Journal of Women's Health, 28*(8), 1037-1050. https://doi.org/10.1089/jwh.2018.7480

Wu, P., Mamas, M. A., & Gulati, M. (2022). Health care professional's knowledge of pregnancy complications and women's cardiovascular health: An international study utilizing social media. *Journal of Women's Health*. https://doi.org/10.1089/jwh.2021.0298

Wu, Y. (2022). Tobacco Control Measures' Role in Improving Employees' Health Under the Impact of Health Education and Media Campaign. *Frontiers in Public Health*, *10*, 904894. https://doi.org/10.3389/fpubh.2022.904894

Xue, R., Li, Q., Geng, Y., Wang, H., Wang, F., & Zhang, S. (2021). Abdominal obesity and risk of CVD: A dose–response meta-analysis of thirty-one prospective studies. *British Journal of Nutrition, 126*(9), 1420-1430. https://doi.org/10.1017/S0007114521000064

Ying, W., Catov, J. M., & Ouyang, P. (2018). Hypertensive disorders of pregnancy and future maternal cardiovascular risk. *Journal of the American Heart Association, 7*(17), e009382. https://doi.org/10.1161/JAHA.118.009382

Young, B., Hacker, M. R., & Rana, S. (2012). Physicians' knowledge of future vascular disease in women with preeclampsia. *Hypertension in Pregnancy, 31*(1), 50-58. https://doi.org/10.3109/10641955.2010.544955

Yu, E., Rimm, E., Qi, L., Rexrode, K., Albert, C. M., Sun, Q., Willett, W. C., Hu, F. B., & Manson, J. E. (2016). Diet, lifestyle, biomarkers, genetic factors, and risk of cardiovascular disease in the nurses' health studies. *American Journal of Public Health, 106*(9), 1616-1623. https://doi.org/10.2105/AJPH.2016.303316

Yu, Y., Soohoo, M., Sørensen, H. T., Li, J., & Arah, O. A. (2022). Gestational diabetes mellitus and the risks of overall and type-specific cardiovascular disease: A population-and sibling-matched cohort study. *Diabetes Care, 45*(1), 151-159. https://doi.org/10.2337/dc21-1018

Yue, J., Mao, X., Xu, K., Lü, L., Liu, S., Chen, F., & Wang, J. (2016). Prevalence, awareness, treatment and control of diabetes mellitus in a Chinese population. *PLOS One, 11*(4), e0153791. https://doi.org/10.1371/journal.pone.0153791

Yusuf, S., Hawken, S., Ôunpuu, S., Dans, T., Avezum, A., Lanas, F., McQueen, M., Budaj, A., Pais, P., & Varigos, J. (2004). Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): Case-control study. *The Lancet, 364*(9438), 937-952. https://doi.org/10.1016/S0140-6736(04)17018-9

Yusuf, S., Joseph, P., Rangarajan, S., Islam, S., Mente, A., Hystad, P., Brauer, M., Kutty, V. R., Gupta, R., & Wielgosz, A. (2020). Modifiable risk factors, cardiovascular disease, and mortality in 155 722 individuals from 21 high-income, middle-income, and low-income countries (PURE): A prospective cohort study. *The Lancet, 395*(10226), 795-808. https://doi.org/10.1016/S0140-6736(19)32008-2

Zera, C. A., Nicklas, J. M., Levkoff, S. E., & Seely, E. W. (2013). Diabetes risk perception in women with recent gestational diabetes: Delivery to the postpartum visit. *The Journal of Maternal-Fetal & Neonatal Medicine, 26*(7), 691-696. https://doi.org/10.3109/14767058.2012.746302

Zhang, Y., Vittinghoff, E., Pletcher, M. J., Allen, N. B., Zeki Al Hazzouri, A., Yaffe, K., Balte, P. P., Alonso, A., Newman, A. B., & Ives, D. G. (2019). Associations of blood pressure and cholesterol levels during young adulthood with later cardiovascular events. *Journal of the American College of Cardiology, 74*(3), 330-341. https://doi.org/10.1016/j.jacc.2019.03.529

Zhou, B., Danaei, G., Stevens, G. A., Bixby, H., Taddei, C., Carrillo-Larco, R. M., Solomon, B., Riley, L. M., Di Cesare, M., & Iurilli, M. L. C. (2019). Long-term and recent trends in hypertension awareness, treatment, and control in 12 high-income countries: An analysis of 123 nationally representative surveys. *The Lancet, 394*(10199), 639-651. https://doi.org/10.1016/S0140-6736(19)31145-6

Zumbo, B., Kelly, K., Begoray, D., Kazanjian, A., Mullet, J., & Hayes, M. (2006). *The development and validation of measures of "health literacy" in different populations.* Citeseer.

Appendices

All appendix material is reproduced here as it was used in the study.

Appendix A: Human Research Ethics Committee Approval

Address for all correspondence
Research ETHICS AND GOVERNANCE Office
Royal Prince Alfred Hospital
CAMPERDOWN NSW 2050
TELEPHONE: (02) 9515 6766
EMAIL: SLHD-RPAEthics@health.nsw.gov.au

Health
Sydney
Local Health District

X19-0437& 2019/ETH13440

13 December 2019

This letter constitutes ethical approval only. You must NOT commence this research project at ANY site until you have submitted a Site Specific Assessment Form to the Research Governance Officer and received separate authorisation from the Chief Executive or delegate of that site.

Dear Professor Khajehei,

Re: X19-0437 & 2019/ETH13440 – 'The Risk of Cardiovascular Disease in Women with a history of Pregnancy Complications: From Awareness to Management of the Risk'

The Executive of the Ethics Review Committee, at its meeting of 13 December 2019 considered your correspondence of 9 December 2019. In accordance with the decision made by the Ethics Review Committee, at its meeting of 13 November 2019, ethical approval is granted.

The proposal meets the requirements of the *National Statement on Ethical Conduct in Human Research.*

This approval includes the following:

- HREA (Version 3, 6 December 2019)
- Protocol (Version 4, 13 December 2019)
- Participant Information Sheet Patient (Master Version 3, 13 December 2019)
- Participant Information Sheet Clinician (Master Version 3, 13 December 2019)

- Consent Form (Master Version 3, 13 December 2019)
- Patient Survey (Master Version 2, 27 November 2019)
- Clinician Survey (Master Version 2, 27 November 2019)
- Email to Managers (Version 1, 27 November 2019)
- Research Data Management Plan

You are asked to note the following:

> **On the basis of this ethics approval, authorisation may be sought to conduct this study within any NSW/QLD/VIC/SA/WA/ACT public health organisation and/or within any private organisation which has entered into an appropriate memorandum of understanding with the Sydney Local Health District, Sydney Local Health Network or the Sydney South West Area Health Service.**

The Committee noted that authorisation will be sought to conduct the study at the following sites:

- Royal North Shore Hospital
- Westmead Hospital

- This approval is valid for five years, and the Committee requires that you furnish it with annual reports on the study's progress beginning in December 2020. If recruitment is ongoing at the conclusion of the four year approval period, a full re-submission will be required. Ethics approval will continue during the re-approval process.
- This human research ethics committee (HREC) has been accredited by the NSW Department of Health as a lead HREC under the model for single ethical and scientific review and is constituted and operates in accordance with the National Health and Medical Research Council's National Statement on Ethical Conduct in Human Research and the CPMP/ICH Note for Guidance on Good Clinical Practice.
- You must immediately report anything which might warrant review of ethical approval of the project in the specified format, including unforeseen events that might affect continued ethical acceptability of the project.
- You must notify the HREC of proposed changes to the research protocol or conduct of the research in the specified format.
- You must notify the HREC and other participating sites, giving reasons, if the project is discontinued at a site before the expected date of completion.
- If you or any of your co-investigators are University of Sydney employees or have a conjoint appointment, you are responsible for informing the University's Risk Management Office of this approval, so that you can be appropriately indemnified.

- Where appropriate, the Committee recommends that you consult with your Medical Defence Union to ensure that you are adequately covered for the purposes of conducting this study.

Should you have any queries about the Committee's consideration of your project, please contact me. The Committee's Terms of Reference, Standard Operating Procedures, membership and standard forms are available from the Sydney Local Health District website.

A copy of this letter must be forwarded to all site investigators for submission to the relevant Research Governance Officer.

The Ethics Review Committee wishes you every success in your research.

Yours sincerely,

Production Note:
Signature removed prior to publication.

Patricia Plenge
Executive Officer
Ethics Review Committee (RPAH Zone) HERC\EXCOR\19-12

Appendix B: University of Technology Sydney, Ethics Ratification

Dear Applicant

Re: ETH20-4707 -
'The Risk of Cardiovascular Disease in Women with History of Pregnancy Complications: From Awareness to Management of the Risk.'

[External Ratification: Sydney Local Health District Research, HREC approval X19-0437 & 2019/ETH13440 – 'The Risk of Cardiovascular Disease in Women with History of Pregnancy Complications: From Awareness to Management of the Risk' – This approval is valid for five years, and the Committee requires that you furnish it with annual reports on the study's progress beginning in December 2020.]

The UTS Human Research Ethics Expedited Review Committee has reviewed your application and agreed that the application meets the requirements of the NHMRC National Statement on Ethical Conduct in Human Research (2007). I am pleased to inform you that your external ethics approval has been ratified.

This ratification is subject to the standard conditions outlined in your original letter of approval.

You are reminded that this letter constitutes ethics approval only. This research project must also be undertaken in accordance with all UTS policies and guidelines including the Research Management Policy.

Your approval number is UTS HREC REF NO. ETH20-4707.

Approval will be for the period specified above and subject to the provision of annual reports and evidence of continued support from the above-named Committee.

Please note that the ethical conduct of research is an on-going process. The National Statement on Ethical Conduct in Research Involving Humans requires us to obtain a report about the progress of the research, and in particular about any changes to the research which may have ethical implications. This report form must be completed at least annually, and at the end of the project (if it takes more than a year). The Ethics Secretariat will contact you when it is time to complete your first report.

This research must be undertaken in compliance with the Australian Code for the Responsible Conduct of Research and National Statement on Ethical Conduct in Human Research.

You should consider this your official letter of approval. If you require a hardcopy please contact the Ethics Secretariat.

To access this application, please click here, a copy of your application has also been attached to this email.

We value your feedback on the online ethics process. If you would like to provide feedback please do so here.

If you have any queries about your ethics approval, or require any amendments to your research in the future, please don't hesitate to contact the Ethics Secretariat and quote the ethics application number (e.g. ETH20-xxxx) in all correspondence.

Yours sincerely,

A/Prof Beata Bajorek
Chairperson
UTS Human Research Ethics Committee
C/- Research Office
University of Technology Sydney
Research.Ethics@uts.edu.au | Website
PO Box 123 Broadway NSW 2007

Ref: E39

Appendix C: Participant Information Sheet (Women)

Participant Information Sheet

Study Title: The Knowledge and Awareness of Cardiovascular Disease Risk in Women with a history of Complications of Pregnancy

Short Title: Cardiovascular Disease Risk in Women

Investigator: Farnoosh Asghar Vahedi

Principal Supervisor: Dr Leila Gholizadeh

Co-Supervisor: A/Prof Marjan Khajehei, Dr Fiona Orr

Introduction

You are invited to participate in this online study because you experienced a complication in one of your previous pregnancies. This could be high blood pressure, gestational diabetes, miscarriage or stillbirth. The aim of this research is to assess the knowledge and awareness of women with history of complications of pregnancy of cardiovascular disease risk factors. We are also interested in researching how health care providers communicate with and manage cardiovascular disease risk in these women.

The study is being conducted by Ms Farnoosh Asghar Vahedi who is a PhD candidate at the Faculty of Health in the University of Technology Sydney, under the supervision of Dr Leila Gholizadeh, A/Prof Marjan Khajehei and Dr Fiona Orr. The results of the research findings will be published in relevant journals and will be disseminated in a form of a PhD thesis.

This Participant Information Sheet/Consent Form gives you information about the research project. This information will help you decide whether or not you want to take part in the research. Please read this information sheet carefully. Ask questions about anything that you do not understand or want to know more about.

The study is being conducted by Ms. Farnoosh Asghar Vahedi, who is a PhD candidate at the Faculty of Health in the University of Technology Sydney, under the supervision of Dr Leila Gholizadeh, A/Prof Marjan Khajehei and Dr Fiona Orr. The results of the research findings will be published in relevant journals and will be disseminated in a form of a PhD thesis.

If you are interested to receive the results of the study, you may write your email address on the consent form, so that you will receive a copy of the results once the study is completed.

The study is being internally funded by in-kind support from the participating hospitals. There are no conflicts of interest to declare for this study and there is no potential for principal investigator to receive financial benefits from the outcomes of this study.

Study Procedures

We aim to recruit 299pregnant women to this study. The Relevant Authorities in this research study are the Faculty of Health at University of Technology Sydney and the Department of Women's and Newborn Health at Westmead Hospital and Royal North Shore hospital.

If you agree to participate in this study, you will be asked to sign the Participant Consent Form. You will need to answer a series of online questionnaires, which will take approximately 15-20 minutes to complete. The questionnaires will cover information regarding your demographic, heart health, life style and your understanding of heart disease risk and risk factors. The questionnaires will be anonymous and will be kept separately from your consent.

Study population

Inclusion criteria: The study inclusion criteria include women ≥ 18 years old, have a history of at least one of the complications of pregnancies including hypertensive disorders in pregnancy, gestational diabetes, miscarriage or stillbirth, being able to speak, read and understand English, and provide a consent to participation in the study.
Exclusion criteria: Women < 18 years of old and/or without any pregnancy complications will be excluded from the study. Furthermore, those who are mentally and/or cognitively impaired, have severe physical health issue disease, and unable to speak, read and understand English will be excluded.

Risks

Answering questions about cardiovascular disease may cause you distress. We will encourage you to communicate with your general practitioner about your cardiovascular health and will provide information on available mental health or social services, if needed.

Benefits

There will be no direct benefit to you from your participation in this research. However, the results of this research will help the researchers to understanding the gap in knowledge and practice and how they can improve the health of women with complicated pregnancies in the future.

Voluntary Participation

Participation in this research is voluntary. If you are interested in participation, you can sign the consent form. By signing it you are agreeing that you:

- Understand what you have read.
- Consent to take part in the research project.

If you do decide to take part, you will be given this Participant Information and Consent Form to sign and you will be given a copy to keep. If you decide to take part and later change your mind, you are free to withdraw from the project at any time before completing and handing the questionnaire. Because the questionnaire is going to be anonymous, so it would not be possible to pull it out.

In case you participate in the study through online questionnaire, completing the survey is considered to be implied consent.

Confidentiality

This is an anonymous study. This means you do not need to write your name on the study questionnaires, no identifying information will be collected from you and no follow up will be required. After we have collected yours and other's answers to the questions, we will analysis them and write up the results.

After you sign the consent form, if you change your mind and decide to withdraw, you can simply disregard the questionnaire, not answer any questions and close the internet browser. If you are in the middle of the questionnaire and decide to withdraw, you can stop answering the rest of the questions and close your internet browser. In this case, your responses will not be collected. However, if you have submitted your responses already (either online or paper format), you cannot withdraw from the study, as the survey is anonymous and the researchers will not be able to identify your responses among others.

The electronic data will be saved in password protected electronic data management REDCap and will be stored in a password protected computer. The computer will be secured with automatic screen locking after 5 minutes of inactively and no one except the research team will have access to the data. The file containing data will also be protected against virus or malicious software. Paper questionnaires will be stored in a locked cabinet in a locked room (Dr Leila Gholizadeh's office) at the UTS. The copies (both electronic and hardcopies) will be stored for five years, after which they will be destroyed securely. I.e., the paper documents will be shredded and deposited into the security bin at the UTS, and the electronic files and any back-ups will be permanently deleted from the computers. It is anticipated that the results of this research project will be published and/or presented in a variety of forums using aggregated data, such as numbers and percent or means in groups and not individual information. However, in none of publications and/or presentations, you can be individually identified.

Ethics approval and complaints

This study has been approved by the Ethics Review Committee (RPAH Zone) of the Sydney Local Health District. Any person with concerns or complaints about the conduct of this study should contact the Executive Officer on 02 9515 6766 and quote protocol number X19-0437.

The conduct of this study at the participating hospitals has been authorised by the Sydney Local Health District. Any person with concerns or complaints about the conduct of this study may also contact the Research Governance Officer on 02 9515 6766 and quote protocol number [X19-0437&2019/ETH13440].

Further information and who to contact

If you want any further information about this project, you can contact the research midwives involved in the study at the hospital that you were enrolled in via the following numbers.

Clinical contact person

Researcher	Mrs Farnoosh Asghar Vahedi
Contact	Farnoosh.asgharvahedi@student.uts.edu.au

Co-supervisor	A/Prof Marjan Khajehei
Contact	Email: Marjan.Khajehei@health.nsw.gov.au Mob

If you have any complaints about any aspect of the project, the way it is being conducted or any questions about being a research participant in general, then you may contact:

Reviewing HREC approving this research and HREC Executive Officer details
Local HREC Office contact (Single Site -Research Governance Officer)

Reviewing HREC name	Sydney LHD HREC
HREC Executive Officer	Ms Patricia Plenge
Telephone	(02) 9515 6766
Email	patricia.plenge@health.nsw.gov.au

Appendix D: Participants' Consent Form (Women's Study)

Consent Form

Study Title: The Knowledge and Awareness of Cardiovascular Disease Risk in Women with a history of Complications of Pregnancy

Short Title: Cardiovascular Disease Risk in Women

Investigator: Farnoosh Asghar Vahedi

Principal Supervisor: Dr Leila Gholizadeh

Co-Supervisor: Dr Marjan Khajehei, Dr Fiona Orr

Declaration by Participant

I, ...of... *[address]* have read and understood the information for participants on the above named research study and have discussed the study with ....

I have been made aware of the procedures involved in the study, including any known or expected inconvenience, risk, discomfort and of their implications as far as they are currently known by the researchers.

I freely choose to participate in this study and understand that I can withdraw at any time.

I also understand that the research study is strictly confidential.

I hereby agree to participate in this research study.

☐ I would like to receive the link to the online survey:
Email:…………………………………………………………………………… , Or
Mobile: ……………………………………………

☐ I would like to be emailed a copy of the study results:
Email:………………………………………………………….

NAME: ....

SIGNATURE: ....

DATE: ....

NAME OF RESEARCHER: ....

SIGNATURE OF RESEARCHER: ....

Appendix E: The Survey Package for the Women's Study

Dear Research Participant

This survey package consists of several sections including sociodemographic information, obstetric history, cardiovascular risk factors, and knowledge and awareness about cardiovascular disease in women.

Please read each question carefully and tick the box that applies to you.

Section 1: Sociodemographic and Medical History

1. What is your age?.................. years

2. What is your ethnicity?

☐ Australian

☐ Australian Aboriginal or Torres Islander

☐ New Zealander

☐ European, British or Irish

☐ North African, Middle Easter or Sub Saharan African

☐ South East Asian or North Asian

☐ North American, South or Central American

3. What is your highest level of education?

☐ Primary school

☐ Secondary school

☐ Certificate

☐ Diploma

☐ Bachelor's degree

☐ Postgraduate degree

4. How would you rate your financial situation?

☐ Excellent

☐ Good

☐ Fair

☐ Poor

5. What is your marital status?

☐ Single/never married

☐ Married

☐ De facto

☐ Divorced

☐ Separated

6. How many miscarriages (pregnancy loss before 20 weeks of pregnancy) have you had?

☐ None

☐ 1

☐ 2

☐ 3 or more

7. How many stillbirths (pregnancy loss after 20 weeks of pregnancy) have you had?

☐ None

☐ 1

☐ 2

☐ 3 or more

8. Have you been diagnosed with high blood pressure during any of your pregnancies (in the form of pre-eclampsia, gestational hypertension, or eclampsia)?

☐ Yes

☐ No

☐ I don't know

9. Have you been diagnosed with gestational diabetes in any of your pregnancies (in the form of diet control or insulin dependent)?

☐ Yes

☐ No

☐ I don't know

Section 2: Cardiovascular Risk Factors

1. Weight ……. Kg

2. Height…….cm

3. Do you currently smoke?

☐ No

☐ Yes

☐ If yes, how many cigarettes do you smoke per day? ....

4. Did you smoke when you were not pregnant?

☐ No

☐ Yes

☐ If yes, how many cigarettes did you smoke per day? ……………………

5. Which one of the items below best describes your physical activity?

☐ Moderate physical activity at least 150 minutes per week

☐ Moderate physical activity less than 30 minutes less than 5 days in a week

☐ Little or no physical activity

6. Do you have your blood pressure checked regularly?

☐ Yes

☐ No

7. Do you have a high blood pressure (blood pressure greater than or equal to 140/90)?

☐ Yes

☐ No

☐ I don't know

8. Is your blood pressure usually within the recommended range, i.e., less than 120/80 mmHg?

☐ Yes

☐ No

☐ I don't know

9. Do you have a family history of heart disease?

☐ Yes

☐ No

☐ If yes, who in your family has heart disease?...................

10. Have you ever being diagnosed with high blood pressure?

☐ Yes

☐ No

11. Have you had your blood sugar level checked within the last 12 months?

☐ Yes

☐ No

12. Have you ever been diagnosed with diabetes?

☐ Yes

☐ No

13. Is your fasting blood sugar level usually within the recommended range of 4.0 to 5.9 mmol/L?

☐ Yes

☐ No

☐ I don't know

14. Have you had your blood cholesterol level checked within the last 12 months?

☐ Yes

☐ No

15. Do you have high blood cholesterol (total cholesterol level greater than 5 mmol/L)?

☐ Yes

☐ No

☐ I don't know

16. Is your blood cholesterol level usually within the recommended range of less than 5mmol/L?

☐ Yes

☐ No

☐ I don't know

17. Have any of you family members (father, mother, sister, or brother) been diagnosed with heart disease before the age of 65?

☐ Yes

☐ No

☐ I don’t know

Section 3: The Knowledge of Cardiovascular Disease Risk and Risk Factors in Women with a History of Complications of Pregnancy Questionnaire

The questions in the following section aim to assess your knowledge and awareness about different aspects of heart disease. Please note that very few people answer all these questions correctly. So, just do the best you can. For each item below, please put a checkmark in either the 'True', 'False', or 'I don't know' column.

Questions	True	False	I don't know
1. A woman would always know if she has a heart disease.			
2. Heart disease is better defined as a short-term illness than a chronic or long-term illness.			
3. Heart disease is the number one killer of women in Australia.			
4. The chance of developing heart disease in women reduces after menopause.			
5. Women are more likely to die from breast cancer than heart disease in Australia.			
6. A positive family history of heart disease increases the risk of heart disease for women in the future.			
7. The older a woman is, the greater her chance of developing heart disease.			
8. Taller people are at greater risk of developing heart disease.			
9. Smoking increases the risk of heart disease in women.			
10. A woman who stops smoking will lower her risk of developing heart disease.			
11. Stress in the most important cause of heart attack.			
12. High blood pressure increases the risk of heart disease in the future.			

13. A woman has *high* blood pressure if her blood pressure is 140/90 (systolic/diastolic) or higher.			
14. Most people would know if they have a high blood pressure.			
15. Keeping blood pressure under control will reduce the risk of heart disease in women.			
16. High blood cholesterol increases the risk of heart disease.			
17. If your 'good' cholesterol (HDL) is high, you are at a higher risk of heart disease.			
18. T2DM increases the risk of heart disease in women.			
19. Being overweight increases the risk of heart disease in women.			
20. Feeling weak, lightheaded, and fainting are the common symptoms of heart attack in women.			
21. Regular physical activity will lower the risk of heart disease in women.			
22. Only exercising at a gym or in an exercise class will lower the risk of heart disease.			
23. Walking and gardening are considered exercise that will help lower the risk of heart disease.			
24. Polyunsaturated fats are healthier than saturated fats for the heart.			
25. Eating a lot of red meat increases the risk of heart disease.			
26. Trans-fats are healthier than most other types of fats for the heart.			
27. Eating a high fibre diet does not affect the risk of heart disease.			

28. Women who have had diabetes in pregnancy are more likely to develop *diabetes* in the future.			
29. Women who have had diabetes in pregnancy are more likely to develop *heart disease* in the future.			
30. Having a history of stillbirth has no effect on women's heart in the future.			
31. Women who have had miscarriage/s are at higher risk of heart disease in the future.			
32. Women who have been diagnosed with high blood pressure during their pregnancies are more likely to have high blood pressure in the future.			
33. Being diagnosed with high blood pressure during pregnancy has no effect on women's heart in the future.			

Appendix F: Participants' Information Sheet (Healthcare Providers)

Participant Information Sheet

Study Title: Healthcare Providers' knowledge and Practice about the Risk of Cardiovascular Disease in Women with a History of Complications of Pregnancy

Short Title: Cardiovascular disease risk in women

Investigator: Farnoosh Asghar Vahedi

Principal Supervisor: Dr Leila Gholizadeh

Co-Supervisor: A/Pro Marjan Khajehei, Dr Fiona Orr

Introduction

This research aims to investigate health professionals' knowledge and awareness about cardiovascular disease risk in women; they manage this risk in women. This participant information sheet gives you information about the study, which will help you make a decision whether or not you want to take part in this research. Please read this information carefully, and ask questions about anything that you do not understand or want to know more about.

The study is being conducted by Ms Farnoosh Asghar Vahedi who is a PhD candidate at the Faculty of Health in the University of Technology Sydney, under the supervision of Dr Leila Gholizadeh, A/Prof Marjan Khajehei and Dr Fiona Orr. The results of this research will be published in relevant journals, presented in scientific conferences, and will be disseminated as a PhD thesis. If you are interested to receive the results of the study, you may write your email address on the consent form, so that we will send you a copy of the results once the study is completed.

The study is being internally funded by in-kind support from the participating hospitals. There is no conflict of interest to declare about this study and there is no potential for the principal investigator to receive any financial benefits from the outcomes of this study.

Study procedures

We aim to recruit at 383 healthcare providers to this study. The relevant authorities in this research study are the Faculty of Health at University of Technology Sydney and the Department of Women's and Newborn Health at Westmead Hospital and Royal North Shore Hospital.

If you agree to participate in this study, you will be asked to sign a consent form. If you complete the survey online, your submission of the survey will indicate your consent to the research. The survey will ask questions about your sociodemographic and practice, and your knowledge of cardiovascular disease risk in women. It will take approximately 10-15 minutes to complete the survey. This survey is anonymous, which means that the researchers will not be able to identify you by your responses to the survey questions.

Risks

There is no anticipated risk associated with this research. However, you may feel uncomfortable when completing the survey questions.

Benefits

There will be no direct benefit to you from your participation in this research. However, the results of this research will help the researchers to understand the gap in knowledge and practice. This understanding is important to improve the cardiovascular health of women with complicated pregnancies in the future.

Costs

There are no costs associated with participating in this research, nor will you be paid.

Voluntary participation

Participation in this research is voluntary. If you are interested in participation, you can sign the consent form. By signing it you are agreeing that you:

- understand what you have read, and
- consent to take part in the research project.

If you decide to take part, you will be given a copy of this participant information sheet to keep. If you decide to take part and later change your mind, you are free to withdraw from the project at any time before completing and submitting the questionnaire. However, you will not be able to withdraw from the study after you have submitted the survey. This is because the survey is anonymous, and the researchers will not be able to identify you from your responses to the survey questions.

If you complete the survey online, your submission will be considered as consent to the study.

Confidentiality

This is an anonymous study, which means you do not need to write your name on the study questionnaires. No identifying information will be collected from you and no follow up will be required.

Data storage

All data collected for this study will be stored safety and in accordance with approved guidelines. The electronic data will be stored in a password protected computer. The computer will be secured with automatic screen locking after 5 minutes of inactively and no one except the research team will have access to the data. The file containing data will also be protected against virus or malicious software. Paper questionnaires will be stored in a locked cabinet in a locked office (Dr Leila Gholizadeh's office) at the UTS. Both paper and electronic data will be stored for five years, after which they will be destroyed safely i.e., as the paper documents will be shredded and deposited into the security bin at UTS, and electronic files and any back-ups will be permanently deleted from the computers.

Ethics approval and complaints

This study has been approved by the Ethics Review Committee (RPAH Zone) of the Sydney Local Health District. Any person with concerns or complaints about the conduct of this study should contact the Executive Officer on 02 9515 6766 and quote protocol number X19-0437.

The conduct of this study at the participating hospitals has been authorised by the Sydney Local Health District. Any person with concerns or complaints about the conduct of this study may also contact the Research Governance Officer on 02 9515 6766 and quote protocol number [X19-0437&2019/ETH13440].

Further information and who to contact

If you want any further information about this research project, you can contact the researchers below:

Clinical contact person

Researcher	Mrs Farnoosh Asghar Vahedi
Contact	Mobile: [redacted]; Farnoosh.asgharvahedi@student.uts.edu.au
Co-supervisor	A/Prof Marjan Khajehei
Contact	Email: Marjan.Khajehei@health.nsw.gov.au Mobile: [redacted]

If you have any complaints about any aspect of the project, the way it is being conducted or any questions about being a research participant in general, then you may contact:

Reviewing HREC approving this research and HREC Executive Officer details

Local HREC Office contact (Single Site -Research Governance Officer)

Reviewing HREC name	Sydney LHD HREC
HREC Executive Officer	Ms Patricia Plenge
Telephone	(02) 9515 6766
Email	patricia.plenge@health.nsw.gov.au

Appendix G: Participants' Consent Form (Healthcare Providers)

Consent Form

Study Title: The Knowledge and Awareness of Cardiovascular Disease Risk in Women with a history of Complications of Pregnancy

Short Title: Cardiovascular Disease Risk in Women

Investigator: Farnoosh Asghar Vahedi

Principal Supervisor: Dr Leila Gholizadeh

Co-Supervisor: Dr Marjan Khajehei, Dr Fiona Orr

Declaration by Participant

I, ...of.. *[address]* have read and understood the information for participants on the above named research study and have discussed the study with ....

I have been made aware of the procedures involved in the study, including any known or expected inconvenience, risk, discomfort and of their implications as far as they are currently known by the researchers.

I freely choose to participate in this study and understand that I can withdraw at any time.

I also understand that the research study is strictly confidential.

I hereby agree to participate in this research study.

☐ I would like to receive the link to the online survey:
Email:……………………………………………………………………………… , Or
Mobile: ……………………………………………

☐ I would like to be emailed a copy of the study results:
Email:………………………………………………………….

NAME: ....

SIGNATURE: ....

DATE: ....

NAME OF RESEARCHER: ....

SIGNATURE OF RESEARCHER: ....

Appendix H: The Survey Package for the Healthcare Providers' Study

Dear Research Participant

This survey package includes multiple sections aimed at gathering information about your sociodemographic and practice-related details, knowledge about cardiovascular risk factors in women with a history of complications in pregnancy, and your approach to managing this risk.

Section 1: Sociodemographic information

Please read each question carefully and tick the box that applies to you.

1. How old are you? ....Years old

2. What is your gender?

   ☐ Female
   ☐ Male
   ☐ Other

3. What is your qualification?
   ☐ General practitioner

   ☐ Midwife

   ☐ Obstetrician/gynaecologist

   ☐ Cardiologist

4. In which country did you complete your initial qualification as a healthcare provider? ....
5. How many years have you been practising in your speciality?...........Years

6. What is your current area of practice? Tick more than one box if applicable.

   ☐ Public hospital
   ☐ Private hospital
   ☐ Private clinic

Please answer the following questions based on your speciality.

If you are an obstetrician/gynaecologist:

7. What is the main area of your practice?

☐ Obstetrics
☐ Gynaecology
☐ Both

If you are a cardiologist:

8. What is the main area of your practice?

☐ Invasive cardiology

☐ Non-invasive cardiology

☐ Both

If you are a general practitioner:

9. Are you qualified to provide GP shared care (looking after women during pregnancy along with public hospital)?

☐ Yes
☐ No

10. Do you practice as a GP specialist?

☐ Yes
☐ No
If yes, in which area?
…………………………………………….

If you are a midwife:

11. How did you obtain your midwifery qualification?

☐ Graduate diploma after completion of a nursing degree
☐ Bachelor of Midwifery degree

Section 2: Healthcare Providers' Knowledge of Cardiovascular Disease Risk in Women Questionnaire

This questionnaire assesses your knowledge of cardiovascular disease risk factors in women. Please read each statement carefully and answer by ticking the relevant box for "True", "False", or "I don't know" if you are not sure about the answer. Remember that this is not a test; so just do the best you can.

Questions	True	False	I don't know
1. Diabetes is a stronger risk factor for cardiovascular disease (CVD) in women than men.			
2. After menopause, women are almost at the same risk of developing CVD as men.			
3. A family history of CVD may increase the risk of developing heart disease.			
4. Dyslipidemia is a risk factor for CVD in women similar to men.			
5. Women with a history of miscarriage are at increased risk for developing CVD in the future.			
6. Having a history of induced abortion increases the risk of CVD in women in the future.			
7. The risk of stroke is higher in women with a history of miscarriage.			
8. There is no relationship between the *number* of miscarriages and the risk of CVD in women.			
9. There is no relationship between *early or late* miscarriage and the risk of CVD in women.			
10. Women with a history of gestational diabetes are more likely to develop CVD in the future.			
11. The risk of stroke increases in women with a history of stillbirth.			
12. The risk of future hypertension increases in women with a history of gestational hypertension or pre-eclampsia.			
13. The risk of T2DM is higher in women with a history of gestational diabetes.			

14. Gestational diabetes increases the risk of future CVD in women.			
15. Antioxidant supplements can help reduce the risk of CVD in women.			
16. Prescribing oestrogens and progestins is recommended for prevention of CVD in women.			
17. The available programs and treatments are not really effective in reducing the risk of CVD in high risk women.			
18. Women with a history of complications of pregnancy need to be monitored closely for asymptomatic CVD and treated for modifiable risk factors.			
19. A detailed pregnancy history should be considered as part of CVD risk assessment in women.			
20. Women with a history of hypertensive disorders in their pregnancy should take a low dose of aspirin to reduce their CVD risk.			
21. Women with a history of hypertension in pregnancy or gestational diabetes should completely avoid or stop smoking.			
22. Women with a high blood pressure should not drink more than one standard alcohol per day.			
23. To reduce the risk of CVD, women should be encouraged to do at least 150 minutes of moderate-intensity physical activity per week.			
24. Regular monitoring of waist circumference and BMI is important in women at a high risk of CVD.			
25. The low-density lipoprotein cholesterol (LDL-CL) should be maintained at less than 1.8 mmol/L in women.			
26. The target high-density lipoprotein cholesterol (HDL-C) is more than 2.0 mmol/L in women.			
27. The target triglyceride (TG) is less than 2.0 mmol/L in women.			

28. The non–high-density lipoprotein cholesterol (NHDL-C) should be maintained at less than 3.5 mmol/L in women.			
29. Blood pressure should be kept less than 120/80 mmHg to reduce the risk of CVD in women.			

Section 3: Healthcare providers' approach on managing CVD risk in women with a history of complications of pregnancy

The following statements relate to your approach to managing cardiovascular disease (CVD) risk in women who have experienced complications during pregnancy. Please select the box that best represents your approach for each statement.

1. I often assess the risk of CVD in women with a history of complications of pregnancy.

   ☐ Strongly disagree
   ☐ Disagree
   ☐ Neither agree nor disagree
   ☐ Agree
   ☐ Strongly agree

2. I am confident in assessing the risk of CVD in women with a history of complications of pregnancies.

   ☐ Strongly disagree
   ☐ Disagree
   ☐ Neither agree nor disagree
   ☐ Agree
   ☐ Strongly agree

3. I often discuss with women who have a history of complications of pregnancy about their risk of CVD in the future.

   ☐ Strongly disagree
   ☐ Disagree
   ☐ Neither agree nor disagree
   ☐ Agree
   ☐ Strongly agree

4. I often refer these women to an appropriate practitioner/specialist for detailed assessment
   and management of their risk.

   ☐ Strongly disagree
   ☐ Disagree
   ☐ Neither agree nor disagree

☐ Agree
☐ Strongly agree

5. I take actions to reduce the CVD risk in women with a history of complications of pregnancy.

☐ Strongly disagree
☐ Disagree
☐ Neither agree nor disagree
☐ Agree
☐ Strongly agree

6. It is not my responsibility to assess, refer, or manage CVD risk in women with complications of pregnancies.

☐ Strongly disagree
☐ Disagree
☐ Neither agree nor disagree
☐ Agree
☐ Strongly agree

Duff, E. (2019). A structural equation model of empowerment factors affecting nurse practitioners competence. *Nurse education in practice, 38*, 145-152.