Exploring the attitudes, beliefs, barriers, and facilitators to the uptake of and adherence to exercise and physical activity among Saudi women diagnosed with coronary artery disease: a qualitative study

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Abstract

Introduction: Coronary artery disease (CAD) is the leading cause of death among women in Saudi Arabia. However, women often underestimate their CAD risk. Physical activity (PA) is an integral part of secondary prevention of CAD. PA is known to lower mortality rates and improve the quality-of-life among individuals with established CAD. PA levels vary between different ethnicities and genders. In Saudi Arabia, the percentage of women meeting the PA recommendation is as low as 10%. Despite the low prevalence rate among Saudi women in general, little is known about their PA habits post-diagnosis of CAD.

Aim: To explore attitudes, beliefs, barriers, and facilitators to the uptake of and adherence to exercise and PA among Saudi women diagnosed with CAD.

Methods: A descriptive qualitative study was undertaken. Thirty-two semi-structured interviews were conducted between June 2024 and November 2024, sixteen with Saudi women diagnosed with CAD and sixteen with healthcare professionals. The theoretical domain framework informed the data collection and data analysis, which was undertaken using framework analysis. The findings were fed into the COM-B model and the behavioural change wheel (BCW) to identify a potential intervention to promote PA uptake and adherence among Saudi women post-CAD diagnosis.

Findings: Nine themes and subthemes were identified from both datasets. Religious and sociocultural influences were highlighted as a main theme as women reported familial and social obligations take priority over being physically active, and discussed the effect of the lack of exercise during their upbringings on their ability to uptake and adhere to exercise and PA. Other themes discussed knowledge gap, social and professional support and the perceived barriers and facilitators to being physically active.

Conclusion: This study has provided an insight into the experience of Saudi women diagnosed with CAD with exercise and PA. Identified facilitators and barriers were used to develop a potential PA-promoting intervention to improve overall health and well-being, which was visually illustrated in a logic model featuring the intervention's key ingredients, based on the findings of the application of the COM-B model and BCW.

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List of Abbreviations

BACPR	British Association for Cardiovascular Prevention and Rehabilitation
BCW	Behavioural Change Wheel
BCT	Behavioural Change Technique
CAD	Coronary Artery Disease
CHD	Coronary Heart Disease
COM-B	Capability, Opportunity, Motivation and Behaviour
CR	Cardiac Rehabilitation
CVD	Cardiovascular Disease
DALY	Disability-Adjusted Life Years
EMR	Eastern Mediterranean Region
HCP	Healthcare Professionals
HHS	The U.S. Department of Health and Human Services
IHD	Ischemic Heart Disease
LTPA	Leisure-Time Physical Activity
MI	Myocardial Infarction
MOH	Ministry of Health
PA	Physical Activity
PhD	Doctor of Philosophy
PRISMA-ScR	Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews
QATSDD	Quality Assessment Tool for Studies with Diverse Designs
TDF	Theoretical Domains Framework
WHO	World Health Organisation

Chapter 1 Introduction

This chapter introduces the reader to the research project. It starts with an overview of the research topic, followed by a discussion of the background and the context in which the research has taken place: Saudi Arabia. Next, the study rationale, research problem and the aims and objectives will be outlined. Finally, the thesis structure is provided to help the reader navigate through this PhD project.

1.1 Overview

Physical activity (PA) is an integral part of the secondary prevention of coronary artery disease (CAD) (Smith et al., 2011; Vasankari et al., 2021). Engaging in regular exercise and PA is known to reduce future cardiac events, lower mortality rates, and improve the quality of life among individuals with established CAD (Vasankari et al., 2021; Anderson et al., 2016a). However, most people do not reach the recommended level of PA per week (a minimum of 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity PA), especially in the Arab and Middle Eastern countries (Murtagh et al., 2021; Sharara et al., 2018; WHO, 2024c). This results in increased prevalence of chronic diseases, including CAD (WHO, 2024c).

Exercise-based cardiac rehabilitation (CR) programmes were introduced to prevent further complications arising from CAD and to help individuals regain control of and manage their health and well-being (Rashed et al., 2020). However, the availability of such programmes varies between countries and is generally limited in the Middle East and Saudi Arabia (Turk-Adawi et al., 2019b; Turk-Adawi et al., 2019a). Even when available, cardiac rehabilitation programmes remain underutilised globally, especially by women in general and ethnic minority groups (Ragupathi et al., 2016; Sawan et al., 2022; Mathews and Brewer, 2021a). Compared to men, women who have been diagnosed with CAD, and are eligible for CR, are less likely to be referred to and receive written CR instructions (Mathews and Brewer, 2021a). Credible information regarding CR referral and enrolment rates is usually obtained from nationwide registries around the world (Mathews and Brewer, 2021a). However, no Middle Eastern registry was found to have published such information (Grace et al., 2024). Consequently, little is known about Middle Eastern women's participation in CR

programmes after being diagnosed with CAD. Moreover, there is a lack of research investigating the PA habits of Arabian and Middle Eastern women post-diagnosis of CAD outside structured CR programmes. Therefore, this thesis aims to explore the attitudes, beliefs, barriers, and facilitators to the uptake of and adherence to exercise and PA among Saudi women diagnosed with coronary artery disease.

1.2 Background

Cardiovascular diseases (CVDs) remain the leading cause of death globally, accounting for 32% of all deaths worldwide (WHO, 2024b). CVDs refer to different disorders affecting the heart and the blood vessels, including ischemic heart disease and stroke (WHO, 2020). Ischemic heart disease (IHD), also known as coronary artery disease (CAD) or coronary heart disease (CHD), is defined as inadequate circulation to the heart caused by stenosis or occlusion in the coronary arteries (The US Institute of Medicine, 2010).

Among the various cardiovascular disorders, the foremost cause of death is coronary artery disease (CAD), which accounted for 13.25% of the world's total deaths in 2021 (GBD, 2021). Similar to global statistics, the primary cause of death and disability in Saudi Arabia is CAD, accounting for 20.76% of the total documented deaths in 2021 (GBD, 2021) and responsible for 10.9% of the total disability-adjusted life years (DALYs).

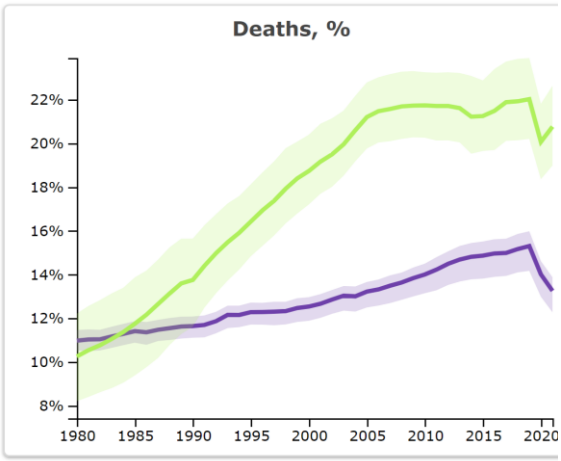

Figure 1.1The Saudi Arabia and global mortality rate attributed to Ischemic heart disease (GBD, 2021)

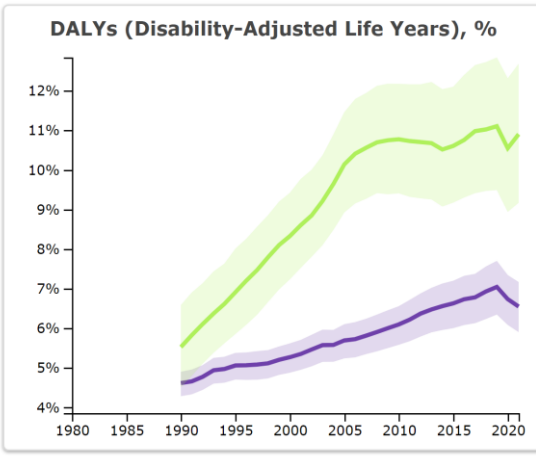

Figure 1.2 The total disability-adjusted life years (DALYs) attributed to Ischemic heart disease in Saudi Arabia and globally (GBD, 2021)

CVD is also the leading cause of mortality among women worldwide, exceeding the mortality rates for breast cancer (WHO, 2024d). However, unlike breast cancer, women are often unaware of the danger of cardiovascular disease and continue to underestimate their own CVD risk (Sarma and Scott, 2017). A survey, conducted by the American Heart Association, showed that the awareness of American women from all age groups and ethnicities, of CAD as the leading cause of death among women, has declined over the past ten years (Cushman et al., 2021). Despite women having a slightly lower CAD mortality rate compared to men globally (13.21% vs 13.28%) and in Saudi Arabia (19.4% vs 21.41%), women often have a poorer prognosis and worse clinical outcomes (Khamis et al., 2016; Pathak et al., 2017; GBD, 2021). This might be attributed to advanced age at the time of diagnosis, worse risk profiles and comorbidities among women (Pathak et al., 2017). However, data from seven Arabian Gulf registries showed that younger women were also less likely to receive thrombolytic therapy or percutaneous coronary intervention and had higher mortality rates in the first year after a cardiac event than men of the same age (Shehab et al., 2020). This suggests that it is important to bring more attention to CAD in women, to ensure they receive guideline-endorsed treatments, which could improve their prognosis after a cardiac event. Therefore, more research

that focuses on women's experience of being diagnosed with CAD and how they have been diagnosed, treated and followed up needs to be undertaken. Additionally, awareness must be raised among both the public and healthcare professionals regarding the effects of CAD on women to avoid underestimation of the seriousness of CAD in women and emphasise gender equity in the efforts exerted to prevent and manage CAD (Shehab et al., 2020).

Besides receiving revascularisation and reperfusion therapy, the guidelines also recommend certain secondary prevention interventions to reduce the mortality rate of individuals diagnosed with CAD (Piepoli et al., 2014). After a cardiac event (angina, infarction, percutaneous coronary intervention or coronary artery bypass graft surgery), it is imperative to implement secondary prevention strategies to reduce rehospitalisation and improve the morbidity and mortality rates associated with CAD (Faggiano et al., 2019b). Secondary prevention of CAD involves pharmacological therapy, identification of the risk factors associated with developing CAD and advocating lifestyle modification (Faggiano et al., 2019b). Multiple risk factors have been associated with CAD. While some factors are non-modifiable, such as having a family history of CAD, others, such as a lack of PA, smoking and diabetes, can either be eliminated or controlled (Hajar, 2017; Adhikary et al., 2022). A lack of physical activity has been identified as one of the main reasons for the high prevalence rate of CAD in the Eastern Mediterranean region (WHO, 2024a). Regular PA has been established as the cornerstone of secondary prevention of CAD (Piepoli et al., 2016). Therefore, efforts to increase the engagement in and maintenance of PA among individuals with CAD, such as raising awareness of the importance of PA and motivating individuals diagnosed with CAD to be physically active, must be made.

Exercise and PA are two different terms related to body movement, but despite differences, the terms are often used interchangeably (Caspersen et al., 1985). Caspersen et al. (1985) defined physical activity as “any bodily movement produced by skeletal muscles that results in energy expenditure” (Caspersen et al., 1985, p.126), distinguishing it from exercise, which has been defined as :

> A subset of physical activity that is planned, structured, and repetitive and has as a final or an intermediate objective, the improvement or maintenance of physical fitness" (Caspersen et al., 1985, p.126).

Therefore, PA is a much broader term and includes sports and leisure-time activities, as well as household duties and active travelling, which are performed as regular parts of daily activities. Exercise is specific to sports and leisure-time activities performed purposefully for physical fitness and is considered a subset of PA. To be considered physically active, adults aged 18 years and older, including older adults (aged 65 years or older), and those with chronic illness should perform at least 150-300 minutes of moderate-intensity PA or at least 75-150 minutes of vigorous-intensity PA per week (WHO, 2020). Moderate-intensity physical activity is defined as any activity that corresponds to a range of 3.0 to 5.9 METs, while vigorous-intensity activities correspond to 6.0 METs or more (PAGAC, 2008). Metabolic equivalent (MET) refers to resting energy expenditure, the energy we consume while being at rest, which is believed to be an oxygen uptake of 3.5 ml/kg/min (PAGAC, 2008). This classification of the intensity of activity is useful for exercise trainers to ensure the trainee gets the health and fitness benefits intended. However, this is rather complicated for the layperson to comprehend. Simple and clear instructions are likely to enable individuals to reach the recommended level of intensity. The *talk test* is often used to identify the intensity level of PA (HHS, 2018), i.e. someone performing moderate-intensity PA would be able to speak comfortably but cannot sing, while performing vigorous-intensity PA would only manage to say a few words between breaths (HHS, 2018).

Engaging in regular PA is proven to reduce future cardiac events, cardiovascular and all-cause mortality rates and improve the quality of life among individuals with established CAD (Vasankari et al., 2021; Anderson et al., 2016a; Piepoli et al., 2016). However, global PA levels remain unsatisfactory, with about 1.8 billion adults (31% of the world population) not meeting the weekly PA recommendations (WHO, 2024c). Without intervening, physical inactivity is projected to reach 35% by the year 2030 (WHO,2024c), and thus, CAD incidence and complications are also projected to rise. Global statistics indicate that women are less active than men (WHO,2024c). In the Arab world, PA levels vary considerably between the countries, ranging from

95% in Jordan to 32% in Saudi Arabia, with PA levels failing to reach 60% in most studied Arab countries (Sharara et al., 2018; Murtagh et al., 2021). Parallel to the global gender differences, several studies conducted in Arab and Muslim countries revealed that PA levels are lower among women and young girls in comparison to men and younger boys (Chaabane et al., 2020; Kahan, 2015; Sharara et al., 2018; Yammine, 2017; Murtagh et al., 2021). A systematic review conducted in 2021 on the prevalence of PA among adults in the Arab world demonstrated a difference in the prevalence of PA among men compared to women, which ranges from 5.7% to 16% (Murtagh et al., 2021). Similarly, a cross-sectional survey conducted across Saudi Arabia demonstrated that 91.1% of female participants did not meet the required 150 minutes of PA per week to achieve health benefits (Alqahtani et al., 2021). Such high physical inactivity levels among healthy individuals are alarming considering how they contribute to increased incidence of CAD, and subsequently increased future events and mortality rate after being diagnosed with CAD (WHO, 2024b; WHO, 2024c; Vasankari et al., 2021). Moreover, with the scarcity of research investigating PA levels among Arab and Middle Eastern women after women after being diagnosed with CAD, more effort should be focused on PA and lifestyle modifications, and participation in cardiac rehabilitation post-diagnosis of CAD.

The prevalence of physical inactivity in the Arab and Middle East world could be partially attributed to environmental factors, such as urban growth and the use of modern means of transportation (Sharara et al., 2018). Urbanisation, especially where there is a lack of safe and walking-friendly spaces, can have a significant effect on active transportation and consequently the level of PA undertaken by the inhabitants (Sallis et al., 2016; Zhong et al., 2022). As many Arab and Middle Eastern countries are becoming more urbanised (Nathaniel et al., 2020), PA levels are declining, and accordingly, the prevalence of obesity and chronic diseases is increasing (WHO, 2024a; Zhong et al., 2022). In addition, religious and sociocultural factors influence the amount and type of PA undertaken by the Arab and Middle Eastern population generally, and specifically Arab and Middle Eastern women. An analysis of 38 Muslim countries demonstrated that Arab women are 2.15 times more likely to be physically inactive than non-Arab women (Kahan, 2015). This indicates that

ethnicity and culture have an impact on the likelihood of being physically active. Gender inequality in undertaking PA in the Arab world has also been attributed to the lack of appropriate types of PA that are culturally and religiously suitable for Arab women, as well as a lack of culturally sensitive facilities that provide privacy for these women (Langoien et al., 2017). Therefore, research exploring the PA experience of Arab women needs to be undertaken through a 'culturally sensitive' lens.

Due to the recognition of the important role that PA plays in the secondary prevention of CAD, cardiac rehabilitation programmes (CR) were established (Redfern et al., 2022). A Cardiac rehabilitation programme is a structured secondary prevention programme that was introduced around fifty years ago, to help individuals diagnosed with cardiac diseases regain their function, resume their daily activities and return to work (WHO,1964; Rashed et al., 2020). Cardiac rehabilitation has been defined by the World Health Organisation (1993) as:

> The Sum of activities required to influence favourably the underlying cause of the disease, as well as to provide the best possible physical, mental and social conditions, so that the patients may, by their own efforts, preserve or resume, when lost, as normal a place as possible in the community (WHO, 1993, P.01).

A more recent definition, derived from the definition of the WHO, was introduced by the British Association for Cardiovascular Prevention and Rehabilitation (BACPR, 2023). Similar to the WHO, the BACPR defined CR as a group of interventions designed to help individuals, who have been diagnosed with CAD, improve their physical, mental and social status. However, BACPR avoids stressing a pre-defined normal condition for the individuals attending CR, which they must regain, and focuses on a progressive and steady improvement in the physical, mental, and social functioning to the best of the individual's capacity, which in turn improves their cardiac health, betters their prognosis and prevents or reduces potential future complications.

Cardiac rehabilitation programmes have evolved over the last decade and typically involve three phases:

Phase I - an in-patient phase that starts while the patient is hospitalised by encouraging early mobilisation to promote patients' self-care after discharge; **Phase II** - an out-patient phase of risk assessment, health education and supervised exercises;

Phase III- a long-term maintenance phase that aims to preserve the physical fitness gained in the previous phases and can be offered in outpatient, community, or home settings (Ambrosetti et al., 2020; Mampuya, 2012; Piepoli et al., 2014).

Comprehensive CR programmes should consist of the following core components: patient assessment, nutritional counselling, lipid and weight management, hypertension management, diabetes management, smoking cessation, and psychological counselling, in addition to physical counselling and exercise training (Ambrosetti et al., 2020; Taylor et al., 2022; Richardson et al., 2019). Exercises should be prescribed individually according to the needs of the trainee and include both aerobic and resistance training (Niebauer, 2017; BACPR, 2023). The number of sessions received by the participants varies between countries. There are no standard recommendations for the number of sessions per week multiplied by the total number of weeks in the universal guidelines (Medina-Inojosa et al., 2021), which may lead to variation in the benefits gained by the participants, as well as the financial cost of the programme (Medina-Inojosa et al., 2021). Generally, three sessions per week are delivered, and a minimum of 36 sessions in total is recommended for favourable outcomes (Simon et al., 2018; Santiago De Araujo Pio et al., 2017).

Cardiac rehabilitation has been endorsed by many medical and cardiological associations for its substantial benefits in reducing future cardiac events and decreasing the cardiovascular mortality rate in individuals diagnosed with CAD (Price et al., 2020; Dibben et al., 2021). A systematic Cochrane review confirmed that exercise-based CR reduced the incidence of myocardial infarction (MI), and all-cause readmissions and improved health-related quality of life (HRQoL), while slightly reducing all-cause mortality in individuals diagnosed with CAD (Dibben et al., 2021). The Cochrane review included 85

trials. Most trials were conducted in Europe, followed by the USA and Canada. Around 16% of trials were conducted in Asia, particularly in China, Japan, Bangladesh, and two Middle Eastern studies, in Egypt and Saudi Arabia. Despite trying to include trials with more women, the percentage of women included in these trials remains small (<15%) (Dibben et al., 2021). In the two Middle Eastern studies, women accounted for 32% of the participants in the Egyptian trial, however, the result of the trial was not reported by gender (Hassan and El Nahas, 2016). In contrast, no women were included in the Saudi trial (Mutwalli et al., 2012). All these studies demonstrate that Middle Eastern women are poorly represented in national and international research.

Despite the evidenced benefits of CR, such programmes are limited in the Middle East (Turk-Adawi et al., 2019b). In light of the incidence of CAD in the Eastern Mediterranean region, there is an average of one CR place for every 213 patients in countries with CR programmes, whereas globally, the ratio is one place for every 21 patients (Turk-Adawi et al., 2019b). A survey of CR delivery around the world reported that CR delivery in nine Middle Eastern and North African countries (MENA region), (Algeria, Bahrain, Egypt, Lebanon, Kuwait, Morrocco, Qatar, Saudi Arabia, United Emirates), eight countries offer one CR programme, except for Egypt which offers two programmes (Turk-Adawi et al., 2019a). Another survey of the availability and delivery of CR in the Eastern Mediterranean Region (EMR) reported CR programmes available in 12 out of the 22 countries, with the number of programmes offered per country ranging from only one in nine countries to 34 in Iran (Turk-Adawi et al., 2019b). This survey confirms the availability of one CR programme in Saudi Arabia with a CR density of 335 (one CR place for 335 patients) (Turk-Adawi et al., 2019b). Interestingly, women-only classes are available in more than half of the programmes in the EMR, reflecting cultural sensitivity in the design and service delivery of CR programmes, to accommodate the needs of Arab and Muslim women (Turk-Adawi et al., 2019b). The previous surveys highlight a significant lack of CR programmes in the Middle Eastern region, or alternatively, a lack of published sources and proper documentation for the available programmes (Turk-Adawi et al., 2019a; Turk-Adawi et al., 2019b; Rashed et al., 2020). For example, Rashed et al. (2020) mentioned four programmes in Saudi Arabia, while the previous surveys published only a year earlier reported one CR

programme in Saudi Arabia (Turk-Adawi et al., 2019a; Turk-Adawi et al., 2019b; Rashed et al., 2020). International studies often depend on the availability of online information regarding the existence of CR programmes in a certain country, in addition to reaching out to renowned cardiologists and cardiac societies in the region (Turk-Adawi et al., 2019b). This suggests that a lack of online documentation on available programmes in a specific country and poor response from cardiologists and cardiac societies may lead to an underestimation of the availability of CR programmes in the region. Nonetheless, there remains an imbalance between the supply and demand for CR in the Middle East, leaving many eligible patients with no access to rehabilitation services. Consequently, little is known about the PA levels of individuals diagnosed with CAD in the Middle East outside the structured CR programmes. This is especially true for Middle Eastern women, who are often underrepresented in research, and when invited to participate in a study for individuals diagnosed with CAD, their participation is usually modest, and researchers rarely report their findings based on gender (Osailan and Abdelbasset, 2020; Mutwalli et al., 2012; Nabolsi and Carson, 2011; Abdelhalem et al., 2018).

1.3 The context of the study: Saudi Arabia

Saudi Arabia is strategically located in the heart of the Middle East, between the three continents: Asia, Africa, and Europe. It is the largest country of the Arabian Peninsula, with a land area of about 2,000,000 square kilometres and a population of 32.2 million inhabitants (GaStat, 2022; GaStat, 2019). Saudi citizens comprise around 58.4% of the population; 62% are males and 38% are females, while the rest of the citizens are expatriates (GaStat, 2022). Saudi Arabia is also one of the wealthiest countries in the Middle East and is said to have the world's fastest economic growth in 2022 after a rapid recovery from the economic depression caused by the COVID-19 pandemic (EIU, 2022). The healthcare system in Saudi Arabia started about a century ago when the first public health department was established in 1925, followed by the official foundation of the Ministry of Health (MOH) in 1950 (Al-Hanawi et al., 2019). The majority of healthcare facilities in Saudi Arabia are operated by the Ministry of Health, which offers free service for all Saudi citizens and non-Saudi employees of governmental sectors (Almalki et al., 2011; Al Asmri et al., 2020). Other

healthcare providers include governmental ministries and universities that have their own medical institutes and offer free health services to their employees, as well as the private sector. The private sector was limited to mostly non-Saudis, as most Saudis preferred not to pay for services that the MOH provided for free. However, with the implementation of an insurance system requiring non-governmental employers to pay the healthcare cost of their employees, more and more Saudis started utilising private sector health services free of charge (Almalki et al., 2011; Walston et al., 2008). Healthcare services in Saudi Arabia have improved tremendously over the years and have successfully managed to lower the incidence of communicable diseases (Ministry of Health, 2010). However, due to the change in disease patterns from communicable to non-communicable diseases, a surge in population growth rate, and increased life expectancy, the burden on the MOH, as the main provider of health services, increased (Almalki et al., 2011). Therefore, the Kingdom of Saudi Arabia has moved toward privatisation of public hospitals and primary health care centres affiliated to the MOH and other governmental sectors, and increasing the private sector involvement in the provision of health care services in Saudi, whilst keeping services free of charge through paid insurance (Almalki et al., 2011; Al Asmri et al., 2020; Alasiri and Mohammed, 2022).

The Kingdom of Saudi Arabia has always strived to provide the best standard of care. Vision 2030 was launched in 2016 based on three pillars: A vibrant society, a thriving economy, and an ambitious nation (Vision 2030, 2016). The vision aims to achieve major advancements in all aspects of life, including healthcare services (Vision 2030, 2016). The various organisations involved in healthcare transformation have identified several challenges in the provision of healthcare, including inadequate disease prevention services, as the rate of non-communicable diseases, including heart diseases, remains high (Chowdhury et al., 2021). Consequently, the vision recognised the importance of PA in lowering the incidence of many non-communicable diseases and therefore aims to increase the percentage of individuals participating in PA at least once a week from 13% to 40% by the year 2030 (Ministry of Health, 2020). In 2020, the MOH published PA guidelines for health practitioners to assist them in encouraging Saudi citizens to participate in PA. The guidelines included special instructions according to the age of the individual and the presence of

any medical conditions, such as CAD (Ministry of Health, 2020). People diagnosed with CAD are advised to perform moderate-intensity PA for at least 150 minutes per week, 75 minutes of vigorous-intensity PA per week or a combination of both (Ministry of Health, 2020), which is similar to international guidelines (WHO, 2024c). In addition, health education clinics for chronic diseases were established in primary healthcare centres to promote self-control of chronic diseases and reduce further complications (Ministry of Health, 2022). However, the effect of these transformations is yet to be seen. Al-Hazzaa and AlMarzooqi (2018) documented the public initiatives launched to encourage PA in Saudi Arabia (Al-Hazzaa and AlMarzooqi, 2018). PA initiatives across the kingdom were found to be uncoordinated, fragmented and unsustainable (Al-Hazzaa and AlMarzooqi, 2018). To effectively improve community awareness of the importance of PA, efforts exerted need to be sustainable, continuously reviewed and tailored to the needs of the public (Al-Hazzaa and AlMarzooqi, 2018). As PA levels in Saudi Arabia remain low, especially among women (Alqahtani et al., 2021; Chaabane et al., 2020), more research that focuses on the effects of these initiatives on the PA habits of individuals in general and specifically women post-diagnosed with CAD is needed. Given the reported physical inactivity levels among healthy Saudi women (Alqahtani et al., 2021), Saudi women diagnosed with CAD need to be offered assistance, support, and follow-up from healthcare professionals (HCPs) to help them integrate PA into their daily routines. Therefore, it is necessary to understand Saudi women's views and attitudes toward exercise and PA, especially after being diagnosed with CAD, and to explore their perceived barriers and facilitators to the uptake of and adherence to exercise and PA, from a psychological perspective, while taking into consideration the religious and sociocultural factors that can affect women's ability and desire to be physically active (Rio and Saligan, 2023; Davis et al., 2015). Thus, yielding unique findings that are likely to be useful in improving the health outcome in the context of Saudi Arabia. Many psychological theories have been used to understand motivation to adopt certain behaviour (Davis et al., 2015), including the theoretical domains framework, which encompasses most barriers and facilitators relevant to behaviour change (Cane et al., 2012).

1.4 Research problem, aim and Objectives

Despite the reported high levels of physical inactivity among Saudi Arabian women, and the role of PA as an integral part of the secondary prevention of CAD, little is still known about the attitudes, beliefs, barriers and facilitators to the uptake of and adherence to exercise and PA among Saudi women, who have been diagnosed with CAD.

Aim: To explore the attitudes, beliefs, barriers, and facilitators to the uptake of and adherence to exercise and physical activity among Saudi women, diagnosed with coronary artery disease (CAD), using the Theoretical Domain Framework (TDF) to underpin the study.

Objectives:

1) To identify the attitudes and beliefs toward the uptake of and adherence to exercise and physical activity among Saudi women diagnosed with CAD.
2) To identify the barriers and facilitators to the uptake of and adherence to exercise and physical activity among Saudi women diagnosed with CAD using the TDF.
3) To identify healthcare professionals' perspectives on the barriers and facilitators experienced by Saudi women, diagnosed with CAD, in taking up and adhering to exercise and physical activity using the TDF.
4) To explore healthcare professionals' perceived role in promoting/encouraging and delivering exercise and physical activity programmes to Saudi women diagnosed with CAD using the TDF.
5) To explore potential perceived changes to the provided services/programmes that could improve uptake of and adherence to exercise and PA among Saudi women diagnosed with CAD.
6) To map the study's findings to the capability, opportunity, motivation and behaviour (COM-B) model, in order to identify intervention components and a potential intervention aimed at improving the uptake and maintenance of exercise and PA among Saudi women diagnosed with CAD.

1.5 Thesis structure:

This thesis comprises eight chapters. **Chapter One** introduces the reader to the research topic, discusses the background and the context of the research,

highlights the significance of the research project and introduces the research aim and objectives.

Chapter two presents a scoping review of the nature, scope and type of PA undertaken by Middle Eastern women who have been diagnosed with CAD. This review was conducted to identify the knowledge gap in PA and cardiovascular research in Saudi Arabia, which was used as the foundation of the research project.

Chapter three discusses the research paradigm, design, methodological approach, and the theoretical and conceptual frameworks used in designing and conducting this research project.

Chapter four presents the methods used in conducting this research; the procedures of gaining access to the setting, participants' recruitment, data collection and analysis, and all the ethical issues and considerations involved in the process.

Chapter five introduces the first part of the study results. These findings are related to the first two objectives of the research study; (i) to identify the attitudes and beliefs toward the uptake of and adherence to exercise and PA among Saudi women who have been diagnosed with CAD; (ii) to identify the barriers and facilitators to the uptake of and adherence to exercise and PA among Saudi women who have been diagnosed with CAD. The findings were obtained by analysing the interviews of Saudi women diagnosed with CAD.

Chapter six introduces the second part of the study results. These findings are related to the study's third, fourth and fifth objectives; (iii) to identify healthcare professionals' perspectives of the barriers and facilitators experienced by Saudi women diagnosed with CAD in taking up and adhering to exercise and PA; (iv) to explore healthcare professionals' perceived role in promoting/encouraging and delivering exercise and PA programmes to Saudi women diagnosed with CAD; (v) to explore potential perceived changes to the provided services/programmes that could improve the uptake of and adherence to exercise and PA among Saudi women diagnosed with CAD. These findings were obtained by analysing the interviews of the healthcare professionals responsible for the treatment and follow-up of Saudi women diagnosed with CAD.

Chapter seven addresses the final objective of the research: mapping the study's findings to the COM-B model and behavioural change wheel to identify intervention components to develop a potential intervention designed to improve the uptake of and maintenance of exercise and PA among Saudi women diagnosed with CAD. The potential intervention was visually illustrated using a logic model of change.

Chapter eight integrates the findings from chapters five and six, interpreting and discussing these results while considering the existing literature. Finally, a **conclusion** is presented with a discussion of the study's limitations and the research implications in the academic and professional fields. Next, the strategies used to ensure the rigour of the research project are reported. Lastly, a concluding note marks the end of this chapter.

1.6 Conclusion

This chapter has highlighted the impact of CVD as the leading cause of mortality in women in Saudi Arabia and worldwide and underlined that women diagnosed with CAD often have a poor prognosis and a bad clinical outcome. The chapter then discussed the importance of PA as a secondary prevention measure for ameliorating the effects of and managing CAD and reviewed the prevalence of low levels of PA among the Saudi Arabian population, particularly among Saudi women. Considering the serious impact of CAD on women's health and the low prevalence of PA among Saudi women, when PA is needed to halt or reverse the progress of the disease, research focusing on the PA habits of Saudi women after being diagnosed with CAD is warranted. Therefore, this PhD aims to explore Saudi women's attitudes, beliefs, barriers and facilitators to the uptake of and adherence to exercise and PA after being diagnosed with CAD to help them achieve and maintain better cardiac health and overall quality of life.

Chapter 2 Literature Review

2.1 Introduction

The previous chapter discussed the importance of PA in the secondary prevention of CAD and the low prevalence rates of PA in Arab and Middle Eastern women. This chapter presents a review of the literature concerning Middle Eastern women's PA habits post-diagnosis of CAD. The chapter starts by providing a rationale for choosing a scoping review. Next, the aim and objectives of the review are outlined, followed by a description of the scoping review methods and stages. Lastly, the findings of the scoping review are presented and discussed, as well as the gap in research knowledge.

2.2 Rationale for conducting a scoping review

One of the purposes of conducting a literature review is to get better informed about the existing literature on the topic of interest prior to conducting any empirical research, thus identifying the knowledge gaps, and avoiding wasting time, effort and resources conducting a study that does not add to the body of knowledge (Baumeister and Leary, 1997). There are several types of literature reviews from which the researcher can choose (Grant and Booth, 2009). The most common types of reviews conducted in the field of healthcare are systematic reviews and scoping reviews (Munn et al., 2018).

Before deciding on the type of review to be conducted, preliminary searches on exercise and PA among women diagnosed with CAD in Saudi Arabia were conducted using the MEDLINE database to estimate the number of studies which could be included. Very few studies investigated exercise and PA, as a secondary prevention measure, post CAD diagnosis in Saudi Arabia. Therefore, the search was broadened to cover the Middle East, as Middle Eastern countries are geographically adjacent to Saudi Arabia and share religious and sociocultural similarities. Nonetheless, retrieved research investigating exercise and PA among women in the Middle East was still limited. Men often comprised the majority of the research sample in Middle Eastern studies, and the research findings were rarely reported by gender. Thus, conducting a narrow-focus review would have yielded little to no results. A literature review informed by a

broad question to collect all available information regarding the PA habits of Middle Eastern women who have been diagnosed with CAD was deemed the most appropriate approach.

Systematic reviews are conducted to answer a specific question and synthesise literature that investigates a particular concept related to the topic of interest, which has been set before conducting the review, e.g. a specific intervention (Tricco et al., 2016). On the other hand, a scoping review is often undertaken to broadly explore the research field and identify the existing literature related to the review question (CIHR, 2010; Arksey and O'Malley, 2005). The retrieved literature is then systematically arranged to identify key findings and outline knowledge gaps (CIHR, 2010; Arksey and O'Malley, 2005). Compared to systematic reviews, scoping reviews are found to be more suitable for examining the breadth of existing research driven by a broad-focused review question (Tricco et al., 2016; Munn et al., 2018; Arksey and O'Malley, 2005). In addition, scoping reviews are also suitable when relevant research is not plentiful (CIHR, 2010), which was identified by conducting a preliminary search of the research. Therefore, a scoping review was chosen to synthesise the existing primary research related to exercise and PA of Middle Eastern women diagnosed with CAD, and to identify the knowledge gaps in the subject.

Scoping reviews have been criticised in the past for not being rigorous enough and lacking a quality appraisal of the evidence being synthesised (Grant and Booth, 2009). Therefore, the Arksey and O'Malley framework was developed to introduce rigour in undertaking scoping reviews (Arksey and O'Malley, 2005), which was subsequently enhanced through the clarifications and recommendations of Levac and colleagues (Levac et al., 2010). Quality appraisal was identified as being a non-essential activity in the scoping review process. However, it is now recognised as an optional step to be undertaken in subsequent guidelines (Tricco et al., 2018).

2.3 Aim and Objectives

Aim of the Review: This scoping review aimed to identify what is known about the nature, scope and type of PA undertaken by Middle Eastern women post CAD diagnosis.

The objectives of the review:

1. To identify the prevalence of exercise and PA undertaken by adult Middle Eastern women post CAD diagnosis.
2. To identify the type and extent of PA undertaken by adult Middle Eastern women at home or participating in either hospital-based CR programmes or alternative community and/or home-based CR programmes post CAD diagnosis.

2.4 Methods

This scoping review follows the framework originally developed by Arksey and O'Malley (2005) and subsequently enhanced through the clarifications and recommendations of Levac et al (2010), and Tricco et al. (2018). The Arksey and O'Mally framework (2005) consists of five essential stages and a sixth optional one: (1) identifying the research question, (2) identifying relevant studies, (3) study selection, (4) charting the data, (5) collating, summarising and reporting the results, (6) consultation exercise (Arksey and O'Malley, 2005). The Levac extension (2010) then added their recommendations of how each stage should be conducted, including: providing a specific definition of the research question components, developing a clear plan regarding the search strategy (sources, studies' publishing dates and language), listing the inclusion and exclusion criteria, developing a data extraction sheet and providing a description of the included studies and reporting the findings concerning the research question (Levac et al., 2010). In addition, more clarifications were added in Tricco et al. (2018), as the authors developed a detailed checklist for transparent reporting of scoping reviews, called the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) (Tricco et al., 2018).

2.4.1 Stage one: Identifying the Research Question(s):

This scoping review was guided by the following question:

What is known about the physical activity undertaken by Middle Eastern women who have been diagnosed with coronary artery disease?

This broad question was further classified into more specific questions:

1. What is the prevalence of PA among Middle Eastern women post-diagnosis of CAD?

2. What is the duration, type and extent of PA undertaken by women diagnosed with CAD in the Middle East?
3. What is the prevalence of participation in and utilisation of hospital-based CR programmes or alternative rehabilitation programmes among Middle Eastern women diagnosed with CAD?
4. What are the barriers and facilitators to the uptake of and adherence to PA among Middle Eastern women post-diagnosis of CAD?

2.4.2 Stage two: Identifying relevant studies:

2.4.2.1 Information sources

Searches were undertaken using six electronic databases: MEDLINE, CINAHL, Embase, PsycINFO, Scopus and SPORTDiscus, and the grey literature was searched using the Google Scholar engine. Reference lists of included papers were also searched. The databases chosen contain studies from the fields of medicine, nursing, psychology and sports medicine. A study of the optimal combination of databases for systematic review by Bramer and colleagues recommended using MEDLINE, EMBASE, Web of Science, and Google Scholar to conduct a thorough review (Bramer et al., 2017). The authors also suggested searching PsycINFO and CINAHL, where appropriate, as it may yield some unique results, which was true for this scoping review, as one of the included studies, (Nalini, 2014), was only found in CINAHL (Bramer et al., 2017). However, Web of Science was replaced by Scopus as it was found to be superior in the field of medical research (Mongeon and Paul-Hus, 2016). The search process was undertaken from December 2021 to January 2022. To ensure this review included recent studies, the saved searches were rerun on each database again in August 2024.

2.4.2.2 Search strategy

Search terms were developed under the headings: Physical activity, Middle East, and coronary artery disease. It is recommended for scoping reviews to use the PCC (population, concept and context) framework (Glonti et al., 2017; Aromataris and Munn, 2020). The PCC framework has roots in the more commonly used framework for systematic reviews, PICO (population, intervention, comparator, and outcome (Glonti et al., 2017), however, without a comparator. The PCC framework is perhaps more similar to the population,

exposure, outcome (PEO) framework, which can fit non-clinical trial studies (Pollock and Berge, 2018). Therefore, the research question was broken down into three essential elements: the desired population: Middle Eastern women, the exposure or context: having been diagnosed with CAD, and the concept or outcome being studied: physical activity (Table 2.1).

Table 2.1 The PCC framework:

Population	Concept	Context
Middle Eastern women	Physical Activity	Diagnosed with coronary artery disease

The Google search engine was used to identify search terms related to the Middle East. The operational definitions for each component of the PCC framework are presented in Appendix A, and the details of the electronic search strategy can be found in Appendix B.

2.4.3 Stage three: Study selection and eligibility criteria

This review was set to include all types of primary research (randomised and non-randomised controlled trials, observational studies and qualitative studies, and one clinical audit).

The search period was chosen to identify the earliest relevant papers. Attention to secondary prevention of CAD in the Middle East has only started recently. About half of the countries that reported having CR programmes established their first programme after 2010 (Turk-Adawi et al., 2019a). Therefore, the year 2010 was first considered as the search's starting point. However, the starting point was pushed back a year, to 2009, based on two identified systematic reviews of CR (Clark et al., 2015; Dibben et al., 2021); where the earliest article from the Middle East was found in Clark et al. (2015), published in 2009 (Roth et al., 2009; Clark et al., 2015). Therefore, no relevant literature was expected to be found earlier than 2009. Nonetheless, Ruth (2009) was eventually excluded from the review for not describing or measuring the participants' PA habits.

The search of databases was limited to studies in English. The choice to restrict the search to articles written in English is based on the fact that English is the

dominant language in the medical field, and the vast majority of studies are published in English for effective dissemination and better citation (Wulff, 2004; Lira et al., 2013). In addition, a lack of funds for translation hindered the ability to use non-English studies. Nonetheless, a systematic review on the effect of English language restriction in systematic reviews and meta-analyses found no evidence of systematic bias resulting from excluding non-English studies (Morrison et al., 2012). A summary of the inclusion and exclusion criteria is presented in **Table 2.2**.

Table 2.2 Inclusion and exclusion criteria.

Factor	Inclusion criteria	Exclusion criteria
Purpose	Studies focusing on the PA habits of Middle Eastern women post CAD diagnosis.	Studies focus on diet, medications, and other aspects of the prevention and management of CAD or other CVDs.
Study	Primary research: Randomised and non-randomised controlled trials, observational studies, qualitative studies published in peer-reviewed journal papers, and grey literature, e.g., research reports from academic units and theses. Clinical audits: Although audits are not considered research, one audit was found to report information relevant to the aim and objectives of this scoping review and was included, as the purpose of conducting a scoping review is to broadly identify what is known about the research inquiry.	Reviews, non-research literature other than clinical audits, i.e. policy papers or opinion pieces.
Text	Full-text	Posters and conference abstracts
Participants	Women	Men and children

Age	18 and above	Less than 18
Country of origin	20 Middle Eastern and North African (MENA) countries: Algeria, Bahrain, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Palestine, Qatar, Saudi Arabia, Syria, Tunisia, Turkey, United Arab Emirates, and Yemen	Other countries
Language	English	Other languages
Time-limit	Studies published in 2009 or later	Studies published before 2009

A total of 5509 studies were identified. 5306 hits were found from all six databases. In addition, the first 200 search results were retrieved from Google Scholar as suggested by Bramer and colleagues (2017) and added to the list (Bramer et al., 2017). Lastly, three articles were identified from the reference list of the selected articles. All studies were extracted into an Excel sheet. First, the results of MEDLINE were screened to ensure that the search terms used were appropriate. After that, the remaining databases, as well as Google Scholar hits, were screened. Excel removed the duplicates within and across the database, then the studies were screened by title, abstract and full text for their eligibility to be included in the review. Full-text articles were exported into the EndNote reference manager. In August 2024, the saved searches were rerun, and the previous screening process was repeated. More details can be found in

Figure 2.1 the PRISMA ScR.

2.4.4 Stage four: Charting the Data:

This stage involved extracting key information from the selected studies and presenting it in a table. A data extraction sheet was developed using the JBI manual guidance (Aromataris and Munn, 2020) and improved through discussion with the supervisors. The final data extraction sheet is presented in Appendix C.

2.5 Results:

2.5.1 Stage five: Collating, summarising, and reporting results:

After removing duplicates and screening the studies' titles and abstracts for relevance, a total of 219 full-text studies were retrieved and examined for eligibility. Twelve studies met the inclusion and exclusion criteria and, therefore, were included in this review (

Figure 2.1).

2.5.1.1 Study characteristics

Eight of the twelve studies addressed the prevalence of PA undertaken by adult Middle Eastern women post CAD diagnosis, and/or the scope and type of PA performed, in addition to the barriers and facilitators of adopting an active lifestyle (Acar et al., 2017; Donnelly et al., 2012; Farahani et al., 2008; Gerber et al., 2011b; Gerber et al., 2011a; Alsaleh and Baniyasin, 2022; Tunsi et al., 2023; Vahedi et al., 2023). Two of the twelve studies focused on the participation of Middle Eastern women in hospital-based CR or alternative community and home-based CR programmes post CAD diagnosis (Dankner et al., 2015; Nalini, 2014), whilst the remaining two studies investigated both unstructured PA and CR (Sadeh et al., 2021; Zhao et al., 2017).

Generally, there was little cardiac rehabilitation research identified in the Middle East and Arab world. Only four studies discussed CR; one was conducted in Iran (Nalini, 2014), which has the largest number of CR programmes in the Middle East (Turk-Adawi et al., 2019b); two were conducted in Israel (Dankner et al., 2015; Sadeh et al., 2021), and only one study was identified in an Arab country. This was an international audit that collected Middle Eastern data from Saudi Arabia (Zhao et al., 2017).

Nine of the 12 included studies were quantitative (Acar et al., 2017; Dankner et al., 2015; Gerber et al., 2011a; Gerber et al., 2011b; Nalini, 2014; Sadeh et al., 2021; Zhao et al., 2017; Vahedi et al., 2023; Alsaleh and Baniyasin, 2022) and three were qualitative studies (Farahani et al., 2008; Donnelly et al., 2012; Tunsi et al., 2023). The research designs of the quantitative studies included two cohort studies (Acar et al., 2017; Sadeh et al., 2021), two longitudinal (Gerber et al., 2011a; Gerber et al., 2011b), three cross-sectional (Nalini, 2014; Vahedi et al., 2023; Alsaleh and Baniyasin, 2022) one clinical audit (Zhao et al., 2017),

and one non-randomised controlled trial (Dankner et al., 2015). The details of the characteristics of the included studies can be found in Appendix C.

There was heterogeneity in ethnicity within the study population due to the existence of many ethnic groups in the Middle East (Altschiller, 2012). Whilst the majority of the inhabitants of the Middle Eastern countries are Arabs, only four studies were conducted in regions with an Arab majority, particularly Jordan, Qatar, and Saudi Arabia (Donnelly et al., 2012; Zhao et al., 2017; Alsaleh and Baniyasin, 2022; Tunsi et al., 2023). The remaining studies were conducted on a non-Arab sample or in areas where Arabs are considered to be a minority group. One study was conducted on a Turkish population (Acar et al., 2017), three studies were conducted in Iran, where the majority of the sample were Persians (Farahani et al., 2008; Nalini, 2014; Vahedi et al., 2023), and four studies were conducted in Israel, where Arabs are considered to be a minority group (Dankner et al., 2015; Gerber et al., 2011a; Gerber et al., 2011b; Sadeh et al., 2021).

As few studies were found eligible to be included in this review, and due to the heterogeneity across the selected studies in terms of the research design, data collection tool and the ethnicity of the population, a textual, narrative synthesis, guided by the review questions, was undertaken, as it manages to group the studies into more homogenous groups (Lucas et al., 2007). Textual narrative synthesis also allows for explicit description of the diversity in the included studies and the ethnicity of the participants, and underlines the quality of the used evidence (Lucas et al., 2007).

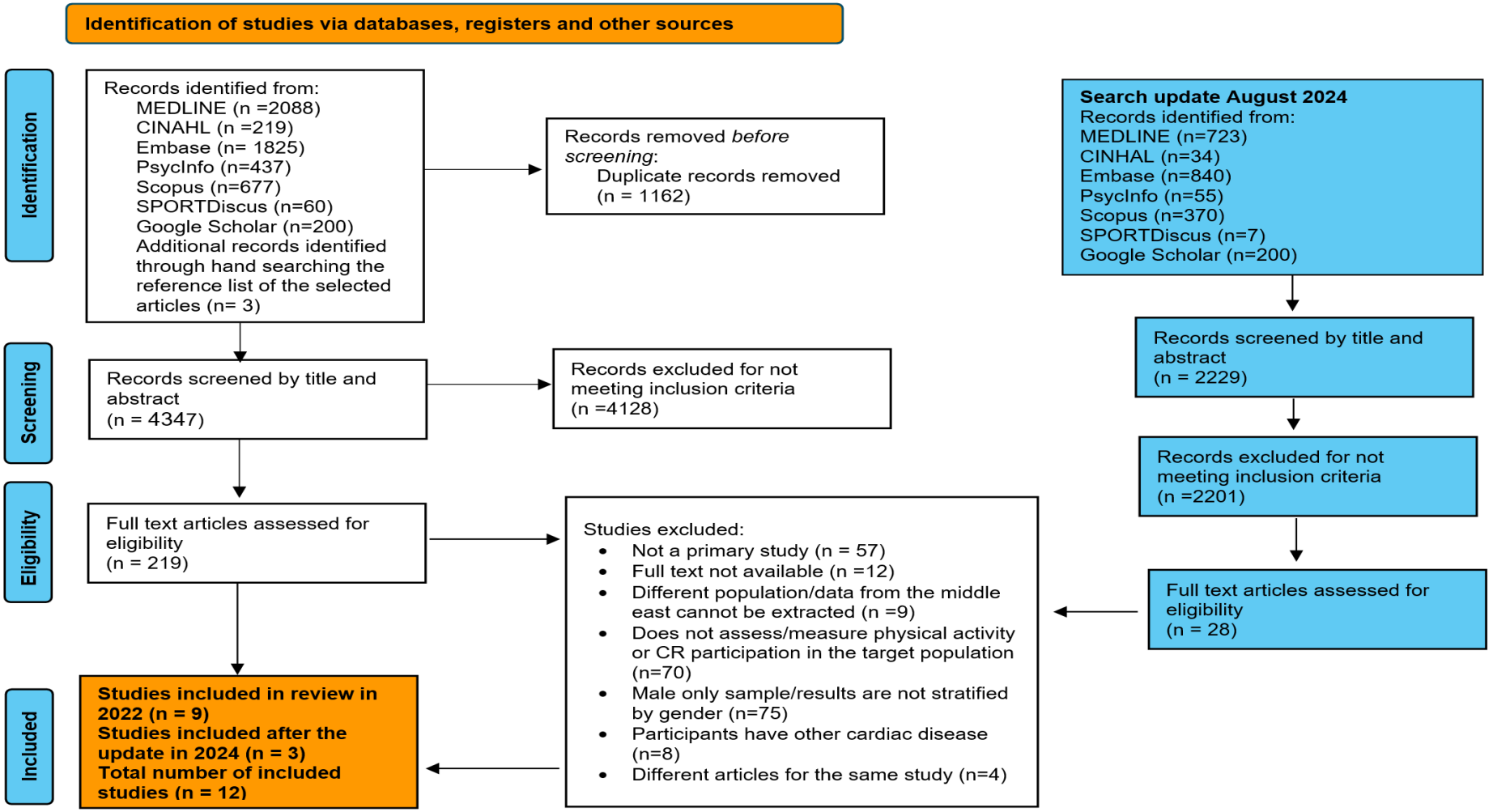

Figure 2.1 The PRISMA-ScR flow chart for the selection of studies.

Quality appraisal

The quality of the studies was critically appraised using the Quality Assessment Tool for Studies with Diverse Designs (QATSDD) (Sirriyeh et al., 2012). The tool was chosen because it can be applied to studies of different methodologies, which enables comparing the quality across all included studies (Sirriyeh et al., 2012). The tool consists of 16 items; 14 of which apply to quantitative studies, 14 apply to qualitative studies, and all 16 apply to mixed-method studies. The items are scored from 0-3 according to a published rubric, and cover areas such as theoretical framework, clarity of the aim, setting, sample size, recruitment process, data collection and analysis, users' involvement in the study and strengths and limitations (Sirriyeh et al., 2012).

All included studies scored more than 50%, ranging from 54.8 to 97.6 %, reflecting moderate to high-quality research. Criteria often missed in the studies included an explicit theoretical framework, statistical calculation of sample size, details of the recruitment process, rationale for choosing the data collection tool, validity, and reliability of the tool, and evidence of users' involvement in the design of the study. One of the qualitative studies included in this review (Tunsi et al., 2023) scored the highest (41/42, 97.6%), having excluded a justification for choosing framework analysis. Further details on the critical appraisal of the included studies are provided in Appendix D.

2.5.2 Prevalence of physical activity among Middle Eastern women post CAD diagnosis

Five studies reported the prevalence of PA post-CAD diagnosis (Acar et al., 2017; Gerber et al., 2011b; Sadeh et al., 2021; Zhao et al., 2017; Alsaleh and Baniyasin, 2022). The PA participation rate ranged from 13% to 91%. In Acar et al. (2017), it was found that only 13% of the female sample was physically active (Acar et al., 2017). Similarly, Gerber et al. (2011) reported that among those who survived the duration of the study, only 14% of women remained continuously active throughout the follow-up period (Gerber et al., 2011b).

In one of the studies that investigated both PA and CR participation, Sadeh et al. (2021) stated that 26.3% of the women in their sample participated in physical activity, however, some did not reach the recommended level of 150 minutes/ per week (Sadeh et al., 2021). The exact percentage for those not

achieving the target cannot be ascertained as the study categorises one of the durations of PA as 1- 2.49 hr/week, which encompasses the recommended duration. The study also found that at baseline, 22.2% of women who did not participate in CR and 45.5% of those who enrolled in the programme were physically active. While the baseline rate of participation in PA in women who opted not to enrol in CR (22.2%) is relatively close to the rates identified in other studies, the rate is much higher among those who joined the CR programme. This suggests that those who are physically active prior to referral are more likely to participate in CR programmes. This was also stated by Danker et al. (2015), who found that participants in CR reported more regular PA than non-participants. On the contrary, Alsaleh and Baniyasin (2022) reported a higher prevalence of PA (44%) in their cross-sectional study of 141 Jordanian women (Alsaleh and Baniyasin, 2022).

While four out of five studies reported a prevalence of PA less than 50% among Middle Eastern women post CAD diagnosis (Acar et al., 2017; Sadeh et al., 2021; Gerber et al., 2011b; Alsaleh and Baniyasin, 2022), Zhao et al. (2017) astonishingly reported that 91% of the women in their sample were physically active. The international clinical audit found that out of 413 Saudi women representing the Middle East in the study, 91% reported performing adequate PA, defined by the author as moderate or vigorous PA for at least 30 minutes three times or more a week. However, after adjustment for age, the results showed that women were less likely to be physically active than men in the Middle East (p=0.003), with an odds ratio of 0.63 (0.50:0.80, CI 95%, values less than 1 favour men) (Zhao et al., 2017). Zhao et al. (2017) is an international clinical audit investigated the recording and management of cardiovascular risk factors relying on self-reported PA, thus, could have been vulnerable to reporting and social desirability bias. However, this may not be enough to explain the difference from the previously mentioned studies that had also relied on self-reported PA data. Overall, most of the studies included in the review suggest a low prevalence of PA among Middle Eastern women who have been diagnosed with CAD.

2.5.3 Duration, type and extent of physical activity undertaken by women post CAD diagnosis in the Middle East

Although any active time is better than none, the WHO emphasises that adults of 18 years and more, including older adults (age 65 years or more) and those with chronic diseases, must perform at least 150-300 minutes of moderate-intensity PA or the equivalent of 75-150 minutes of vigorous-intensity PA per week to gain physical and mental health benefits (WHO, 2024c).

Out of the 12 included studies, only two discussed the duration of PA performed by Middle Eastern women post CAD diagnosis. Acar et al. (2017) reported that study participants of both genders exercised for a median of an hour per day/two days per week (120 minutes), and therefore did not achieve the recommended total time per week (Acar et al., 2017). Sadeh et al. (2021) provided more details on the length of PA sessions undertaken by all participants and stratified the results by gender and participation in CR. Among non-CR participant women, 11.8% performed PA for 1-2.49 hours per week, 9.8% performed PA for 2.5 to 4.99 hrs/week, and only one person (0.7%) stated performing PA for more than 5 hrs/week. On the other hand,18.2% of the female CR participants reported performing PA for 1-2.49 hrs/week, and 27.3% reported engaging in PA for 2.5 to 4.99 hrs/week. Although none of the women participating in CR reported performing PA for more than 5 hrs per week, the CR participant group was generally more physically active and successful in achieving the weekly PA recommendations than their non-participant counterparts (Sadeh et al., 2021).

However, the duration of PA alone does not guarantee that the participants are adequately active. The adequacy must be determined by considering the duration, frequency, type, and intensity of PA undertaken. Unfortunately, only one study reported the type of PA performed by participants. Walking was found to be the most common type of PA undertaken (Acar et al., 2017). No more information was offered to determine the intensity of the walking.

2.5.4 Prevalence of participation in and utilisation of hospital-based cardiac rehabilitation programmes or alternative rehabilitation programmes among Middle Eastern women post CAD diagnosis

There are five important concepts related to engagement in CR; referral: being invited to attend CR by health care professionals, enrolment: undertaking

cardiac rehabilitation's initial assessment, participation: attending any number of CR sessions, adherence: percentage of the attended sessions, and lastly, completion: attending all the prescribed session and undertaking post-programme assessments (Faisal et al., 2021; Grace. et al., , 2011; Grace et al., 2002). Adherence is preferred to the term compliance as it denotes a more active engagement in one's treatment plan (Ambrosetti et al., 2020).

Four of the twelve included studies discussed the involvement of Middle Eastern women in CR. The clinical audit of Zhao et al. (2017) reported no sex difference in participation in CR among the Middle Eastern population represented by Saudi Arabia, as both sexes were not adequately participating in CR. On the other hand, Nalini (2014) found that Iranian women's participation in and completion of CR was significantly lower than men's (Nalini, 2014). Similarly, Sadeh et al. (2021) and Dankner et al. (2015) reported that participants in CR programmes are more likely to be men (Dankner et al., 2015; Sadeh et al., 2021). In Nalini (2014) and Sadeh et al. (2021), less than 18% of women participated in CR (Nalini, 2014; Sadeh et al., 2021).

Women's low participation levels in CR could be a direct result of not being referred (Grace et al., 2002; Pasquali et al., 2001). Low CR referral rates of women compared to men is seen as a global issue (Colella et al., 2015). However, only one out of the twelve included studies discussed CR referral rates. Nalini (2014) showed that less than half of the women in their sample were referred to a CR programme, which was less than the men's referral rate, but was not statistically significant (Nalini, 2014). When referred, one-third of the referred women enrolled in the programme (36.3%), and just under a third (32.3%) completed the programme. The reasons for this gender inequality in CR referral rates were not fully explored. However, when participants were classified according to the distance of their place of residence from the CR centre, the referral rates of women living some distance from the CR centre were found to be significantly lower than those of men who also lived at a distance from the centre (Nalini, 2014). This suggests that healthcare professionals may be more reluctant to refer women for CR, especially when they live at a distance from the CR centre. The hesitation may be attributed to the perceived difficulty of transportation for women more than men. Nonetheless, healthcare professionals should refer and encourage eligible

patients, of both genders, to participate in due to its substantial health benefits in reducing future cardiac events and decreasing cardiovascular mortality rates (Dibben et al., 2021).

Nalini (2014) has also investigated the effect of implementing systematic referral. The systemic referral system included a systematic discharge order set for all eligible patients, providing them with personal bedside information about the rehabilitation programme, written invitations, and programme brochures. Patients were advised to enrol in a hospital-based programme; however, if they could not, they were invited to join the hybrid programme. This system significantly increased both referral and participation rates among both genders. However, the referral and participation rates rose more for women. The referral rate of women increased from 33.4% to 95.1%, while the participation rate rose from 12.3% to 33.5% ($P<0.001$) (Nalini, 2014). This shows that systemic referrals of all eligible patients to CR can positively enhance the participation rates.

Regarding the mode of delivery of CR, only one study reported the availability of alternative modes of CR (Nalini, 2014). A hybrid programme consisting of eight hospital sessions, one session per week (instead of 24 sessions in the hospital-based programme, three sessions per week) was offered to participants who could not join the hospital-based programme. Those participants also had access to the rehabilitation team via telephone calls and were encouraged to perform daily aerobic exercises, especially walking. 24.8% of CR participants opted for the hybrid programme, and 81.1% of those lived away from the CR centre (Nalini, 2014). This was reported similarly between men and women (Nalini, 2014). The significant difference in choosing the hybrid programme over the hospital-based programme between those living at a distance from the CR centre versus others who live near the centre ($P < .001$) indicates that the provision of more hybrid CR programmes may yield better participation and completion of CR programmes among Middle Eastern women who live some distance from the CR centres and may experience difficulty reaching the centre three times per week.

2.5.5 Identified barriers and facilitators to the uptake and adherence of physical activity post CAD diagnosis

Nine out of twelve included studies provided information on factors that facilitate or hinder Middle Eastern women's engagement in PA (Donnelly et al., 2012; Tunsi et al., 2023; Alsaleh and Baniyasin, 2022; Acar et al., 2017; Nalini, 2014; Farahani et al., 2008; Gerber et al., 2011a; Vahedi et al., 2023; Dankner et al., 2015). The facilitators of engaging in PA were reported in one qualitative study investigating women's experience in adopting a healthier lifestyle (Donnelly et al., 2012). The sample comprised of Qatari citizens and resident women of Middle Eastern origin. Participants reported that having a social support system of family and friends and health care professionals' encouragement made a difference in their engagement in PA. They also stressed the positive effect of the Qatari government support through providing designated gymnasiums and parks free of charge, or at affordable fees (Donnelly et al., 2012). Other factors that favourably influenced women to be active included: valuing individual responsibility for their health, the desire to look good and feel healthy, being knowledgeable about the causes and risk factors of heart diseases, including physical inactivity, the positive influence of religion, as Islam advocates to care for one's health, and the positive influence of the changing sociodemographic and economic conditions in Qatar, which has led to more independence of women and freedom to go to parks and gymnasiums without needing the company of a male guardian (Donnelly et al., 2012). A similar, recent study was conducted in Saudi Arabia. Tunis et al. (2023) conducted a qualitative study to explore the barriers and facilitators to lifestyle change after cardiac events among patients in Saudi Arabia (Tunsi et al., 2023). Tunis's sample, however, included both men and women; therefore, only a few quotes identified as those of women were included in this review. The identified quotes spoke mainly about the barriers to engaging in PA (Tunsi et al., 2023). The female participants perceived sociocultural norms to negatively affect their ability to be physically active, as one participant spoke about the gender role in Saudi society and the need for the husband's permission to go to the gym, and the other participant discussed the difficulty of being physically active wearing Abaya (long and loose Muslim women's attire), which forced her to opt for private indoor activities, despite her preference for walking outdoors (Tunsi et al., 2023).

Donnely et al. (2012) also captured women's opinions regarding the challenges that deter them from being physically active and reported similar findings to Tunsi et al. (Tunsi et al., 2023; Donnelly et al., 2012). Traditional values and practices that restrict women's mobility in Qatari society still exist in certain families and apply especially among the older generations (Donnelly et al., 2012). Spousal support was identified as essential to being physically active (Donnelly et al., 2012). Also, some participants mentioned family and household responsibilities as a barrier, which was also reported by Nalini (2014) and Farahani et al (2008), as the participants felt that PA was not a priority for them and they chose to neglect it for the sake of taking care of the family (Donnelly et al., 2012; Farahani et al., 2008; Nalini, 2014). Similarly, the female participants in Alsaleh and Baniyasin (2022) reported not having enough time as a barrier to PA more than their male counterparts (Alsaleh and Baniyasin, 2022). Moreover, some women felt that the change in the economic conditions and the availability of housemaids in many houses in Qatar caused housewives to be less active (Donnelly et al., 2012). Other discussed barriers included the hot weather and their health conditions, as some participants felt dyspnoeic or uncomfortable when performing PA (Donnelly et al., 2012; Alsaleh and Baniyasin, 2022).

Similarly, Dankner et al. (2015) investigated reasons for not participating in CR (Dankner et al., 2015). Lack of knowledge was the most stated reason, which was significantly less stated in the group that had received educational intervention regarding CR, especially by the women in the group (Dankner et al., 2015). This suggests that women benefit from health education. The other stated reason for not enrolling was poor accessibility (Dankner et al., 2015), which was also mentioned as a reason for not completing the CR programme (Nalini, 2014). Other factors that hindered CR completion include physical disabilities, non-cardiovascular diseases, lack of motivation, dissatisfaction with the programme, and job-related problems (Dankner et al., 2015).

In addition, a regression analysis to identify predictors of PA showed that being a female was a predictor of physical inactivity or decreased levels of PA (Acar et al., 2017; Gerber et al., 2011a; Vahedi et al., 2023). In Vahedi et al. (2023), gender was significantly associated with PA in univariate analysis, with men exhibiting higher levels of PA (Vahedi et al., 2023). However, in multivariate logistic regression, the difference became statistically insignificant ($p = 0.55$)

(Vahedi et al., 2023). Other reported predictors include being unemployed, younger age, having low education or low income, the neighbourhood socioeconomic status, lack of regular follow-up, comorbidities, anterior myocardial infarction, smoking, obesity, poor self-rated health, and pre-MI leisure time PA level (LTPA) (Acar et al., 2017; Gerber et al., 2011a). Pre-MI LTPA being a predictor for PA level after being diagnosed with CAD or suffering a cardiac event highlights the importance of proper education, support and follow-up for Middle Eastern women diagnosed with CAD, as physical inactivity was found to be prevalent in the Middle Eastern population in general and among women specifically (Chaabane et al., 2020; Kahan, 2015; Sharara et al., 2018).

2.6 Discussion of the review

This scoping review was conducted to identify what is known about the nature, scope and type of PA undertaken by Middle Eastern women after being diagnosed with CAD. The review's objectives were to investigate the prevalence of PA undertaken by adult Middle Eastern women after being diagnosed with CAD and the type and extent of PA undertaken by adult Middle Eastern women at home or participating in either hospital-based CR or alternative community, and home-based CR programmes post CAD diagnosis.

2.6.1 Lack of physical activity among Middle Eastern women post CAD diagnosis

Several studies have shown that physical inactivity is prevalent among healthy women in the Middle Eastern population (Yammine, 2017; Sharara et al., 2018; Chaabane et al., 2020; Murtagh et al., 2021). Our findings indicate that low engagement rates in physical activity persist among women post CAD diagnosis. This was not surprising as the level of PA before a cardiac event affects the engagement in exercise and PA after the cardiac event, and was found to be the strongest predictor of leisure time PA after myocardial infarction (Gerber et al., 2008). This, however, does not apply to everyone. Although the level of PA has declined among the largest number of participants after being diagnosed with CAD (46%), Stewart et al. (2013) reported that 20% of the sample increased their PA levels since the diagnosis (Stewart et al., 2013). This suggests that there remains a possibility for improving PA levels among

individuals post-CAD diagnosis. Investigating the reasons for physical inactivity and designing a suitable behavioural change intervention can make a difference regardless of the population's level of PA prior to CAD diagnosis.

Despite the variation in the prevalence rate of physical inactivity between different ethnicities, low PA levels among women post CAD diagnosis are generally consistent with the findings from other populations. An observational study conducted to measure the change in PA after suffering MI among post-menopausal women showed that 49% of the predominantly white sample either maintained a low level of PA or decreased their PA level compared to before the cardiac event (Gorczyca et al., 2017). In addition, Faggiano et al. (2019a) studied secondary prevention measures of CAD in Italy and reported that almost half of the women in their sample did not engage in any PA (Faggiano et al., 2019a). Lastly, a South Korean study investigated the intensity and domain of PA among CAD and non-CAD individuals and found that 6.4% of women diagnosed with CAD in their sample engaged in enough leisure time PA to achieve the universal PA recommendation, and 27.7% realised the universal target through leisure-time PA and transportation (Goo et al., 2024). Unfortunately, little information about the type and intensity of PA in which Middle Eastern women diagnosed with CAD opt to perform was found.

2.6.2 Lack of cardiac rehabilitation research

Middle Eastern women's utilisation of CR service was also found to be suboptimal. This echoes the universal studies indicating women are less likely to be referred and enrol in CR programmes than their male counterparts (Sawan et al., 2022; Mathews and Brewer, 2021a). However, there is limited information on the utilisation of CR programmes in Arab countries by women and men alike. Although most of the inhabitants of the Middle Eastern countries are of Arab ethnicity, only four out of the twelve included studies in this review were conducted in countries with an Arab majority, and only one provided information about CR utilisation (Zhao et al., 2017). The other three studies that discussed CR utilisation were conducted in Iran and Israel (Nalini, 2014; Dankner et al., 2015; Sadeh et al., 2021), where, in the first study, the citizens were mainly Persians, and in the latter study, Arabs constituted a minor percentage of the population. Despite the geographical proximity and/or shared religion, other ethnicities living in the Middle East may not be representative of

Arabs due to differences in culture and attitude toward illness. This was reported in an Israeli study that stratified the results by ethnicity; Reges et al. (2013) found that more Arab patients were physically inactive six months after the cardiac event than Jewish patients (53% vs. 18.2%) and had significantly lower perceived benefits of exercise ($p<0.01$) (Reges et al., 2013). The authors also reported ethnicity as a predictor for exercise habits at hospitalisation, and perceived benefits of regular exercise as a predictor for participation in CR (Reges et al., 2013). This means that the majority of Arabs diagnosed with CAD in the sample were physically inactive, did not believe exercise would benefit them, and, therefore, were unlikely to join the CR programme (Reges et al., 2013). The previous findings indicate that results from non-Arab studies cannot be generalised for the Middle Eastern population of the Arabian majority, as different ethnicities may differ in their general PA habits before being diagnosed with CAD and might have varying levels of perception of the benefits of exercise, both of which could affect their engagement in exercise and PA post CAD diagnosis.

Several studies have been published recently discussing the current state of CR in Saudi Arabia and the challenges these programmes face, providing recommendations for the advancement of the services (Adam et al., 2023; Kinsara et al., 2023; Osailan, 2024). However, they did not provide information regarding referral, enrolment, adherence or completion rates. Two recent studies were conducted to evaluate the effectiveness of a single CR programme in Qatar and the United Arab Emirates (Faisal et al., 2021; Thrush, 2023). The Qatari study provided useful information on the number of sessions attended by the participants and the programme completion rate. However, 89.9% of the patients referred were male, and women's adherence and completion rates were not reported (Faisal et al., 2021). On the other hand, Thrush (2023) reported that 436 post-operative women of different cardiac diagnoses were found eligible for CR referral, but no information was provided as to how many women were actually referred or enrolled onto the programme (Thrush, 2023). The author only reports that 92 women (21.1% of the eligible women) have completed the CR programme (Thrush, 2023). Nonetheless, the existence of CR services in the Middle East is still limited (Turk-Adawi et al., 2019a; Turk-

Adawi et al., 2019b) and suggests that there is a vital need for more CR centres and more research on the utilisation of the existing programmes.

2.7 Research gaps

A research gap is defined as a partial or complete lack of information necessary to make a decision or arrive at a conclusion regarding a particular phenomenon (Robinson et al., 2013). This includes the absence of data, as well as insufficiency, inaccuracy, bias or inconsistency of the available evidence (Nyanchoka et al., 2018). Multiple research gaps have been identified from this scoping review. The available literature that discusses the PA habits of Middle Eastern women post CAD diagnosis is scarce. Moreover, there is a lack of evidence related to the education and support systems offered to Middle Eastern women post CAD diagnosis to encourage them to become more physically active. The studies that reported the prevalence of PA participation of Middle Eastern women post CAD diagnosis (Acar et al., 2017; Amen et al., 2020; Gerber et al., 2011b; Sadeh et al., 2021; Zhao et al., 2017) showed low participation rates. However, little is known about the health education, advice, and support provided to these women by healthcare professionals to encourage them to become physically active, and whether there is any follow-up, given that Danker et al. (2015) demonstrated that women respond well to proper education (Dankner et al., 2015). On the other hand, CR is a well-structured programme designed to help both women and men, diagnosed with CAD, to maximise their health and prevent further complications from the disease. Yet, little is known about the extent of the existence of these programmes in the Middle East, particularly in Saudi Arabia, as well as women's referral, participation, adherence, and completion rates. The only study included in this review that reported on referral rates demonstrated gender inequality in CR referral (Nalini, 2014), which is consistent with other global studies (Colella et al., 2015; Mathews and Brewer, 2021a; Sawan et al., 2022). Additionally, there remains a lack of information regarding the availability of alternative, and perhaps more attractive, modes of CR for women who are unable to attend hospital-based programmes, such as home-based, community-based, hybrid and digital or internet-based programmes.

The representation of women in Middle Eastern research is often less than that of men. For example, the percentages of women who participated in three of

the included studies in this scoping review are 26.1%, 28.3% and 38.1% (Zhao et al., 2017; Nalini, 2014; Tunsi et al., 2023). Therefore, it is imperative to have more research that focuses on women's PA habits post CAD diagnosis in the Middle Eastern region, and their utilisation of CR services, to ameliorate their cardiac health and avoid further complications. Despite globally having a slightly lower mortality of CAD compared to men, it is important to include women in cardiovascular research, as they often have a poorer prognosis and worse clinical outcomes (Khamis et al., 2016; Pathak et al., 2017; GBD, 2021). Several studies were excluded from this review because they had more men than women in the sample, and they did not stratify their results by gender. Women need to be represented more in Middle Eastern research, so that research findings can be used to improve women's experience with the secondary prevention measures of CAD. Finally, there is a dearth of research exploring women's attitudes, beliefs, barriers and facilitators to undertaking exercise and PA as a part of their daily routine or within CR programmes, as understanding these behavioural determinants is necessary to help women diagnosed with CAD achieve better health outcomes.

Thus, this supports undertaking empirical research that aims to explore the attitudes, beliefs, barriers, and facilitators to the uptake of and adherence to exercise and PA among Saudi women diagnosed with CAD, in order to improve the secondary prevention strategies received by women and consequently reduce the morbidity and mortality rates associated with CAD and enhance women's quality-of-life.

As for the methodological gap, there is a lack of qualitative studies that focus on the experience of individuals post CAD diagnosis in the Middle East, how they adopt a more physically active lifestyle and if and how they are encouraged by their healthcare professionals to undertake exercise and PA to improve their health outcomes. In this review, only three qualitative studies were identified that discussed both diet and PA (Farahani et al., 2008; Donnelly et al., 2012; Tunsi et al., 2023), two of which followed the (McLeroy et al., 1998) socioecological model and an interpretation of the model (Donnelly et al., 2012; Tunsi et al., 2023; McLeroy et al., 1998; Green et al., 1996). While the studies' aims are close to the aim of this PhD project, the topic of exercise and PA involves details concerning the type, intensity, duration and frequency of the

exercise and PA. These details are what make an individual physically active or not and are often missed in research studying multiple risk-factor modifications. Moreover, while the sample in the Donnally et al. (2012) study was all Qatari and Middle Eastern women, in Tunsi et al. (2023) study, women comprise less than half of the sample (38.1%), and the authors did not mention the gender of the participants they were quoting (Tunsi et al., 2023; Donnelly et al., 2012). CAD is a serious health concern for women, and with the unique sociocultural nature of Saudi Arabia, which shapes men's and women's lifestyles and experiences differently, Tunis and colleagues recommended conducting research focusing on women or performing a gender-specific analysis of the research data (Tunsi et al., 2023). Finally, using the TDF provided a comprehensive psychological underpinning for understanding participants' attitudes and beliefs toward exercise and PA, their stance on adopting a physically active lifestyle, and the factors that support or deter them from deciding to become physically active. These psychologically informed findings were used to identify intervention components and develop a potential behaviour change intervention, which is where the true novelty of this study lies.

2.8 Strengths and limitations

This scoping review was conducted to synthesise the literature on the PA habits of Middle Eastern women diagnosed with CAD. To my knowledge, this is the first review to investigate the PA undertaken by Middle Eastern women post CAD diagnosis. A systematic search of several electronic databases with a breadth of search terms has been used in the search strategy, as well as hand-searching the reference lists of the relevant articles, to increase the likelihood of capturing all relevant publications. Also, even though a quality appraisal is not mandatory in scoping reviews (Tricco et al., 2018), a critical appraisal was conducted using the Quality Assessment Tool for Studies with Diverse Designs (QATSDD) tool (Sirriyeh et al., 2012), and all included studies were of moderate to high quality. However, this review is not without limitations. First, due to a lack of translation funding, the review only included English papers and excluded research published in other languages, which may have led to the omission of some relevant information. In addition, other than Google Scholar, the grey literature was not searched, and thus, relevant studies may have been missed. However, with the scanning of the retrieved results, it was evident that

very few Arab and Middle Eastern researchers classify the results according to gender and even more rarely focus solely on women. Also, this scoping review focuses on CAD and excludes other cardiovascular conditions like heart failure. CR has been used for stable individuals with heart failure, however, it was decided to exclude them as the referral and enrolment rate of individuals diagnosed with heart failure remains low compared to those of individuals diagnosed with CAD (Taylor et al., 2023).

2.9 Conclusion

This chapter has described the process of conducting a scoping review to learn about the nature, scope and type of PA undertaken by Middle Eastern women after being diagnosed with CAD. The review showed a lack of PA among Middle Eastern women diagnosed with CAD and a low participation rate in CR. Little to no information about the type, intensity, duration, and frequency of the PA in which women engaged was found. In addition, the review also demonstrated that few studies focused on exploring women's attitudes, beliefs, barriers and facilitators to undertaking exercise and PA on their own as well as a part of comprehensive CR programmes. Lastly, there is a lack of qualitative research in the Middle East and inadequate female involvement in research compared to men. The proposed PhD project is intended to address some of these gaps and to learn more about Saudi women's experience with exercise and PA post CAD diagnosis.

Chapter 3 Research Methodology

3.1 Introduction

This chapter discusses the methodological choices for this PhD research, including the philosophical views, the research approach and design. This chapter will also outline the theoretical frameworks followed during the planning and execution of the study, along with the rationale for choosing them, and the choices for sampling, data collection and data analysis techniques in relation to the chosen study design.

3.2 Research paradigm and philosophical view

The research paradigm is the philosophical framework that guides the research process and has been defined as:

> A set of values and techniques which is shared by members of a scientific community, which act as a guide or map, dictating the kinds of problems scientists should address and the types of explanations that are acceptable to them" (Kuhn, 1970, p.175).

As such, a research paradigm is the lens through which the researcher examines the research problem. Therefore, the researcher must reflect on their views of the world and their philosophical stance before designing a research study, as it will influence how they approach the research problem and collect and analyse the research data. If the researcher embarks on their research journey believing there is a single objective answer to their research question, which exists irrelevant of human perception, then they are going to approach the research problem using scientific methodology that does not allow for human factors to affect the findings (Denzin and Lincoln, 2018). However, if the researcher acknowledges the effect of humans on reality, then they are likely interested in examining how different individuals impact their reality. As such, the researcher is going to approach the research problem in a way that enables them to interact with the individuals involved in the research problem and learn what they personally and subjectively believe is the answer to the research question (Creswell, 2013; Creswell and Creswell, 2018). Therefore, researchers' views of the world must align with their methodological choices throughout the research study.

Research paradigms are based on four philosophical views: ontology, epistemology, axiology and methodology (Lincoln and Guba, 1985; Jacobsen, 2021). These views must be in harmony with each other for the research study to be coherent and capable of answering the research question.

3.2.1 Ontology

Ontology is concerned with describing the nature and characteristics of reality (Creswell, 2013; Denzin and Lincoln, 2018). An objectivist believes reality exists and has its own objective meaning and truth independent from the way we perceive it (Crotty, 1998), whilst a constructivist rejects the notion of objectivism and believes in subjectivism and individualised realities shaped by our experience (Creswell, 2013; Creswell and Creswell, 2018; Jacobsen, 2021). This study aims to explore Saudi women's attitudes, beliefs, understanding, experiences, barriers and facilitators concerning the uptake of and adherence to exercise and PA post CAD diagnosis. Therefore, the study must adopt an ontological perspective that fits the research aim and objectives.

3.2.1.1 Social constructionism versus critical realism

Social constructionism was first considered as the ontological view for this study because it is composed of individualised reality. Social constructionism believes that individuals form their own meaning of the world they live in, based on their experiences and interactions with others (Creswell, 2013; Creswell and Creswell, 2018). Saudi women diagnosed with CAD may differ in their attitude and beliefs regarding the uptake of and adherence to a regular PA programme and may have very different experiences, barriers and facilitators to undertaking and adhering to exercise and PA. Therefore, to investigate the factors that are involved in women's decision making around being physically active, the Theoretical Domains Framework (TDF) was used to guide the data collection and subsequent analysis (Cane et al., 2012) (more in section 3.5.1). The TDF consists of 14 domains explaining the way behaviour change comes about. Many of these domains are either internal factors of human agency (e.g., goals, intentions, optimism) or external factors of social interaction (e.g. social influences and reinforcement), however, both fit well within the social constructionism outlook. The TDF still recognises the influence of factors existing outside of ourselves, our perception, and our interaction with others.

Environmental context and resources are identified as possible facilitators or barriers that must be considered when studying behaviour change. Therefore, this research fits somewhere in the middle of the subjective-objective continuum, as it recognises the presence of a reality that exists independent of our awareness but does not neglect the way we individually and collectively shape our reality. Thus, critical realism was found to be a better fit for this study. Critical realism recognises the presence of objective reality that exists whether we have experienced it or not, without neglecting the role of our interpretation in defining our reality (Houston, 2001; Taylor, 2018; Gorski, 2013). Positivists study change as a direct and linear cause-and-effect process, while critical realists believe that change is a process deeply rooted in the relevant social context and therefore affected by many interconnected factors (Denzin and Lincoln, 2018; Crotty, 1998). This means that while X may cause Y in specific circumstances, it will not necessarily cause it in other contexts due to the absence of some of the factors that affected the change but could not be directly observed or measured. For example, the researcher acknowledges the possible effect of extremely hot weather in Saudi Arabia during the summer on the willingness of individuals to exercise. However, this relationship is not a direct inhibitory one and may not apply in all circumstances. Some people may tolerate the hot weather to a certain extent. In contrast, others may find ways to stay active indoors, which can mitigate or eliminate altogether the effect of the weather on their activity level. Nonetheless, hot weather is an existing reality that has the potential to affect people's decision to be physically active. Critical realism allows the researcher to consider the existence of such realities without disregarding the effect of individualised choices and social interaction on participants' lived experiences. As critical realism uses components for both positivist and constructivist paradigms, and allows for investigating causal mechanisms of problems in the social world, it helps in explaining social events and provides solutions to social problems through suggestions for social changes (Fletcher, 2016). Thus, critical realism is compatible with the aims and objectives of the study, as it aids in exploring the causes for the lack of PA as a social problem and helps the researcher use the research findings to suggest interventions and policy recommendations to promote PA among Saudi women post CAD diagnosis.

3.2.2 Epistemology

Epistemology is concerned with our knowledge of reality and how to attain it (Creswell, 2013; Denzin and Lincoln, 2018). The epistemology of critical realism presumes that knowledge of real objects is not derived exclusively from direct observation; rather, it is affected by our personal inclinations and interests and mediated by principles, language and social discourse (Denzin and Lincoln, 2018). We learn a great deal by observing something in the natural world. However, this knowledge becomes meaningful when we internalise it and cast it over our personal experiences. People build their knowledge of the world by looking through a lens formed by their views, perceptions, and emotions. The mere presence of a real object is undeniable information that does not accept different interpretations. The object simply exists, and anyone with the ability to see would agree. However, the knowledge we compose of the said object, and how we judge the object's size, texture and beauty is subjective and personalised. After all, *"Beauty is in the eye of the beholder"*. Outside these individualised filters, pure, unaffected knowledge does not exist (Abdul Rehman and Alharthi, 2016). Therefore, this study employed individualised semi-structured interviews as the method of data collection. This allows for gaining insight from each participant about their knowledge of exercise and PA and the barriers and enablers Saudi women diagnosed with CAD encounter when deciding to become physically active. What is acknowledged as a barrier by one participant may not be considered so by another. For example, a woman may, due to a personal reason (e.g. knee pain), consider daily brisk walking difficult to achieve and require physical fitness. Another woman may disagree and consider brisk walking to be an easy and natural task, but the barrier lies in finding the time to fit it into a busy mother's schedule. Both women's knowledge of daily brisk walking is valid as it represents their individualised knowledge derived from their personal and social experience.

3.2.3 Axiology

Axiology is concerned with the ethics, values and morals (Denzin and Lincoln, 2018). It describes what is considered good or bad (Brunson et al., 2025). The axiology of the research describes the value of conducting the research; a careful consideration of the usefulness of the research and the ethical

implications, of which the researcher must be mindful while conducting the research. Thus, the researcher's moral values influence the research conduct (Aliyu et al., 2015). In critical realism, the researcher has a moral responsibility to use the knowledge created by the research to improve human lives (Brunson et al., 2025). Exercise and PA have been proven to improve the quality-of-life of individuals with CAD (Anderson et al., 2016a). Therefore, this study explored the experiences, attitude, beliefs, barriers and facilitators to the uptake of and adherence to exercise and PA among Saudi women diagnosed with CAD. Moreover, the findings of the study will be used to propose behavioural intervention components using a logic model, which will be further developed, in a future study, to promote PA among women post CAD diagnosis. Thus, the research findings are intended to be used for the better of the study population.

3.2.4 Methodology

Methodology focuses on the best ways to acquire knowledge (Denzin and Lincoln, 2018). Critical realism believes change is a process with a possible cause and a context of circumstance to consider (Denzin and Lincoln, 2018). Thus, a qualitative approach is appropriate for a study that adopts the philosophy of critical realism. Unlike the quantitative approach, which tests and measures variables and direct relationships using numbers and statistics to report objective results (Creswell and Creswell, 2018), qualitative research explores the meanings that different individuals attribute to the research problem, using open-ended questions to allow the participants to express elaborately their opinions and feelings in the context of things which would be neglected with a quantitative approach (Bryman, 2012; Creswell and Creswell, 2018). The methodological approach is discussed in more detail in section. 3.3.

3.3 Methodological approach

The choice of a suitable methodological approach to answer a research question stems from the study's aim. As discussed earlier, this study aims to explore the attitudes, beliefs, barriers, and facilitators to the uptake of and adherence to exercise and PA among Saudi women diagnosed with coronary artery disease (CAD). Because the study focuses on individualised and personalised views of the participants, rather than a mere specific and measurable truth, a quantitative approach would not fulfil the aim of the study

(Creswell and Creswell, 2018). A qualitative approach, therefore, was deemed the most appropriate for this research.

Qualitative research is an approach that places the researcher in the middle of the participants' world to gain a better understanding of the phenomenon of interest from the perspective of those living and experiencing it (Denzin and Lincoln, 2018). Qualitative research is adaptive and emergent and is often identified by the following basic characteristics: (i) studying the relevant phenomenon in its natural setting, (ii) emphasising the meaning that participants give to the phenomenon, (iii) the researcher is an instrument and a vital part of the research, not a mere observant, (iv) the enquiry often follow an inductive approach, where theory is the end-product of the research (Creswell and Creswell, 2018; Bryman, 2012).

A qualitative approach is chosen when there is a need to explore people's experiences and understand their perceptions and beliefs toward certain concepts (Pathak et al., 2013). It provides in-depth information about the investigated issue through non-numerical data that can be categorised into themes, from which new theories emerge (Jacobsen, 2021). Whenever there is a social and cultural impact to a problem, a qualitative approach is imperative to fully acknowledge how all these factors come together to influence individuals' decisions (the specific qualitative approach chosen is discussed in section 3.4).

The characteristics of qualitative research and its congruent ontological and epistemological views made it the most suitable approach. However, while many qualitative researchers follow an inductive approach (from data to theory), other approaches have also been used in qualitative research (Creswell, 2013). It is not unusual for qualitative research to use a mix of inductive and deductive approaches (Creswell, 2013). In fact, Creswell (2013) believes the use of complex reasoning in working with data "bottom-up; inductive" while also using predetermined themes and categories from the literature to analyse data "top-down; deductive" is among the defining characteristics of qualitative research (Creswell, 2013). Therefore, this study used an inductive-deductive approach informed by the Theoretical Domains Framework (TDF) (Cane et al., 2012). TDF is discussed in more detail in Section 3.5.1

While a quantitative approach was not appropriate for the aim of the study, a mixed-method design using qualitative and quantitative approaches could have been used. A survey on the barriers and facilitators to the uptake of and adherence to exercise and PA among Saudi women post CAD diagnosis conducted before (explanatory design) or after (exploratory design) conducting the semi-structured qualitative interviews would have enriched the study. However, due to the limited time available for data collection during the PhD study (as per the Saudi cultural bureau's policy, sponsoring this scholarship), sequential studies were not feasible. Also, a survey of the different cardiac centres in Saudi Arabia would have been helpful to learn more about the different practices and the education and support offered to Saudi women diagnosed with CAD across the kingdom. However, the lack of connections or networks between hospitals in Saudi Arabia made it difficult to ensure a satisfactory response rate and valid results within the time frame.

Moreover, an intra-paradigm mixed qualitative approach with non-participant observation and semi-structured interviews was first proposed. However, with the focus of the study being on exploring the women's attitude, beliefs and experience with exercise and PA, to help them become physically active, overtly observing the interaction between healthcare professionals and Saudi women diagnosed with CAD will not necessarily be reflective of the usual practice when there is no one to observe (Pope and Mays, 1995). It is hard to assert when these interactions are genuine and unaffected by the presence of the researcher, known as the Hawthorne effect (Phommachanh et al., 2019; Pope and Mays, 1995). Therefore, an intra-paradigm approach with semi-structured interviews and non-participant observation was discounted.

3.4 Research design

This study follows a descriptive qualitative design (Sandelowski, 2000). Qualitative research is often categorised into five main designs: Grounded theory, Phenomenology, Ethnography, Narrative research and Case study (Creswell, 2013; Denzin and Lincoln, 2018). Each of these designs has its own objective and approach to data collection and analysis. While these five designs are the most recognised, they are not the only ones for qualitative researchers to choose from. Some qualitative studies do not fit in any of the previous

designs, and for those, other options exist, including exploratory, descriptive, and comparative studies (Rendle et al., 2019). These three designs are commonly used in health research for the following purposes: exploratory designs are suitable for exploring a new topic when there is little to no prior knowledge about it, descriptive designs are applicable when only basic exploratory data exists, and comparative designs are used when both exploratory and descriptive findings are available (Rendle et al., 2019). More details on the different qualitative designs can be found in **Table 3.1**.

Table 3.1 Common qualitative research designs

Research Design/ Definition	Suitability for the study
Narrative research: Study individuals' experiences in chronological order of the lived events through storytelling (Creswell, 2013).	Narrative research is appropriate for collecting data from a small number of participants who have gone through a profound life experience of which they are expected to have a long and detailed account, e.g. being diagnosed with a serious disease, having surgery, or living through a pandemic. *While this study is interested in learning about the experience of women diagnosed with CAD, with exercise and PA, it was expected that some of the participants may have had limited to no experience with PA and, therefore, would not have a long narrative of their experience with PA. Rather, they will have a good account of the barriers to engaging in exercise and PA, which is very important to the aim and objectives of the study. It would have been possible to use the narrative approach if all the participants had attended CR for a considerable amount of time to narrate their experience with the programme, however, that is not the case for the participants of this study.*
Phenomenology: Study a group of people who have lived and experienced a certain concept to understand the common meaning they attribute to that particular phenomenon (Creswell, 2013).	Phenomenology research is suitable for studying the life experiences of the research participants. *Initially, this design was considered as an option to study Saudi women's life experience with PA after being diagnosed with CAD. However, this study aims to develop an intervention to help Saudi women engage in exercise and PA. Thus, the study needed a design that is not highly interpretive, to stay data-near.*

	Phenomenology has its own data analysis approach, which differs from the chosen approach for this study: framework analysis informed by the theoretical domains framework. (For more details, please see 3.8). Therefore, phenomenology design was not the best fit for this study.
Grounded theory: A study that collects data from a relatively large number of participants about a lived experience to explain certain behaviour or action by generating a theory that is "grounded" in the collected data (Creswell, 2013; Glaser and Strauss, 1967).	Grounded theory is a suitable design for studies that aim to generate a theory from the collected data. *This study does not aim to develop a theory. Rather, it aims to propose an intervention.*
Ethnography: A study where the researchers immerse themselves in the world of the participants who share a specific culture of interest and learn about them through an extended period of observation (Creswell, 2013; Bryman, 2012).	Ethnography is suitable for studying a specific culture, as in anthropological studies. It is also appropriate for research on people who share a specific culture with a less literal meaning, like the culture of a workplace, a university campus or a prison. *In this study, participants do not share a specific culture or social norms. Other than being all Saudis, they do not necessarily live in similar situations. Saudi Arabia is a large country within which many cultures coexist. Also, participants do not live or work in a specific location where the researcher can observe them extensively. The role of the overall Muslim and Arabic culture will not be neglected*

	as it will be highlighted through the social influence domain of the TDF, however, it is not the main pillar of the research design.
Case study: Studying a unit or multiple units of analysis, which is defined as a bounded entity that can be tangible (person, organisation, geographical location) or intangible (ideas, relationships) by collecting information from multiple sources (Creswell, 2013; Denzin and Lincoln, 2018).	This design is suitable for research that focuses on one or more cases. The cases might be people, hospitals, clinics or geographical areas that are investigated in depth by collecting multiple forms of data. For example, to study a hospital as a case, researchers often use observation and conduct individual and group interviews with the employees and patients while also analysing hospital documents, policies and procedures. *In this study, there is no tangible or intangible entity on which this study wishes to focus. Rather, the study is interested in the attitude and views of the participants (Saudi women diagnosed with CAD and their healthcare professionals) toward the subject of interest (physical activity).*
Exploratory qualitative research: It is a broad and systematic investigation of a problem where little is known, mainly in an inductive way aimed to discover generalisations that can be later used for description (Stebbins, 2001; Rendle et al., 2019).	An exploratory qualitative research design is fit for vague and new concepts where the researcher does not have enough knowledge to choose an angle to focus on and does not intend to explain the problem. It aims to generate broad and general information about the phenomenon (facts, beliefs, social processes) that can be used later in descriptive research. *This study aims to identify the barriers and facilitators to the uptake of and adherence to exercise and PA among Saudi women diagnosed with CAD. Although there is limited research on Saudi women diagnosed with CAD and their PA level, the concept is not new or vague. Several studies have investigated this*

	issue in other cultures, and this literature was used as a base upon which this study was built. This includes the use of the TDF. Moreover, the use of the TDF has made the inductive-deductive approach more appropriate than the purely inductive approach, which is most suitable for exploratory research.
Descriptive qualitative research design: This design aims to study and fully describe the phenomenon of interest in a simple and direct fashion that does not seek to produce an abstract or heavily conceptualised interpretation of the participants' views (Sandelowski, 2000).	Similar to exploratory research, descriptive qualitative design is used in research areas where there is a lack of previous studies. However, rather than a completely new or vague concept of exploratory research, descriptive design is appropriate for areas where basic explanatory information exists, but the phenomenon remains poorly understood from certain angles (Kim et al., 2017; Neergaard et al., 2009; Rendle et al., 2019). Qualitative descriptive designs are commonly used in clinical research and are suitable for answering questions related to clinical practice or developing an intervention (Sandelowski, 2010; Doyle et al., 2020; Neergaard et al., 2009; Sandelowski, 2000). *The literature review conducted prior to designing the study showed that there is little qualitative research conducted on Saudi women diagnosed with CAD. Therefore, their attitudes, views, beliefs, and inclinations are poorly understood. As this study aims to investigate these women's views toward exercise and PA to feed into the development of an intervention to improve their PA levels, qualitative descriptive design was deemed the most appropriate.*
Comparative qualitative design: Comparing a well-researched and	As the name implies, a comparative design is used to compare the phenomenon of interest among different populations or samples from different settings. It can

documented phenomenon of interest in different settings, following a mainly deductive approach to test a priori hypothesis (Rendle et al., 2019).	only be used when enough exploratory and descriptive information exists, and the phenomenon has been properly documented and understood to develop and test a priori hypothesis. *This study does not aim to compare the phenomenon of interest in different settings.*

3.4.1 Qualitative descriptive research design

Many researchers have felt the need to fit their studies into one of the five previously mentioned designs (grounded theory, phenomenology, ethnography, narrative research, case study), when they better fit into the descriptive design (Sandelowski, 2000; Neergaard et al., 2009). Descriptive qualitative design is the most commonly used design in practical research (Sandelowski, 2000). Although it has long existed, the qualitative descriptive design was first described in detail by Sandelowski (2000), who stated that qualitative descriptive design is a distinctive qualitative research design that seeks to fully describe a phenomenon of interest in a simple and straightforward fashion that does not render participants' views in an abstract manner (Sandelowski, 2000). Despite being referred to as basic, Sandelowski emphasised that qualitative descriptive design is not inferior to other qualitative designs; rather, it is valuable and useful when justifiably chosen for the purpose of the research. The design is particularly suited for healthcare studies concerned with end-users' opinions of the provided services and their interaction with the HCPs, since the reported results do not notably transform from participants' original views (Neergaard et al., 2009). This and other purposes mentioned in **Table 3.1** fit well with the aim and objectives of this study, and therefore, a qualitative descriptive design (Sandelowski, 2000) was chosen. Evans et al. (2014) is an example of a descriptive qualitative study in health research. A multi-site, mixed-method project funded by the National Institute of Nursing Research (NINR), where the qualitative part was conducted through semi-structured interviews with Mexican American caregivers (Evans et al., 2014). The authors expressed their choice to stay close to the data in their interpretation as a reason for choosing the descriptive qualitative design (Evans et al., 2014).

3.4.2 Critical realism and descriptive qualitative design

Critical realism has often been criticised due to the lack of a clear methodological approach (Yeung, 1997; Oliver, 2011). Critical realism philosophy has been developed as a bridge between positivism and constructivism approaches and thus has generally been associated with mixed methodology (Denzin and Lincoln, 2018; Oliver, 2011; Fletcher, 2016). However, critical realism can be applied in qualitative research (Oliver, 2011;

Fletcher, 2016). While Oliver (2011) perceived critical realism to be compatible with grounded theory, a methodological approach that aims to generate a theory, Fletcher (2016) argued that using a flexible deductive approach is more fitting of the critical realist's ontological and epistemological views (Oliver, 2011; Fletcher, 2016). Nonetheless, Fletcher (2016) perceived critical realism as a general research framework, not associated with any specific methodological approach (Fletcher, 2016). Many critical realists rebut the criticism of critical realism not aligning with a particular methodology by arguing that critical realism should remain a pragmatic philosophy that allows the research question to determine the suitable methodology (Oliver, 2011). In addition, critical realists believe the world can be partially explained but not determined by theories (Bhaskar, 2020). Therefore, using an initial theory influencing, without controlling, the result of the study is recommended in critical realism (Bhaskar, 1979). Consequently, if the researchers adopt critical realism ontological and epistemological views, they are encouraged to choose any methodological approach that is suitable for the research question, aim and objectives, and conduct a research quest influenced but not controlled by existing theories. For this study, descriptive qualitative research was chosen because it is fitting for the research aim and objectives (more in section 3.4.1). In addition, the study is underpinned by the TDF (more in section 3.5), which guided the data analysis in an inductive-deductive approach that allowed for consideration of the emerging data (more in section 3.8 and section 4.8). Therefore, the study's methodological choices, the descriptive qualitative approach and the use of a theoretical framework are congruent with the principles of critical realism.

3.5 Theoretical and conceptual frameworks

Sandelowski (2000) first described qualitative descriptive design as being among the least theoretical designs of qualitative research (Sandelowski, 2000). However, the author further clarified that even though descriptive studies are not obligated to adhere to a theory, it does not mean the design cannot be influenced by an existing theory (Sandelowski, 2010). Descriptive qualitative studies have used theoretical frameworks to develop interview guides and predetermined codes and categories used in data analysis (Kim et al., 2017). Therefore, this research project has availed of the existing psychological theories, frameworks, and models in designing and implementing the study.

3.5.1 The Theoretical Domains Framework (TDF)

Numerous behavioural theories have been used in research to understand motivations and challenges to behavioural modification (Davis et al., 2015). These include the Social Cognitive Theory (Bandura,1986), the Socio-Ecological Model of behavioural change (Panter-Brick,2006), the Protection Motivation Theory (Rogers, 1975), the Self-efficacy theory (Bandura,1977), and the TDF (Michie et al., 2005). While some behavioural theories are well-established, the TDF is relatively new. However, unlike a single theory that focuses on one specific behavioural influence, the TDF is broad, comprehensive and covers most of the barriers and enablers associated with change in health behaviour, thus minimising the risk of missing an important factor affecting the behaviour of interest (Mosavianpour et al., 2016; Phillips et al., 2015). Therefore, TDF was chosen as the underpinning theoretical framework for this research.

The TDF was developed by psychology theorists in 2005 and verified by both health researchers and psychologists to be used in implementation research in 2012 (Michie et al., 2005; Cane et al., 2012). The framework first used thirty-three theories of behavioural change to develop twelve domains, categorising the various factors that affect human behaviour (Michie et al., 2005; Atkins et al., 2017; Mosavianpour et al., 2016). The TDF was then validated by a group of experts in 2012 and refined into a fourteen-domain framework with 84 components describing barriers to change from a theoretical perspective (Cane et al., 2012). These domains were used to develop the interview schedule for the data collection in this research project and guided the data analysis through framework analysis.

Moreover, TDF facilitated the utilisation of the results in proposing a potential intervention designed to improve the uptake of and adherence to exercise and PA among Saudi women diagnosed with CAD. Interventions developed and underpinned by psychological theories are more likely to be effective, as they are designed with an understanding of the factors that enable or hinder the desired behavioural change (Michie et al., 2008). Hence, the Medical Research Council (MRC) advocates using theory as a base for designing complex interventions (Skivington et al., 2021b; Craig et al., 2008). The Medical Research Council (MRC) framework (Skivington et al., 2021b) is also used as a

guiding framework for this PhD project, as the project's ultimate aim is to propose a potential intervention to improve the uptake of and adherence to exercise and PA among Saudi women post CAD diagnosis (More details in section 3.5.5).

3.5.2 The COM-B Model

The COM-B model is a simple model that can be used for behaviour change interventions. It illustrates the three elements that affect behaviour (B), which are capabilities (C), opportunities (O), and motivation (M) (Mayne, 2017; Michie et al., 2011). The model explains how these three elements interact to bring about the desired change. For the behaviour change to occur, individuals must have the capability to perform that certain behaviour, opportunities allowing them to practice the behaviour, and lastly, they should be motivated enough to engage in the behaviour. Each of these three elements is then further classified into two sub-elements: physical and psychological capabilities, physical and social opportunities, and reflective and automatic motivation (West and Michie, 2020). The first element, capabilities, is defined as physical and psychological attributes within the individual which enable them to perform the behaviour (Michie et al., 2011). Physical capabilities refer to body strength and endurance, while psychological capabilities refer to knowledge and understanding of the required behaviour (Michie et al., 2011; West and Michie, 2020; West et al., 2020). The second element, opportunities, is defined as attributes outside the individual, residing in their physical and social environment, that facilitate or hinder the behaviour. Physical opportunities are concerned with the physical environment and resources, while social opportunities are related to social norms, culture, and family and community support (Michie et al., 2011; West and Michie, 2020; West et al., 2020). Motivation is defined as the mental process that drives the individual to engage in the behaviour. Reflective motivation is controlled by the mind's decisions, processing, and thoughts, while automatic motivation is controlled by emotions and personal habits (Michie et al., 2011; West and Michie, 2020; West et al., 2020). Through analysing influences affecting certain behaviours, the COM-B model is useful for diagnosing which factors have the greatest impact on the desired behaviour and then targeting these factors through the designed intervention. Moreover, the COM-B model fits perfectly with the TDF, as the TDF is considered to be a

more detailed version of the COM-B model (West et al., 2020). Thus, as the TDF guided the data collection and analysis, the results can be easily fed into the COM-B model to make the diagnosis and then design the intervention using the behaviour change wheel.

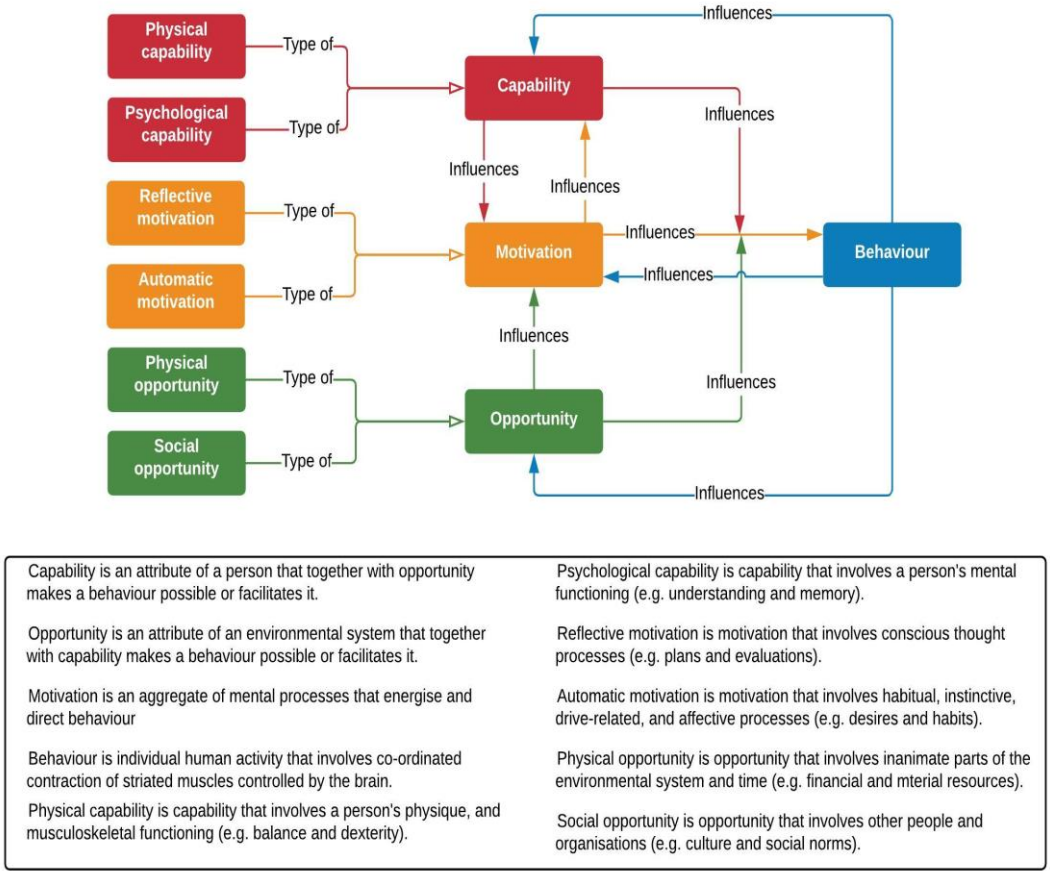

Figure 3.1 The COM-B Model (Michie et al., 2011; West and Michie, 2020)

3.5.3 The behaviour change wheel (BCW)

After using the COM-B model to determine the factors that affect the desired behaviour the most, the BCW offers nine interventions, along with policy categories that can be used to target the desired behaviour. Just like the COM-B model, the BCW was developed by Susan Michie, Maartje M van Stralen, and Robert West to help in designing an intervention that promotes behaviour change (Michie et al., 2011). The nine interventions are: education, persuasion, environmental restructuring, training, coercion, incentivisation, modelling, restriction, and enablement (Michie et al., 2011; West et al., 2020). The BCW can also be used by legislators and decision-makers who have the authority to implement policies to influence public behaviour. The policy categories proposed by the BCW are: regulation, legislation, guidelines, marketing and

communication, service provision, fiscal measures and environmental and social planning (Michie et al., 2011; West et al., 2020). Furthermore, during every step of the process (choosing the target behaviour, diagnosing the influencing factors, designing or implementing the intervention), assessments can be made using the APEASE criteria: Acceptability, Practicability, Effectiveness, Affordability, Side-effects, and Equity to prioritise the most suitable intervention(s) for the real-world setting (West et al., 2020). Therefore, by using the BCW to choose the appropriate intervention for the factors identified through the COM-B model, researchers can propose an intervention that is likely to promote the desired behaviour change.

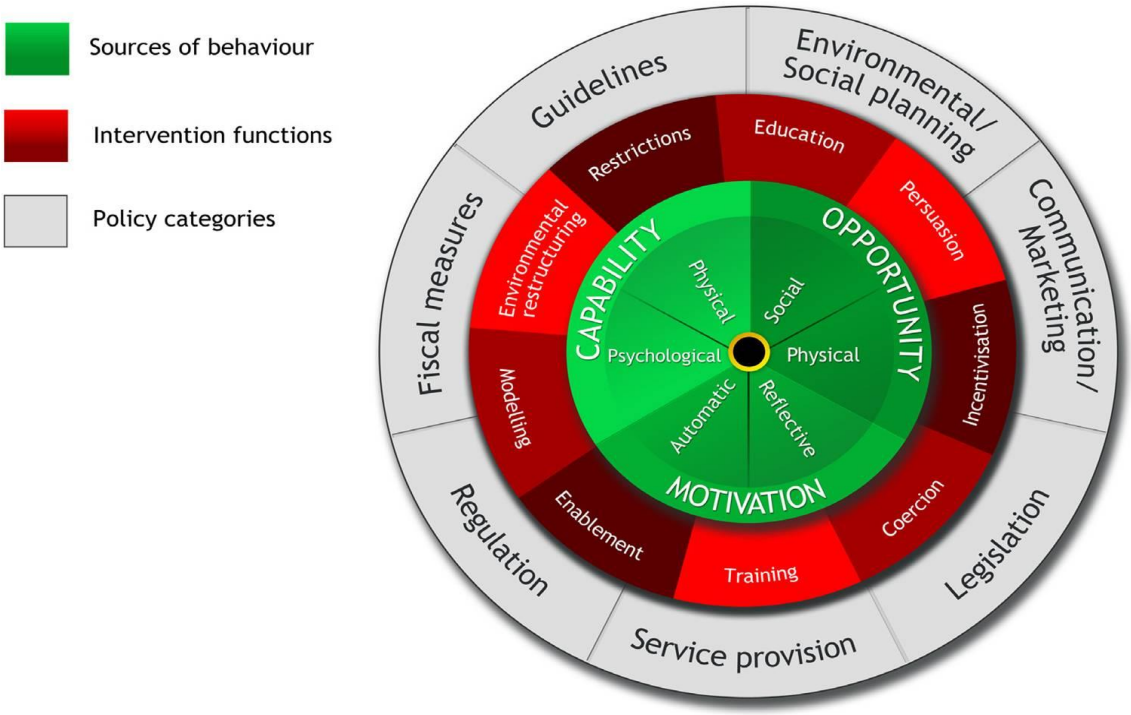

Figure 3.2 The Behaviour Change Wheel (BCW)

3.5.4 The Behaviour Change Techniques (BCTs)

Behaviour change techniques are the smallest component of a given intervention. BCTs are often referred to as the active ingredients of the intervention (West et al., 2020; Michie et al., 2013). Michie et al. (2013) have identified 93 BCTs that can be used to develop an intervention under the name of behaviour change technique taxonomy V1 (BCTTV1) (Michie et al., 2013; West et al., 2020). The taxonomy offers specific definitions and examples for each technique (Michie et al., 2013). The purpose of creating the taxonomy is to precisely define and describe the intervention in a way that facilitates

implementation, as well as to unify the components of the intervention so that the intervention can be replicated accurately in another setting (Michie et al., 2013). A specific website is designated for the taxonomy (https://www.bct-taxonomy.com), along with a mobile application, to expedite the use of BCTs in designing an intervention.

3.5.5 Medical Research Council (MRC) Framework for Developing Complex Intervention

To develop an effective intervention in healthcare, it must be designed with consideration of all factors affecting the desired change. An intervention can be considered complex for several reasons, including the number of outcomes, the difficulty of the behaviours to be achieved, the level of skills required by those delivering and/or receiving the intervention, the organisational level targeted by the intervention, and the allowed flexibility in implementing the intervention (Craig et al., 2008; Skivington et al., 2021b). In light of the aforementioned reasons, an intervention for promoting the uptake of and adherence to exercise and PA among Saudi women post CAD diagnosis is indeed a complex intervention. PA may require some skills from someone who has possibly been inactive for a long time. In addition, although any activity is better than no activity at all, there is a specific duration and intensity of the exercise recommended for people with CAD to perform per week, denoting less flexibility. Moreover, more governmental and organisational resources may be needed to create opportunities for women to engage in exercise and PA.

The Medical Research Council (MRC) framework for developing complex interventions was first introduced in 2000 (Medical Research Council, 2000) as guidance for developing and evaluating randomised controlled trials for complex interventions. The guidance was revised in 2006 and was recently replaced by a new framework that is a joint work of the Medical Research Council and the National Institute for Health Research (Craig et al., 2008; Skivington et al., 2021b). The new framework is an iterative four-phased approach which starts with defining and understanding the problem and the dynamic relationship between the intervention and its context (Skivington et al., 2021b). A new intervention can be developed, or an existing intervention can be chosen, tested for feasibility, implemented and evaluated (Skivington et al., 2021b). During all four phases, the core elements (context, programme theory, financial

resources, stakeholders' involvement, key issues or doubts and intervention modification) are revisited (Skivington et al., 2021b).

Therefore, the MRC framework principles for developing complex interventions were chosen as guidance for this study (Skivington et al., 2021b). This research undertakes the first phase of the framework, which is developing a new intervention or identifying an existing one. Also, the MRC encourages the use of a theoretical approach in exploring the process of behavioural change, hence, TDF was employed in conducting this study, and the COM-B model and BCW guided the process of proposing a potential behavioural change intervention (Skivington et al., 2021b; Craig et al., 2008; Michie et al., 2014a).

3.6 Sampling strategy

This section is dedicated to explaining the choice of the sampling technique in relation to the research approach and design. The sampling strategy is further described in the next chapter (Chapter four, sections 4.4 and 4.5).

One of the most notable differences between quantitative and qualitative research lies in the sampling strategy. The purpose of the sample, technique, and size are all very different between the two research approaches (Patton, 1990). In quantitative research, the main purpose of the study is to discover findings generalisable beyond the study sample and setting. Therefore, quantitative researchers opt for a large, randomised probability sample, where every individual in the population of interest has an equal chance of being selected (Creswell and Creswell, 2018; Patton, 1990) Another valid technique for quantitative sampling is a systematic sample, where a group of individuals are randomly selected and then participants will be chosen systematically from that group (e.g. every third person of the visitors of clinic X will be invited to participate) (Creswell and Creswell, 2018). On the other hand, qualitative researchers do not plan to statistically generalise the research results to the whole population. Rather, qualitative studies intend for the results to be transferred to a similar setting with a population that shares the sample’s characteristics (Koch, 1994; Markham et al., 2009; Shaheen et al., 2019). Therefore, qualitative researchers rely on a small but information-rich sample, choosing depth over breadth (Patton, 1990). The most appropriate sample for qualitative research is a non-probability sample. It is not chosen randomly.

Participants are intentionally and purposefully selected due to their meaningful experience with the phenomenon of interest, hence, their ability to provide the researcher with valuable insights to answer the research question. Non-probability samples include the purposive sample, convenience sample and quota sample (Naderifar et al., 2017). In the convenience sample, participants are chosen simply because they are easily accessible to the researcher and, therefore, considered the least desirable sampling technique (Creswell and Creswell, 2018). Similar to the convenience sample, quota sampling involves choosing participants with certain characteristics among the conveniently accessible sample, in an effort to be more inclusive and representative of the population (Vehovar et al., 2016). Lastly, purposive sampling involves purposefully choosing the participants based on their ability to answer the research question (Patton, 1990). It is a widely used technique in qualitative studies, as it yields deep and rich information with limited resources and a small sample. Purposive sampling is also the recommended sampling technique in qualitative descriptive designs, especially with maximum variation (Sandelowski, 2010; Sandelowski, 2000; Neergaard et al., 2009; Milne and Oberle, 2005). Therefore, purposive sampling (Patton, 1990) with maximum variation was employed in this study.

According to Patton (1990), there are 16 types of purposeful sampling: extreme/deviant case, intense case, homogenous, maximum variation, typical, criterion, stratified, critical case, snowball, opportunistic, theory-based, confirming/disconfirming cases, random purposeful, politically important cases, convenient, and mixed purposeful sample (Patton, 1990). Patton's different types of purposeful sampling are explained in **Table 3.2**. Along with maximum variation, snowballing and opportunistic sampling techniques were used in this PhD study to help increase the number of participants and reach data saturation within the allocated time for data collection. Combining different strategies of purposeful sampling is identified by Patton (1990) as a valid choice to facilitate the recruitment of participants (Patton, 1990).

Table 3.2 Purposeful sampling types (Patton, 1990).

Type of purposive sample	Definition
Extreme or deviant cases	Involves recruiting participants from the opposite ends of the continuum, e.g., Cases with the lowest and highest body mass index.
Intense cases	Involves selecting rich cases that highlight several classifications along the continuum (e.g., superior, average, and borderline IQ).
Homogeneous sample	Indicates that participants share common characteristics, opposite to the *Maximum variation sample*.
Maximum variation sample	Indicates choosing a diverse sample, opposite to the *Homogeneous sample*.
Typical sample	Selecting the normal average cases
Criterion sample	Selecting participants with specific criteria, for example, individuals who were discharged against medical advice.
Stratified purposive sample	Involves selecting cases from subgroups, which allows for comparison between them.
Critical case	Choosing a case which allows for generalisation, where if something occurs, it is likely to occur in other settings.
Snowball sampling	Identify eligible participants by asking those who have already participated to nominate anyone they know who fits the inclusion criteria of the study and might be interested in participating in the research (Patton, 1990; Suri, 2011)

Opportunistic sampling	Allows the researcher to make decisions while working in the field, to collect data from any participant who is willing to participate and able to answer the research question (Patton, 1990; Patton, 2002)
Theory-based sampling	Similar to criterion sampling, participants are chosen based on having specific, theory-derived characteristics.
Confirming/disconfirming sampling	After an initial data analysis, the researcher will select participants who can enhance the analysis either by confirming what has been found or contradicting the initial findings.
Random purposeful sampling	When the potential purposeful sample is too large, the researcher may use randomisation to select participants from the purposive sample. This not only reduces the size of the sample but also avoids the reliance on the researcher's judgment, which improves the trustworthiness of the study.
Political sampling	Purposefully selecting or avoiding participants based on political affiliations or having encountered politically sensitive issues.
Convenience sampling	Choosing readily available and accessible participants. It is the weakest type of sampling and has the lowest credibility.
Combination or mixed purposeful sampling	Choosing multiple and different purposeful sampling techniques to offer the researcher flexibility and ease in recruiting participants.

3.7 Data collection

This section is dedicated to justifying the choice of the data collection method in relation to the research approach and design. The data collection strategy is further described in the next chapter (Chapter four, section 4.7).

In qualitative research, data is usually collected through observation, interviews, or documents and other audio-visual and digital material analysis (Creswell and Creswell, 2018). Qualitative descriptive designs usually employ individual or group interviews (Sandelowski, 2010). In this study, data were collected using qualitative interviews. The semi-structured, in-depth interview was chosen as the method for data collection because it allows for a deeper understanding of participants' views, opinions, and insights (Chen, 2012). An individualised one-to-one interview allows the researcher to come close to the participants: Saudi women post CAD diagnosis and healthcare professionals caring for them, to understand their perspectives on the barriers and facilitators to exercise and PA, thus achieving the study aim.

Group interviews or focus groups were not considered because the researcher was interested in individualised, subjective perspectives. Views shared by a minority of the group during a focus group interview tend to be suppressed by the commonly shared views of the group majority. This is especially true when the subject of interest, being physically active, is subjected to social desirability (Morgan, 2001). In addition, participants may not be equally confident in their views or articulate in their expressions (Creswell and Creswell, 2018), which risks their becoming overshadowed by those who are well-spoken during group interviews.

Conducting group interviews following the individualised interviews was not possible either. Conducting a group interview with HCPs who work together is possible in theory because they are likely to be comfortable being in the same room. However, scheduling an interview for just one healthcare professional proved difficult, as they could have urgent calls at any time, and finding a time suitable for all of them would have been much harder. Moreover, conducting a group interview with the women was also not considered. The women are strangers to each other and are possibly from different backgrounds, educational and social statuses, which is likely to make them uncomfortable

being together in the same room. Winslow et al. (2002) conducted a focus group with women in a similar cultural setting but invited participants who were either from the same family or women who were familiar with each other, as they normally gather in a common place; an educational association (Winslow et al., 2002). The authors have also highlighted that illiterate and less educated women felt uncomfortable criticising healthcare facilities and showed more appreciation for what the government has offered (Winslow et al., 2002; Thomas, 2008). This possible reluctance to show disapproval of the provided healthcare services is likely to manifest more in group discussions than in a confidential one-to-one interview. Lastly, while some women preferred face-to-face interviews and were uncomfortable with the online option, they had transportation difficulties as older women still relied on male drivers and were not driving themselves. Others opted for online interviews, and therefore, scheduling a focus interview in a format and time that suits everyone would have been difficult. Thus, for all the aforementioned reasons, focus group interviews were not chosen as a method for data collection.

3.8 Data analysis

This section is dedicated to rationalising the choice of the data analysis method in relation to the research approach and design. The data analysis strategy is further described in the next chapter (Chapter Four, section 4.8).

In qualitative research, data analysis involves organising and sorting the data, identifying codes, merging codes into themes, interpreting the meaning of the themes and reporting the findings (Creswell, 2013; Creswell and Creswell, 2018). There are many approaches to qualitative data analysis. Some approaches have been associated with specific research designs; for example, constant comparative analysis is associated with grounded theory (Glaser and Strauss, 1967), while other approaches are not exclusive to any research design. (e.g., content analysis, thematic analysis and framework analysis). More details on the common approaches for data analysis in qualitative research can be found in **Table 3.3**

The choice of the appropriate approach to data analysis must align with the research questions and the chosen methodology. Sandelowski suggests that content analysis is the strategy of choice for data analysis in qualitative

descriptive designs (Sandelowski, 2000). However, it is not the only option available. Descriptive designs are known to be eclectic in nature and may implement techniques from other research designs (Sandelowski, 2000). Researchers have used a range of data analysis strategies in qualitative descriptive studies (Kim et al., 2017). Rendle et al. (2019) developed a framework for designing and assessing qualitative health research, which suggests that qualitative descriptive studies can use any clear and well-structured analytic steps guided by a theoretical or conceptual framework (Rendle et al., 2019).

Table 3.3 Common approaches utilised for qualitative data analysis

The analytical approach	Definition
Content Analysis	Systematic identification of codes and categories to spot common occurrences and their frequency, and the relationship between the data and the context of the communication (Grbich, 2013).
Thematic analysis	Analysis of data through identification and reporting of common themes (Braun and Clarke, 2006).
Framework Analysis	Analysis of data using a predetermined thematic framework, as well as emergent themes based on the researcher's reflections and interpretations of the data (Ritchie et al., 2014; Bryman and Burgess, 1994).

Framework analysis is an approach to data analysis designed to facilitate data interpretation. This approach was first developed to be used for applied policy research, but has been found useful in different types of studies (Bryman and Burgess, 1994). The use of a predetermined thematic framework is thought to bring order and systematise the process of data analysis in a deductive way, however, Ritchie and Spencer (1994) assert that the use of the analytical tool is highly dependent on the reflection and interpretation of the researcher, thus allowing for some flexibility in the use of the predetermined themes based on

the researcher's discretion and permitting the choice of an inductive-deductive approach to the data analysis (Bryman and Burgess, 1994).

Framework analysis consists of five stages: familiarisation, identifying thematic framework, indexing, charting, mapping and interpretation (Bryman and Burgess, 1994). Familiarisation with the data usually starts during the data collection period, especially if the researcher is the only person involved in collecting the data. It then continues with reflections on what has been collected by listening to the recordings and reading the transcripts. The researchers immerse themselves in the data, as expected from a qualitative researcher, and start to develop a sense of understanding of what the data is revealing before starting the analysis. The researchers form their expectations, connect the dots and establish preliminary meaningful relationships out of the immense, raw data.

Identifying a thematic framework is the next step, which also begins during the step that precedes it. During familiarisation with the data, the researcher jots down ideas and highlights issues and concepts that were found important to the participants. These concepts would naturally be connected to the research aim and objectives, which at the start were used to design the interview schedule. These concepts are now the priori themes for analysis and should be used with a few transcripts at first, before refining them to be more sensitive and inclusive of the collected data. Indexing the data involves the process of coding the transcripts and linking the data to the priori thematic framework. Charting will then ensue, in which the researcher moves from looking into individual transcripts to looking at the bigger picture of the whole data and trying to comprehend the views of the participants as a group. Finally, after sorting and charting the data, accounting for all core themes, priori and emergent, the researcher then makes their final interpretation by mapping the themes to the research objectives and deciphering what these themes mean as answers to the posed research question.

Framework analysis was used to analyse the data in this study. This approach was chosen because it is suitable for research questions that are concerned with understanding people’s experiences and those investigating the cause of certain issues (Bryman and Burgess, 1994). In addition, with the use of the TDF to guide the data collection of this study, it is very fitting and practical to opt for a

framework analysis where the TDF is used to construct the thematic framework, along with emerging data, as framework analysis allows for an inductive-deductive approach of constructing the analytic framework (Parkinson et al., 2016; Bryman and Burgess, 1994).

After data analysis, the reported findings were used to propose intervention components that can improve the uptake of and adherence to exercise and PA among Saudi women diagnosed with coronary artery disease. A logic model was used as a visual illustration of the intervention components, which includes the resources needed for the change to take place (inputs), how these resources should be utilised (outputs), and the expected results (outcomes) (Bisset and Gilman, 2016) (see Figure 7.3). The intervention components were developed using the COM-B model, BCH and BCT taxonomy, and the process was guided by the principles of the Medical Research Council (MRC) (Skivington et al., 2021a). These components form a preliminary intervention plan designed to promote PA among Saudi women post CAD diagnosis. The potential intervention plan will be subsequently developed with all relevant stakeholders in a future study, as such is beyond the objectives of this study. The PhD project flowchart describing the stages of the project is presented in **Figure 3.3**

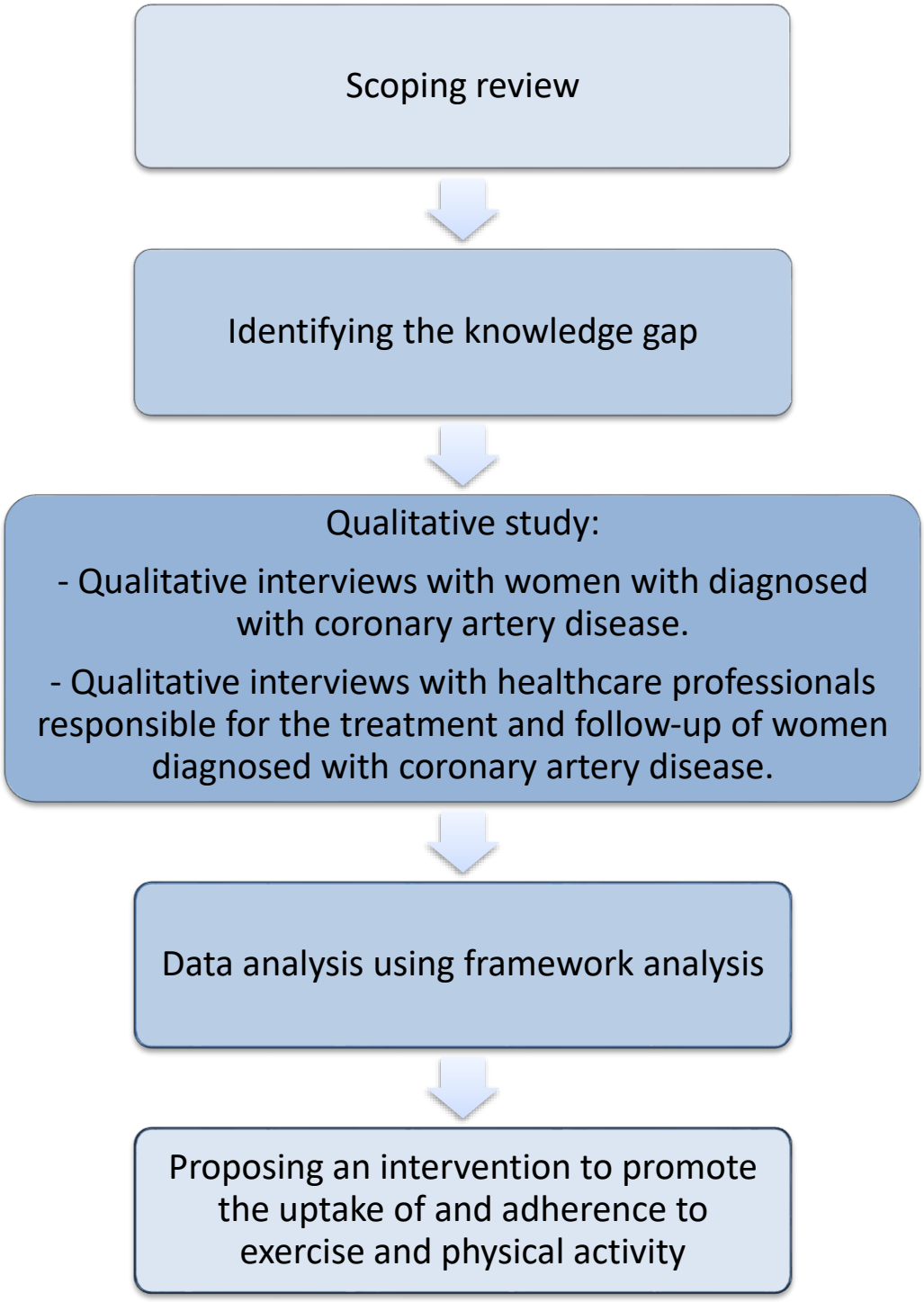

Figure 3.3 The PhD project flowchart.

3.9 Conclusion

This chapter discussed the research methodology for the PhD study. Specifically, critical realism, the philosophical view under which this research was constructed, and the methodological choices for the qualitative approach and descriptive research design have been outlined. A brief description of the

theoretical frameworks used during the planning and execution of the study has also been discussed. Moreover, the choices for purposive sampling, semi-structured interviews and framework analysis approach have been explained and justified in relation to the descriptive qualitative design. The following chapter will present the methods and tools implemented in this research project.

Chapter 4 Research Procedural Methods

4.1 Introduction

This chapter discusses the methods and strategies deployed when conducting this research. This research is a descriptive qualitative study aimed at exploring the attitudes, beliefs, experiences, barriers, and facilitators to the uptake of and adherence to exercise and PA among Saudi women diagnosed with CAD.

In qualitative studies, it is imperative to strive for a transparent discussion of the approaches taken concerning the sampling strategy, data collection and data analysis, to allow the reader to understand better the research findings and their context (Moravcsik, 2019). The chapter begins by describing the settings where the study took place, followed by a description of the recruitment process, the sampling strategy and sample size. The development of the interview schedules is then explained, along with the data collection and analysis processes. The ethical considerations that were taken while conducting this research study and the practice of safeguarding the data are also highlighted. While the principles of rigour and trustworthiness are embedded in the whole research procedural methods, the assessment of the research rigour and the reflexivity process are discussed in detail in Chapter 8 (8.9).

4.2 Setting

The study was conducted in two public hospitals located in the Eastern province of Saudi Arabia. The Eastern province is the largest in the country, with around 4.8 million inhabitants, among whom 64.6% are Saudi citizens (Keyindicators., 2016). The choice for the eastern region was also pragmatic in nature, as it is the region where the researcher lives. The map below (Figure 4.1) illustrates the administrative regions of Saudi Arabia, including the eastern province and some of its main cities from which participants were recruited (Dammam, Qatif, and nearby cities).

The two public hospitals were chosen based on the availability of cardiology departments that deliver services for people diagnosed with CAD. However, the researcher opted for one hospital that offers a CR programme and another that does not deliver such services. In the first hospital, women diagnosed with CAD are followed by cardiologists as well as physiotherapists and CR specialists,

whilst in the latter, women are seen only by the physicians (cardiologists and cardiothoracic surgeons). This choice provided an opportunity to compare the PA levels of women who had access to rehabilitation services and women who did not, thus allowing for exploring the possible effect of attending CR and meeting specialised exercise staff on the PA habits of women diagnosed with CAD. It also offered a better insight into the role different healthcare professionals play in supporting women who have been diagnosed with CAD in the presence and absence of structured CR programmes.

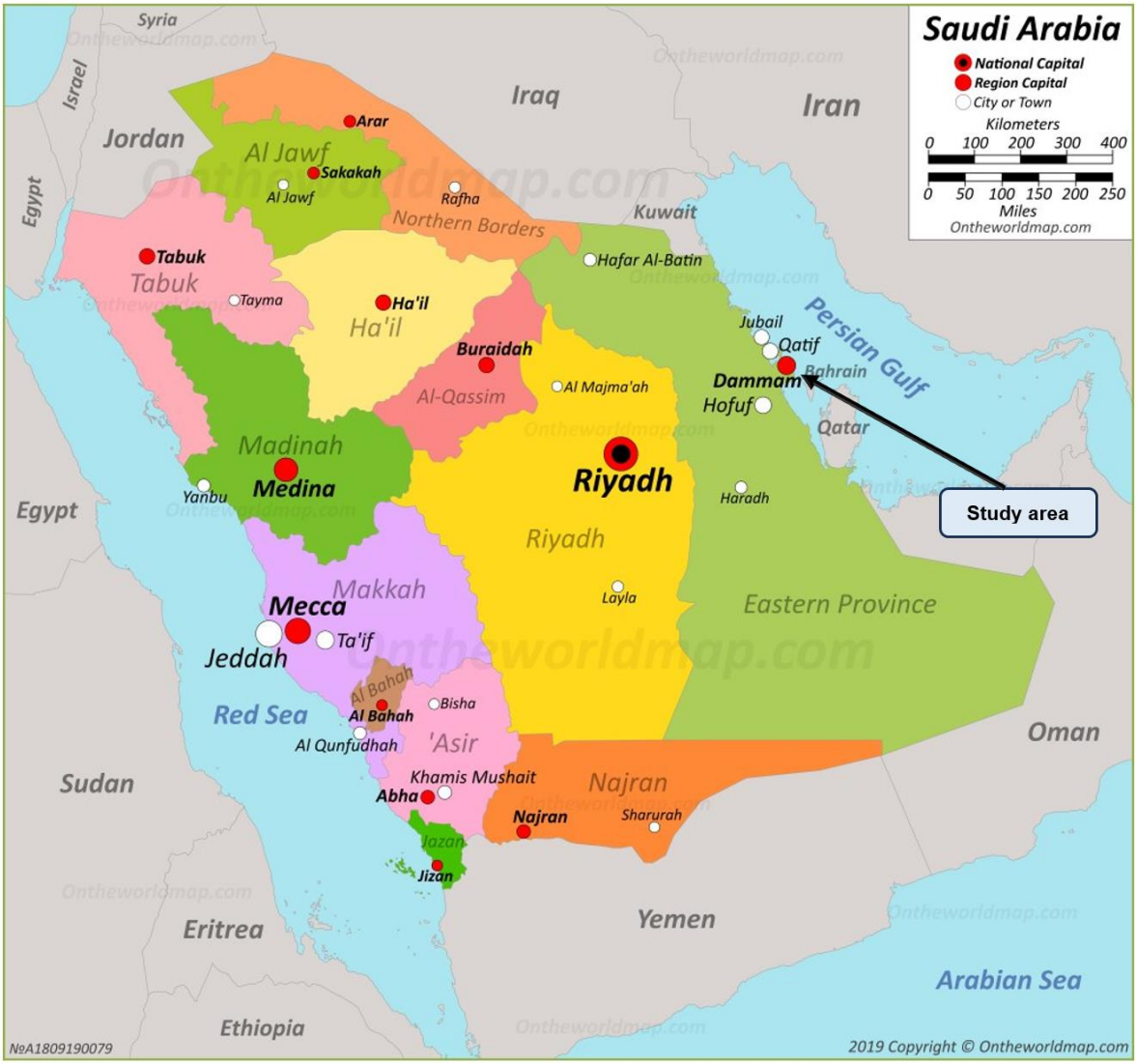

Figure 4.1 Map of Saudi Arabia showing the region from which participants were recruited (Eastern province) (OnTheWorldMap, 2019)

4.3 Study population

The target population for this study was divided into two groups:

1. Saudi women who have been diagnosed with CAD: (i) Women who were referred to the CR programme (ii) women who were not referred to a CR programme due to lack of availability of the services.
2. Healthcare professionals responsible for the treatment and follow-up of Saudi women post CAD diagnosis including: cardiologists, cardiothoracic surgeons, and physiotherapists.

4.3.1 Inclusion and Exclusion Criteria - Saudi Women Diagnosed with CAD

Table 4.1 Inclusion and Exclusion Criteria for Saudi Women Diagnosed with CAD.

Inclusion criteria	Exclusion criteria
• Saudi women • Aged 18 years and above. • Diagnosed with CAD by a healthcare professional. • Discharged (if newly diagnosed and was hospitalised) for at least a month.	• Residents who do not have Saudi citizenship • Less than 18 years of age • Have been diagnosed with CAD less than a month ago. • Being diagnosed with heart failure, physical disability (e.g., paralysis), frailty, or mental illness.

Resident women who do not have Saudi citizenship (e.g. South Asians, Yemenis, Egyptians) were excluded because this study is focused on Saudi women. PA level varies between countries, and it can be affected by culture, religion, and the social environment (Sharara et al., 2018; Kahan, 2015). Therefore, for the researcher to gain a truthful insight into the experience of Saudi women diagnosed with CAD, they must be the focus of this research. Girls less than 18 years old were excluded because the target population of this study are adults. Additionally, women newly diagnosed with CAD were excluded because they may not have had the opportunity to follow the instructions for lifestyle changes or the experience of enrolling into a CR programme and undertaking exercise and PA as recommended. Therefore, women must be

diagnosed with CAD and discharged, if hospitalised, for at least a month before participating in this study. Lastly, women who were diagnosed with co-morbidities that caused physical or psychological limitations around their ability to undertake exercise and/or PA were excluded (see **Table 4.1**).

Inclusion and Exclusion Criteria - healthcare professionals:

Table 4.2 Inclusion and Exclusion Criteria for Healthcare Professionals

Inclusion criteria	Exclusion criteria
• Cardiologists • Cardiothoracic surgeons • Physiotherapists	• Other healthcare professionals who are not responsible for educating and supporting women about exercise and PA, e.g. nurses, dieticians

Healthcare professionals were recruited to provide insight into the PA habits of Saudi women diagnosed with CAD, the possible barriers and facilitators to the uptake of and adherence to exercise and PA experienced by those women, and the potential changes to services that can promote Exercise and PA among them. Physicians: cardiologists and cardiothoracic surgeons were chosen because they are responsible for educating and encouraging women with CAD to modify their risk factors for CAD by adopting healthy habits, including exercise and PA. They are also responsible for referring women to CR programmes if such programmes are available in the area. Physiotherapists were also chosen because they prescribe exercise and supervise women diagnosed with CAD during the CR sessions. Healthcare professionals who are not responsible for educating and supporting women about exercise and PA (e.g., nurses) were excluded because they are unlikely to provide rich insights about the research problem.

4.4 Sample size

Qualitative research aims to obtain rich information to answer the research question and reach data saturation (Patton, 1990; Saunders et al., 2018). Data saturation is the point at which information starts to be repetitive and no new

ideas can be found (Saunders et al., 2018). However, while the data saturation can only be determined after data collection and analysis, a preliminary sample size often needs to be stated before the start of data collection (Hennink et al., 2017). The literature suggests a sample of six to twelve interviews is sufficient for interpretations, especially in a homogeneous sample (Guest et al., 2006). However, Hennick et. al. (2017) differentiated between code/theme saturation and meaning saturation (Hennink et al., 2017). The authors explained that while nine interviews were found to be enough to identify most or all codes, further interviews might be necessary to fully grasp the meaning of these codes (Hennink et al., 2017). To ensure reaching meaning saturation, a target of 15-20 interviews was set prior to data collection, and saturation was to be determined when commencing the processes of data collection and analysis.

(i) Saudi women diagnosed with CAD

16 women were recruited and interviewed from the two settings, eight women from each hospital. Redundancy, where the information gained from the participants started to be repetitive, was observed around the 11th interview; however, in the 12th interview, a new word, “lack of passion”, was stated by one participant that gave more meaning to an already existing code “boredom”. To ensure no information is missed, a few more interviews were conducted, especially since all the first 12 interviews were conducted with housewives/homemakers or retired women, and the views of working women were extremely important to the research topic. Therefore, further recruitment continued, and four more interviews were conducted, two of which were with working women. As no new code, themes or meanings were found, the data collection was stopped at 16 interviews.

(ii) Healthcare professionals

Similarly to the recruitment of Saudi women, a total of 16 healthcare professionals were recruited and interviewed. Six HCPs from the hospital that offers a CR programme and ten HCPs from the other hospital that does not. The variation in number is due to the difference in the size of the cardiology departments in the two hospitals, and therefore, the number of employed HCPs responsible for the treatment and follow-up of women diagnosed with CAD. Redundancy in information occurred around the 12th interview. By then, all the interviewees were cardiologists or physiotherapists working in the CR clinic.

Physiotherapists working in the setting that is not offering CR services were not originally targeted for recruitment. However, two physiotherapists were interviewed to ensure the researcher was not overlooking their views about their role in the rehabilitation of CAD outside of a structured programme. Also, the researcher learned about the existence of a cardiothoracic surgery clinic in one setting. Cardiothoracic surgeons were not originally considered for recruitment but were added to enrich the collected data, as cardiothoracic surgeons are indeed responsible for the treatment of women who have been diagnosed with CAD and undergone a cardiac surgery. After the surgery, the surgeons followed up with the women for a few months before being discharged from the cardiothoracic clinic into the care of cardiologists. Therefore, two cardiothoracic surgeons were recruited and interviewed. As the four interviews after the 12th interview (two with physiotherapists who were not working in CR and two with cardiothoracic surgeons) did not yield new codes/themes/meanings, the data collection was concluded at 16 interviews.

4.5 Sampling strategies

Purposive sampling was employed in the recruitment of participants from the two groups.

(i) Saudi women diagnosed with CAD

Women were purposefully chosen for their experience of being diagnosed with CAD and the need to be physically active, and thus their ability to answer the research question (Patton, 1990). Maximum variation of age, marital status and employment status was sought. However, most of the women who attended the cardiology and CR clinic were married and housewives. Nonetheless, a maximum variation in age was attained (more details in chapter five, section 5.2). Opportunistic sampling was also used to recruit any women who had an outpatient appointment on the day the researcher was present in the setting, considering their willingness to participate and ability to answer the research question (Patton, 1990).

(ii) Healthcare professionals

Healthcare professionals were purposively sampled based on their providing care for Saudi women diagnosed with CAD. To enrich the data, a maximum variation of occupation and years of experience was sought. The participants'

sample included cardiologists, cardiothoracic surgeons and physiotherapists. However, due to the limitation of the number of healthcare professionals dealing with Saudi women diagnosed with CAD in both settings, the recruitment approach took a rather pragmatic turn, and opportunistic sampling was employed. Therefore, all the HCPs were approached and those who were willing to participate were interviewed (Patton, 1990) (more information in chapter six, section 6.2).

The other sampling technique that was employed was snowballing. Interviewed healthcare professionals were asked to nominate anyone they knew who fit the study criteria and would be interested in participating (Suri, 2011). The participating HCPs then contacted their colleagues, informed them about the research and asked for their permission to be contacted by the researcher. When given permission, the researcher contacted the nominated HCPs and recruited them for the interview.

4.6 Ethical issues

4.6.1 Recruitment of participants

Ethical approval was obtained from the School of Healthcare Research Ethics Committee, University of Leeds (Ref no: HREC 22-010), as well as from the ethical committees in both hospital settings chosen (King Fahad University Hospital and Qatif Central Hospital) to commence collecting data and conducting interviews with Saudi women who have been diagnosed with CAD and HCPs responsible for the treatment and follow-up of Saudi women diagnosed with CAD. After procuring the approvals, the researcher contacted the administrators of both hospitals and asked for permission to visit the cardiology/ rehabilitation clinics to recruit participants and permission was granted.

(i) Saudi women diagnosed with CAD

Following the ethical approval of the data collection settings, the researcher met with the head of the cardiology and physiotherapy departments and asked for their help in arranging a meeting with the HCPs in cardiology and CR clinics to seek their help in identifying eligible participants. In King Fahad University Hospital (the hospital that does not offer CR services), the head of the

cardiology department introduced the researcher to the cardiologists in the meeting room inside the catheterisation lab, where the researcher discussed the study with the HCPs and asked them to identify eligible women based on the inclusion and exclusion criteria. The researcher was informed of the weekly schedule of the cardiology clinics and visited the HCPs on the day of the clinic to ask if there were any eligible participants registered to attend the clinic. If eligible women were found on the registration list, the HCPs informed them briefly about the study, gave them the invitation letter and emphasised that participation in the research is voluntary and will not affect their usual care. If they agreed to participate, the HCPs introduced them to the researcher. The researcher then explained the research in more detail and handed them the participant information sheet (PIS) to read and decide if they wanted to participate (Appendix E). In Qatif Central Hospital (the hospital that offers CR services), the head of cardiology introduced the researcher to the CR staff. The researcher discussed the study with the CR staff and asked them to identify eligible women based on the inclusion and exclusion criteria. When an eligible woman visited the CR clinic, the CR staff informed her briefly about the study, gave her the invitation letter and emphasised that participation in the research is voluntary and would not affect their usual care. If they agreed to participate, the CR staff obtained permission for the researcher to contact the potential participant. Then, CR staff contacted the researcher and gave her the potential participant's information. The researcher then contacted the potential participants, explained the research in more detail and emailed them the PIS to read and decide if they wanted to participate in the study.

Upon contacting the potential participants, the researcher emphasised that their participation was voluntary and that their HCPs would not ask them if they had participated in the study. The PIS was in Arabic, with a pictorial version prepared for those with a basic level of education (Appendix F). Those who received the pictorial PIS were also read the detailed PIS by the researcher and explained everything they did not understand. The researcher's contact information was provided at the end of the PIS. Eligible participants were encouraged to contact the researcher and ask questions about the study. Eligible participants were given a week to read the PIS and consider participating in the study. If the eligible participants did not contact the

researcher themselves, the researcher contacted them after a week to remind them of the research and ask them if they were still willing to participate. If confirmed, a suitable date and time for the interview were arranged based on the availability of both the participant and the researcher. An informed consent was obtained from the participants, indicating they had read and understood the PIS (Appendix G). Women who agreed to participate signed the informed consent form before starting the face-to-face interview or audio-recorded their consent by reading and agreeing to each item before the online interview. Ongoing consent was ensured during the interview by taking notice of the ease of the discussion and answering the questions.

(ii) Healthcare professionals

After obtaining the approvals for data collection from both settings, the researcher met with the head of the cardiology and physiotherapy departments and asked for their help in arranging a meeting with the HCPs in cardiology and rehabilitation clinics. At King Fahad University Hospital, the head of the cardiology department introduced the researcher to the cardiologists in the meeting room of the catheterisation lab. In Qatif Central Hospital, the head of cardiology introduced the researcher to the cardiologists and CR staff. The researcher introduced herself and gave a short presentation about the study. The researcher then obtained the HCPs' permission to be contacted and handed them the PIS.

The PIS for healthcare professionals was in English, as healthcare professionals come from different nationalities and speak several languages. However, they are all expected to speak English in healthcare settings. The researcher’s contact information was added at the end of the PIS, and eligible participants were encouraged to contact the researcher and ask questions about the study. Eligible participants were given at least a week to read the PIS and consider participating in the study. If the eligible participants did not contact the researcher themselves, the researcher contacted them after a week to remind them about the research and ask them if they were willing to participate. If they expressed their willingness, the date and time for the interview were arranged based on the availability of both the participant and the researcher. Informed consent was obtained from the participants, indicating they had read

and understood the PIS. HCPs who agreed to participate signed the informed consent form before starting the face-to-face interview at the hospital, or audio-recorded their consent by reading and agreeing to each item before the online interview. Ongoing consent was ensured during the interview by being attentive to the ease of the discussion and answering questions.

4.6.2 Participants' confidentiality and data protection

Participants' information was handled in the strictest confidence. Pseudonyms known to the researcher only were used in the interview transcripts and published quotes. All participants' personal details were destroyed once the data collection was completed. The consent forms were stored securely in a locked cabinet at the researcher's home office, accessible only to the researcher for no more than 48 hours before being scanned. After scanning, electronic forms were stored, encrypted and password-protected on the researcher's OneDrive account provided by the University of Leeds. Paper forms were shredded and destroyed.

4.7 Data Collection

Individual, semi-structured interviews were used to collect data from participants: Saudi women diagnosed with CAD and HCPs responsible for the treatment and follow-up of Saudi women diagnosed with CAD. The semi-structured interview was selected as the tool for data collection because it allows for a deeper understanding of the participants' views and insights (Chen, 2012). The interviews were either face-to-face, which took place in one of the hospitals' empty clinics or meeting rooms, or online via Zoom. The choice of a face-to-face or online interview was based on the participant's preference and availability. Most HCPs' interviews were conducted face-to-face (13/16), whilst five interviews with Saudi women were conducted face-to-face (5/16). More women opted for the online option to avoid the need for transportation to the hospital. Nevertheless, the lack of knowledge on how to install and use the Zoom application created difficulty in scheduling interviews with some potential participants. To solve these issues, some women chose to be interviewed when their children were around to assist them with the programme, whilst others eventually declined to participate.

4.7.1 Development of the interview schedules

The interviews were conducted to collect data to enable the researcher to achieve the research aim; to explore attitudes, beliefs, barriers, and facilitators to the uptake of and adherence to exercise and PA among Saudi women diagnosed with CAD from the perspective of the women themselves as well as their HCPs. The interview schedules were developed based on the literature review using the modified Theoretical Domain Framework's 14 domains (Cane et al., 2012; Atkins et al., 2017), **Figure 4.2**. The questions were mainly open-ended questions, which allowed the participants to express their thoughts freely, as well as some probing questions to encourage the participants to elaborate when necessary (appendix H and I).

Domain/ Definition	Constructs	
Knowledge ***(An awareness of the existence of something)***	• Knowledge (including knowledge of condition /scientific rationale) • Procedural knowledge • Knowledge of task environment	
Skills ***(An ability or proficiency acquired through practice)***	• Skills • Skills development • Competence • Ability	• Interpersonal skills • Practice • Skill assessment
Social/Professional Role and Identity ***(A coherent set of behaviours and displayed personal qualities of an individual in a social or work setting)***	• Professional identity • Professional role • Social identity • Identity • Professional Boundaries	• Professional confidence • Group identity • Leadership • Organisational commitment
Beliefs about Capabilities ***(Acceptance of the truth, reality, or validity about an ability, talent, or facility that a person can put to constructive use)***	• Self-confidence • Perceived competence • Self-efficacy • Perceived behavioural control	• Beliefs • Self-esteem • Empowerment • Professional confidence
Optimism ***(The confidence that things will happen for the best or that desired goals will be attained)***	• Optimism • Pessimism • Unrealistic optimism • Identity	
Beliefs about Consequences ***(Acceptance of the truth, reality, or validity about outcomes of a behaviour in a given situation)***	• Beliefs • Outcome expectancies • Characteristics of outcome expectancies	• Anticipated regret • Consequents
Reinforcement ***(Increasing the probability of a response by arranging a dependent***	• Rewards (proximal / distal, valued / not valued, probable / improbable) • Incentives	• Consequents • Reinforcement • Contingencies • Sanctions

relationship, or contingency, between the response and a given stimulus)	• Punishment	
Intentions ***(A conscious decision to perform a behaviour or a resolve to act in a certain way)***	• Stability of intentions • Stages of change model • Transtheoretical model and stages of change	
Goals ***(Mental representations of outcomes or end states that an individual wants to achieve)***	• Goals (distal / proximal) • Goal priority • Goal / target setting	• Goals (autonomous / controlled) • Action planning • Implementation intention
Memory, Attention and Decision Processes ***(The ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives)***	• Memory • Attention • Attention control • Decision making • Cognitive overload / tiredness	
Environmental Context and Resources ***(Any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence, and adaptive behaviour)***	• Environmental stressors • Resources / material resources • Organisational culture /climate • Salient events / critical incidents • Person x environment interaction • Barriers and facilitators	
Social influences ***(Those interpersonal processes that can cause individuals to change their thoughts, feelings, or behaviours)***	• Social pressure • Social norms • Group conformity • Social comparisons • Group norms • Social support	• Power • Intergroup conflict • Alienation • Group identity • Modelling
Emotion ***(A complex reaction pattern, involving experiential, behavioural, and physiological elements, by which the individual attempts to deal with a personally significant matter or event)***	• Fear • Anxiety • Affect • Stress	• Depression • Positive / negative affect • Burn-out
Behavioural Regulation ***(Anything aimed at managing or changing objectively observed or measured actions)***	• Self-monitoring • Breaking habit • Action planning	
All definitions are based on definitions from the American Psychological Association's Dictionary of Psychology (Washington:2007)		

Figure 4.2 The Theoretical Domain Framework (TDF) V2 (Cane et al., 2012)

4.7.2 Transcription of the data

Transcription is the process of reproducing spoken words in a written format (Halcomb and Davidson, 2006). The interviews from both groups of participants (Saudi women diagnosed with CAD and HCPs) were audio-recorded and then transcribed verbatim. Verbatim transcription means the exact same words that were verbalised by the participants were used to generate the written interview transcripts. The transcription is believed to be the first step of the data analysis and, therefore, must be as accurate as possible and compatible with the research methodology (Wellard and McKenna, 2001; Halcomb and Davidson, 2006). The qualitative descriptive design aims to keep analysis close to the data, and therefore, verbatim transcription was deemed appropriate.

The transcription process was carried out solely by the researcher. The researcher capitalised on her first-hand knowledge and experience with data. Having been there in the interview, listening to the participants, noting and observing their non-verbal cues helped the researcher make sense of the data more than what would have been expected from a professional transcriber (Halcomb and Davidson, 2006). The interviews were recorded using Zoom, which generates auto-captions. The captions were saved as full transcripts and were used as a base for the transcription. After the interview, the researcher listened to the audio tapes and edited the Zoom-generated transcripts, while taking notes of feelings and thoughts evoked by the interviews into a reflective journal.

4.7.3 Translation of the data

The interviews with Saudi women who have been diagnosed with CAD were conducted in Arabic, because the women are native Arabic speakers, and then translated to English. To ensure an accurate transformation of participants' views from one language into another, Breslin’s back translation method was adopted to increase the trustworthiness of the translation and subsequently the data analysis (Brislin, 1970). Breslin (1970) recommends that two bilinguals should be involved in the translation process, one translates from the source language to the target language, while the other reverse-translates the target version back to the source language, without having access to the original transcript in the source language. Similar to the transcription process, the

researcher took advantage of her direct knowledge of the data, due to her involvement in conducting the interviews, and her sufficient level of fluency in the English language to forward translate the data from Arabic (source) to English (target). Later, a professional translator of Egyptian origin was hired to blindly back-translate twenty percent (20%) of the data from English (target) to Arabic (Source). The two Arabic versions of the same transcripts were then compared by the researcher and no major discrepancies were found. The choice to back-translate twenty percent of the data was a practical decision taken after discussion and advice from the supervisors, due to the limitation of the PhD student's (the researcher's) budget. The interviews with the HCPs were conducted in English and therefore did not need to be translated.

4.8 Data analysis

Qualitative data collected from both sets of interviews (i.e. interviews with Saudi women diagnosed with CAD, and interviews with their HCPs) were analysed using the framework analysis approach based on the Theoretical Domain Framework (Ritchie et al., 2014; Cane et al., 2012). The approach to data analysis was inductive-deductive. The interview transcripts were imported into NVivo 14 and read to start the process of familiarisation with the data. Next, the coding process began, which meant specific data was assigned to initial codes. The codes that had similarities were then aggregated to form the major themes and subsequent subthemes. The identified themes were then mapped into the corresponding TDF domains. Most identified themes and subthemes were connected to more than one domain based on the different codes that formed the themes. The names of the final themes and subthemes were modified several times under the guidance and advice of the supervisors.

4.8.1 The process of carrying out framework analysis

Framework analysis is a five-step approach to data analysis: familiarisation with the data, constructing an initial thematic framework, indexing and sorting, reviewing the extracted data and data summary and display (Ritchie et al., 2014) (Rationale for choosing framework analysis in section 3.8).

4.8.1.1 Familiarisation with the data

The first step of framework analysis is familiarisation with the data. Researchers need to immerse themselves in the data and try to deeply understand what the data means to the participants before commencing the data analysis. The purpose of this step is to identify the links between the data and the research aim and objectives. This helps the researcher focus on what the data is revealing about the topic of interest. In this project, the familiarisation started during the data collection, as the researcher conducted the interviews with the participants. The researcher then continued attempting to comprehend and make sense of the data while listening to the audio recordings, transcribing the records into written transcripts, and taking reflective notes. Next, the transcripts were imported into NVivo and initial coding was undertaken. The codes with supporting quotes were discussed with the supervisors (MH and GH), and discrepancies were resolved through discussion. Examples of initial codes and supporting quotes are in Table 4.3.

Table 4.3. Initial codes related to the attitude, barriers and facilitators of the uptake of and adherence to Exercise and PA among Saudi women diagnosed with CAD.

The initial code	The supporting quote
Someone to exercise with	Noha: *My daughters. We go for a run in the morning at 5:30. I wake them up and we pray and go out, I say come on, let us go for a walk for half an hour and go back home.*
Fatigue and pain related to comorbidities	Toqa: *Rheumatism alone is difficult. It is all pain in the joints, so it is difficult for one to do 150 minutes a week. Do you understand me?*
Short clinic time	Nezzar: *Of course, the clinic is busy, not every patient I will tell her [explain to her in detail about PA], but this is what I emphasise to them. I always encourage daily activity. Summer, its hot, go to the mall and walk there. Whenever this subject come up I will*

	encourage the activity, maybe a lot of times, there will be no time but sometimes, if the patient ask I will tell her.

4.8.1.2 Constructing an Initial Thematic Framework

At this stage, the researcher had developed multiple codes related to the research question. These codes need to be organised, sorted and merged into themes. First, the researcher reflected on the research objectives to construct the categories under which the codes will be sorted. The categories must be derived from the research aims and objectives and contribute to answering the research question. As this research project was developed, with the TDF as the underpinning framework, and the data was collected using interview schedules developed using the TDF, the 14 domains of TDF were used as the initial thematic framework for the analysis.

4.8.1.3 Indexing and sorting

The third step of the analysis is indexing and sorting. At this step, the researcher classified the codes and sorted them into the identified framework categories, themes and subthemes. The researchers first reflected on the codes to identify similarities and connections between them. Then, the codes that were grouped together were matched into one of the categories of the framework and were labelled as themes. The process of coding and matching to the corresponding themes was achieved through NVivo software. The code groups, themes and subthemes were shared with the supervisors and refined through productive discussions. Figure 4.3 shows the codes grouped under the categories of the thematic framework i.e. the identified themes.

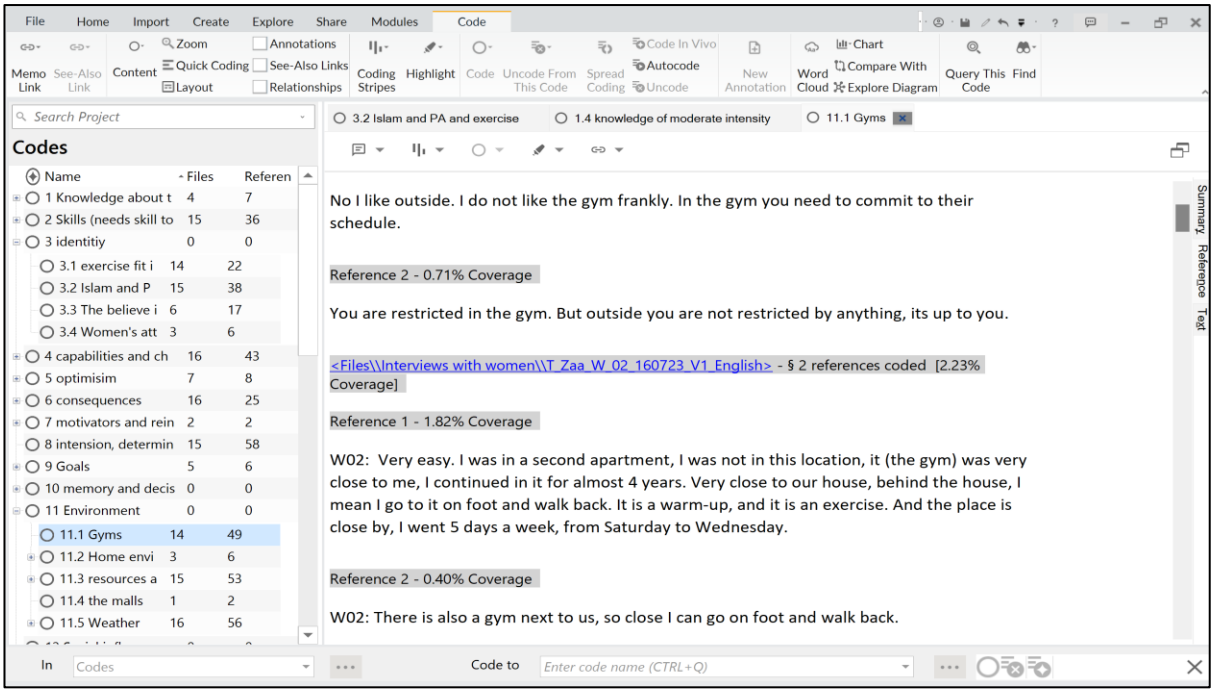

Figure 4.3 The process of coding, indexing and sorting using NVivo 14.

4.8.1.4 Reviewing the extracted data

This is the fourth step of the analysis. It was achieved by reviewing the data and transcripts to ensure the data fits perfectly under the codes, themes and subthemes and that no relevant information has been overlooked. At this stage, the theoretical domain framework initially used as the thematic framework for the analysis appeared excessive, and some categories (i.e. themes) needed to be merged, renamed and reapplied to the data. For example: The theme of professional role and identity, in which the participants expressed their views of the identity of Muslim women, the social influences, their skills, emotions, priorities and other perceived motivators and challenges, these issues were all found to be related to sociocultural factors and therefore were merged under the theme of Religious, and sociocultural influences which consists of three subthemes related to these previously identified issues: Islamic influence, women's cultural attitude toward being physically active, and lack of exercise culture during early childhood. Like previous stages, this stage was completed after reflections and constructive feedback from the supervisors (MH and GM).

4.8.1.5 Data summary and display

The final stage of framework analysis is data summary and display. The purpose of this step is to have the researcher ponder what the data has

revealed by summarising what each participant said about each subtheme. A summary matrix was developed through NVivo to display the data. The matrix rows consisted of the different participants, and the columns consisted of the identified subthemes. A matrix-based summary facilitates the movement between different levels of analysis while staying close to the data and enables both intra-case and inter-case analysis (Miles and Huberman, 1994). In addition, a summary matrix allows the researcher to deeply comprehend the data, which lays a strong foundation for further interpretation and discussion of the findings (Ritchie et al., 2014).

4.9 Conclusion

This chapter has outlined the methods and strategies used in this research project. Semi-structured interviews were conducted with Saudi women diagnosed with CAD and their HCPs from two hospital settings to learn about the attitudes, barriers, and facilitators to the uptake of and adherence to exercise and PA among Saudi women diagnosed with CAD. The data collected was analysed using the framework analysis approach, based on the TDF. The following chapter presents the first part of the study's findings, based on the interviews with Saudi women who have been diagnosed with CAD.

Chapter 5 Findings Part 1: Saudi women diagnosed with CAD

5.1 Introduction

This chapter presents the findings related to answering the study's first two objectives, which were:

(i) to identify the attitudes and beliefs regarding the uptake of and adherence to exercise and PA among Saudi women post CAD diagnosis;

(ii) to identify the barriers and facilitators to the uptake of and adherence to exercise and PA among Saudi women post CAD diagnosis.

The chapter starts with a description of the participant demographics. Next, the themes identified from the data, using the framework analysis approach, are outlined. Then the themes are discussed, evidenced from the interview transcripts and mapped to the TDF domains.

5.2 Participants demographics

Sixteen Saudi women, diagnosed with CAD, agreed to take part in this study. Eight Saudi women had participated in or completed a recognised CR programme, whilst the other eight participants were not referred or did not have access to CR services. Most of the women interviewed (14/16) were unemployed at the time of the interview. Two women were previously employed but had retired at the point of data collection, whilst the remaining twelve were considered housewives. Only two of the women in the sample were employed. The characteristics of the participants are presented in Table 5.1.

Table 5.1 Participants demographics:

Pseudonym	Age	Access to Cardiac Rehabilitation (CR)	Marital and family status	Employment status
Noha	64	Attended CR	Widow, living with daughters	Housewife
Farah	38	Attended CR	Married	Housewife
Hajar	58	Attending CR	Married	Housewife

Pseudonym	Age	Access to Cardiac Rehabilitation (CR)	Marital and family status	Employment status
Manal	62	Dropped out of CR due to rheumatism	Widow, living with her daughter	Housewife
Morooj	58	Joined 2 CR programmes in 2 different hospitals for a good period of time	Married	Housewife
Toqa	47	Dropped out of CR due to transportation difficulties	Married	Housewife
Alia	65	Attended CR	Married	Housewife
Danah	63	Attended CR	Widow, living alone	Housewife
Nawal	45	No	Married	Retired early
Khulood	73	No	Widow, living with a domestic worker	Housewife
Abeer	57	No	Widow, living with children	Housewife
Sameerah	60	No	Married	Housewife
Dalia	52	No	Married	Teacher
Malak	53	No	Married	Housewife
Maymoonah	72	No	Widow, living with daughter	Retired
Zahra	66	No	Widow, living with children	Nanny

5.3 Identified themes

A total of five themes, using a framework analysis approach, were identified through data analysis of the semi-structured interviews conducted with Saudi women, diagnosed with CAD. The main themes and subthemes are presented in Figure 5.1.

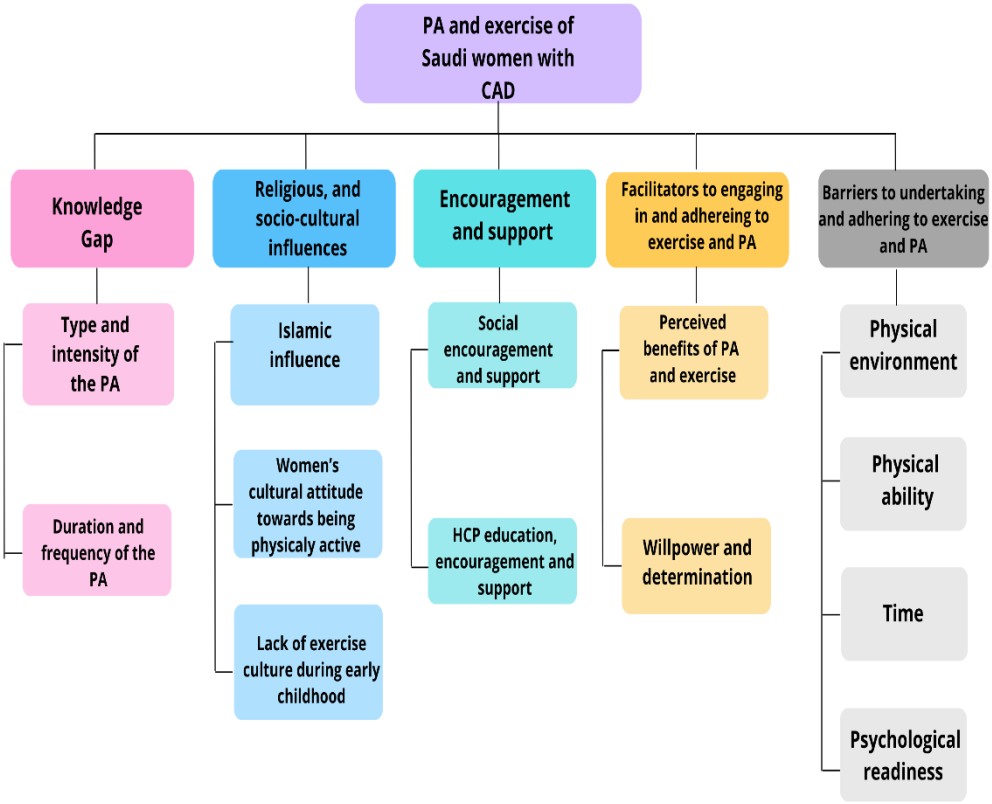

Figure 5.1 Themes and subthemes identified from the analysis of women's interviews.

5.3.1 Theme 1: Knowledge Gap

"Knowledge is light, and ignorance is darkness"

Arabic proverb

The findings suggest that participants lacked knowledge and understanding about the nature of exercise and/or PA that can help them improve and maintain cardiac health. This knowledge gap was particularly evident in relation to the type of exercise and/or PA to engage in. For example, what is the recommended intensity someone diagnosed with CAD should be undertaking for good cardiac health, how frequently and for how long someone with CAD should be physically active/undertake exercise per week. Therefore, this theme consists of two subthemes: (i) type and intensity of the PA, and (ii) duration and frequency of the PA.

5.3.1.1 Type and intensity of the physical activity

Although most participants felt that being physically active was important for the health of the heart, Saudi women interviewed did not appear to be aware of the type of exercise and/or PA was necessary to accomplish their cardiac health goals. When participants were asked what the words exercise and PA meant to them, they could not distinguish between the two terms and often referred to both as sports. When asked during interviews about what the word PA meant to them personally, there was vagueness and/or varying interpretations. For example:

“Physical activity is a sport, maybe walking. Physical activity for me is that I work at home” (Sameerah, 60 years old; did not attend CR).

“Physical activity is a sport. Walk, I mean, run. I mean, for example, I walk for half an hour, go up the stairs, the bicycle machine, I take 15 minutes on it” (Morooj, 58 years old; attended CR).

The quotes above demonstrate that whilst both participants referred to PA as a form of sport or exercise, Morooj, the participant who had attended CR, equated PA with some of the exercises she performs in the CR clinic and Sameerah, who did not attend CR, regarded housework as her form of PA. Therefore, the participants could not distinguish between exercise and PA and referred to different types of physical activities with various degrees of intensity as a sport. This suggests the existence of confusion and a lack of clear perception of the type of physical activity that can promote cardiac health among the participants.

Likewise, most of the participants were unsure or unaware of the term ‘moderate intensity’ PA. Saudi women interviewed explained rather vaguely how the effort should be at a ‘moderate level’ and that they should not ‘stress’ themselves. In their description of what is ‘moderate intensity’, participants often focused on not getting tired, indicating confusion between moderate intensity and light intensity PA. These quotes are examples of the discussion around the term ‘moderate intensity’ PA and demonstrate that what is considered an appropriate level of PA needed for cardiac health promotion is subjective:

“It means I don't get tired, I don't feel tired. Moderate means that if I do the effort it is not the maximum thing, just the middle” (Noha, 64 years old; attended CR).

“It means moderate, not strong exerting a person. It depends on your ability, as much as you can from the fatigue of the heart and the fatigue of the body, so you adjust it to the best of your ability” (Nawal, 45; did not attend CR).

Women did not report using self-indicators, such as an increase in the effort to breathe while maintaining the ability to talk, as an objective way of knowing whether they were exerting enough effort. Rather, participants generally emphasised the perception of not tiring themselves, suggesting that the level of effort exerted may be rather light and does not meet the recommended levels required to improve and maintain cardiac health. No difference was noted between CR attendees and non-CR attendees regarding their awareness of the required intensity level of exercise and PA, suggesting that there is a lack of health education regarding exercise and PA even in the CR clinic, which suggests that the health improvements achieved during the programme will be difficult to sustain after the end of the programme.

As the majority of the interviewees were housewives, with many stating that housework took a high priority over other activities (discussed more in section 5.3.2.2), probing questions were asked about their views of housework, and whether they considered it a form of PA that could help them maintain a healthy heart. Some participants responded affirmatively without distinguishing between the different house chores and the amount of effort required, especially as many spoke about cooking. Others did not perceive any health benefits from doing housework and stressed the need for purposeful exercise to attain the physical and mental health benefits. For example:

“Of course, by God, of course, it [housework] is useful. Moving around the house is beneficial. Do your activity, go to the kitchen, move around the house, do something for yourself” (Manal, 62 years old, dropped out of CR).

“Before there were no housemaids, and women and girls worked in their homes without housemaids. This is considered a physical activity for the house, her housework is considered an activity, it is considered an exercise” (Nawal, 45 years old; did not attend CR).

“No, no, it [housework] is not equal to exercising, no matter how much you work every day from morning to night” (Toqa, 47 years old; dropped out of CR).

The above quotes show a discrepancy in participants’ views about the benefits of housework for cardiac health. Participants, who equated housework with exercise, are potentially risking not achieving their cardiac health goals in an oversight of the difference between the intensity of the various housework activities and, thus, the level of effort they require. On the other hand, participants who did not recognise the benefits of housework in cardiac health

promotion could potentially become demotivated in their endeavours to become physically active, as they may believe that all the efforts exerted doing housework are of no avail. Therefore, individuals diagnosed with CAD should be informed that any type of activity, whether performed purposefully as exercise or undertaken as a part of the activity of daily living, is considered favourable to cardiac health, as long as it exerts enough effort to increase the heart and respiratory rate (Ghaddar et al., 2021; Elin et al., 2014).

5.3.1.2 Duration and frequency of physical activity

In addition to not knowing about the intensity or type of exercise and/or PA participants should be engaging in to improve their cardiac health, none of the participants reported understanding how often (frequency) or how long (duration) they should be aiming for to achieve the recommended levels of physically active per week. The WHO emphasises that adults should spend a minimum of 150 minutes per week engaging in moderate-intensity PA to promote cardiovascular health (World Health Organization, 2024c). However, participants either underestimated or overestimated the recommended frequency and/or duration of PA needed to reach the recommended levels. For example:

“It is assumed that the average is from 3 to 4 days a week” “45 minutes” (Farah, 38 years old, attended CR).

“No. No, I mean, I did not follow precisely to the point of being, certain time, certain number of minutes, or, no, no” (Malak, 53 years old; did not attend CR).

Many participants stated that their HCPs encouraged them to practice exercise and PA as tolerated. However, not knowing what the minimum recommended physically active frequency and duration they should achieve weekly can result in participants failing to accumulate 150 minutes of moderate-intensity PA required to improve cardiac health and wellbeing. Also, it deprives those who attain the minimum required time of PA of the satisfaction of knowing that their PA is contributing favourably to their heart health, which is likely to motivate them to continue. This was evident when participants were asked about what motivated them to be physically active. The perceived health benefits of exercise and PA was the most discussed motivator for being physically active (discussed more in section 5.3.4.1). No difference in the knowledge of the

minimum required time to be physically active per week was noted between those who attended CR and those who did not. This suggests, as mentioned earlier, that the CR participants do not have sufficient knowledge to allow them to remain as physically active after the programme, as they were while attending the programme.

Consequently, not having enough knowledge about what is recommended in terms of the type, intensity, duration and frequency of PA per week may lead some participants to refrain from engaging in exercise and PA out of fear of doing something that can be harmful to their health, or engage in PA that is mild-intensity, and/or for less than 150 minutes per week. Regardless of the women's ability and willingness to undertake 150 minutes of moderate-intensity PA at the time of health education, at discharge or at a follow-up appointment post-discharge, women who have been diagnosed with CAD need to know the type, intensity, frequency and duration of PA they are recommended to perform weekly. If some women are unable to achieve the minimum recommended levels of PA in the first week, then they should be encouraged to gradually increase their PA intensity, duration or frequency until they can successfully reach the minimum recommended level of PA per week. However, many participants perceived that the instructions provided by their HCPs regarding exercise and PA were generally unspecific and lacking in detail. For example:

"No, they didn't tell me, but I finished with them (CR programme) and that's it, I mean it was maybe a month and something, I spend there. Maybe a month and a half, something like that" (Dannah, 63 years old; attended CR).

"No, they didn't tell me anything. I mean, when I asked doctor (...) she told me that if anything makes you tried, don't do it. I asked her, I told her do I walk? I mean I feel myself getting tired, but I don't know what the instructions for after the catheterization are" (Maymoonah, 72 years old; did not attend CR).

"I take great care in not jumping around or running fast or something like I feel, you might find it funny, but I feel my stents might move from their place, they slip from my artery (laughs)" (Dalia, 52 years old; did not attend CR):

The quotes above highlight that participants believed they had not received enough health education from their HCPs regarding the required levels of exercise and PA they can safely undertake post-CAD diagnosis, which made

some reluctant to engage in exercise and PA. This was noted similarly in those who had attended the CR programme and those who did not.

Lastly, in addition to the need for providing further health education on the characteristics of the PA recommended for individuals diagnosed with CAD (type, intensity, duration and frequency) in cardiac clinics, one participant recognised a lack of education on the importance of exercise and PA among women diagnosed with CAD at a community level and expressed her wish for health education campaigns specialised for CAD similar to those undertaken for other diseases, such as breast cancer and diabetes.

"They could have a campaign like they have for breast cancer. They have for diabetes. They have these campaigns. The government could help us, help the people, you know, by having campaigns encouraging them" (Dalia, 52 years old; did not attend CR).

In summary, to encourage women diagnosed with CAD to undertake and adhere to a regular exercise and PA programme, women should be provided with more detailed information about the type, intensity, duration and frequency of exercise and PA that is recommended for them to achieve and maintain their cardiac health goals, whilst feeling assured that the exercise and/ or PA they choose to undertake is safe and not going to have adverse effects on their heart or their general health and wellbeing. Improving general knowledge of what is allowed, in terms of the type of PA, intensity, duration and frequency, for individuals diagnosed with CAD to undertake, could encourage Saudi women diagnosed with CAD to undertake exercise and/or PA and remove any hesitancy that was generated by the ambiguity around the subject.

5.3.2 Theme 2: Religious and socio-cultural influences

"In movement, there is a blessing".

Arabic Proverb

Participants have referred to many religious, cultural and social factors when discussing their PA habits and what motivates or discourages them from undertaking exercise and/or PA. The theme of Religious and socio-cultural influences consists of three subthemes: (i) Islamic influence, (ii) women's

cultural attitude toward being physically active, and (iii) lack of exercise culture during early childhood.

5.3.2.1 Islamic influence

There was general agreement among the participants about the view of Islam towards being physically active. All participants stated that Islam encouraged exercise and PA. For example:

“Islamic laws encourage exercise, and exercise is among Islamic teachings, fitness. Islam encourages physical exercise” (Noha, 64 years old; attended CR).

“Of course, we wear our appropriate Hijab wherever we go. That's our belief, but then I'm free to go anywhere” (Dalia, 52 years old, did not attend CR).

In the above quotes, participants affirm that being a Muslim woman and wearing the Hijab are not barriers to going anywhere and undertaking exercise and PA. However, participants appeared to differ in some of their views, or in the orthodox nature of their Islamic beliefs. For example, one participant expressed concern for her privacy in certain places where there are many men coming and going and stated feeling better in other public, but less crowded, spaces. This point, however, was not mentioned by anyone else. Another mentioned that some women may feel uncomfortable with music in the gym and that they should aim for times when there is no music. This is particularly interesting as another participant mentioned that she liked to play songs at her home and dance, and another mentioned that she wished that there were government-run clubs offering female-only exercise sessions with music and dancing for women to join:

“I mean, some of them can say that there are songs in the gym or something. I mean, this is something else. This is from the point of view of Islam, but you can go another time when they do not play songs” (Farah, 38 years old; attended CR):

“I will even play songs and dance. This is exercise” (Manal, 62 years old; dropped out of CR).

“If there is a club, it has fitness, for example, music, dancing. I mean, we are Muslims, thank God, but between us the women [it would be ok to dance in female-only settings], everyone will be healthy [because they will dance, enjoy and get physically active] (Morooj, 58 years old; attended CR).

The quotes above exemplify, according to Farah, that some women may wish to avoid music, while Manal and Morooj felt that they would enjoy dancing to music as a form of exercise. Moreover, Morooj believed that among women only, music and dancing are acceptable in Islam, and having this option available would lead to better health for everyone. Therefore, variety and choice in what is provided in terms of exercise and PA programmes is important to accommodate people's preferences around exercise and/or PA.

Moreover, the religious influence was evident throughout the interviews as participants were often speaking about God and repeatedly saying phrases like *'God willing',* especially when asked about their intentions and what would happen in the future. For example:

"God willing. God willing, with God's help, God willing, yes" (Toqa, 47 years old; dropped out of CR).

"God willing, I mean this ability of mine is from God. If God made us able. Each one has their circumstances" (Danah, 63 years old; completed CR).

"God willing, oh Lord, whoever reaches this thing [being physically active], seeks walking and controlling the laziness and so on, will be, God willing, will be better" (Abeer, 57 years old; did not attend CR).

These quotes demonstrate a reliance on an external locus of control, God, in relation to planning to become physically active. Participants stated that their strength and willpower are from God, and only if Allah enables them physically and morally, they shall overcome the sluggishness and be fit to exercise. Participants' optimism and trust in God were also highlighted when asked about what they expected to happen as a result of becoming physically active or a consequence of being inactive, as noted in the following quotes:

"Maybe the fat won't increase as you say, fat accumulation inside the arteries and things like that, maybe, the Lord is one and the life is one (laughs) and what God has written for us, we will see" (Sameerah, 60 years old; did not attend CR).

"No, God willing, nothing will happen. I put goodness above all else [I expect good things]. The power of God Almighty. There is nothing but good for us and for you" (Danah, 63 years old; attended CR).

Despite acknowledging the benefits of PA, some participants believe that all is in God's hands and that whatever Allah has written for them, it will happen.

Other participants chose to deny the consequences of physical inactivity and embrace optimism and the belief in God, as a way of inviting health and wellbeing.

5.3.2.2 Women's cultural attitude towards being physically active

All, except one participant, stated that the idea of being physically active was generally compatible with their personality and lifestyle and could fit well in their daily routine. However, many participants expressed certain priorities that took precedence over undertaking exercise and PA, mainly housework, family commitments, and social duties. These participants mentioned that to be physically active, they must first be done with their other commitments to have time for themselves. Otherwise, they would miss their workout for the sake of the perceived, more important duties such as housework and social obligations. For example:

"What I have to do is, for example, finish the housework, finish my duties, pray, and cook lunch, or cook dinner and finish. I don't have anything; nothing is holding me back. They do not say to me, for example, Mother, don't go out, it is not good. No, no, no, on the contrary, they encourage me" (Morooj, 58 years old; attended CR).

"It is difficult if I have work, or I am tired, or something, then I will not be able to, If I have somewhere to go, frankly, I, this place has more priority to me than walking. I will start with the highest priority" (Danah, 63 years old; attended CR).

"Or if I have guests. If I have people in my house and I'm already very busy, then I have to skip walking. These are a few reasons, or if I'm leaving, I'm going out. I'm socialising. Then again, then I won't have time to walk." (Dalia, 52 years old, did not attend CR).

Generally, participants clearly highlighted where their priorities lay in the social context, suggesting that in Saudi culture, women are socialised to perceive housework as their primary duty toward their families, followed by social commitments, which are their duties toward society. It is only when these obligations are achieved that women can have time for themselves. Therefore, to be committed to being physically active, participants needed to accomplish their household duties and fulfil their social obligations, then, with the remaining time and energy, they could engage in exercise or PA. Consequently, it is likely that

Saudi women may need their families' help and support to become physically active (more in section 5.3.3.1).

5.3.2.3 Lack of exercise culture during early childhood

“Learning in childhood is like engraving on stone”

Arabic Proverb

Another perceived socio-cultural aspect, reported to affect the participants’ ability to be physically active, was the lack of preparation or instructions on how to become physically active during childhood. Some participants felt that not being taught physical education in schools and not being raised to be physically active as girls from a young age made it more difficult for them to accomplish their PA goals as older adults. These women felt the absence of exercise culture during their early childhood, and the tendency toward physical inactivity created a challenge for them when deciding to adopt a physically active lifestyle, as habits were hard to break. For example:

“Sure, sure. I mean, getting used to something and learning at a young age is like engraving on stone. If we had got used to it from childhood, like prayer, how did we get used to it since we were children, the same thing” (Sameerah, 60 years old; did not attend CR).

“And of course, it's not like the West. In the West, you see people are so, so, physical in everything. And for them, it is nothing, like the children, the elders, all are active. Here I feel this is not there. This is missing in our part of the world. More physical world, the children are brought up in a different way” (Dalia, 52 years old; did not attend CR).

In the above quotes, two participants who did not have access to CR discussed how they were not brought up to be physically active from a young age. However, other participants felt that this was just a temporary challenge that could be overcome. Undertaking physical activity could be difficult at the beginning, but once someone gets used to it, it becomes easier. For example:

“You feel tired in your knees, tired in your chest, and say, that’s it, I'm tired, but this is for two or three days, and then you won't feel it. If you practice, that’s it” (Noha, 64 years old, attended CR).

“If you resolve yourself, that’s it, like dieting, for example, at first it is difficult, do not eat this, do not eat this, but when you get used to this thing, even if you have a sheep in front of you, you don’t want, you don’t want to eat. You are accustomed to (eating) an apple. You are accustomed to a piece of bread, for example. You are accustomed to this thing. You will continue on this. But in the beginning, it is difficult. How can I sleep when I am hungry? How can I not eat? Is it true or not?” (Khulood, 73 years old; did not attend CR).

The temporary difficulty of building a habit was also highlighted when participants were asked about the presence of active people around them. Most participants stated that there were people around them whom they considered active, women included, and that the number of active people was generally increasing in the community.

“Here is my daughter, God bless her, she go out and walk for about an hour” (Manal, 62 years old; dropped out of CR).

“See, like I said, the way you are exposed to like first we never used to drive. Now the women are driving. But just by that, see the women have become so active. They are carrying the children and they're driving and going and coming. They become so active. It depends, all depends on the exposure you have. So I, around me like generally as a middle-class person there are many ladies, women, even men who are very careful about their health and they take, but the majority don't” (Dalia, 52 years old; did not attend CR).

The above quotes suggest women are becoming more active in Saudi society. Dalia believed that allowing women to drive had increased their levels of PA, as they started to drive the children and run errands. Nonetheless, she felt that the majority of people were inactive, and other participants appeared to share this opinion. For example:

“Never. If they were active, they would have known the value of exercise” (Hajar, 58 years old; attended CR).

Participants highlighted that the level of PA undertaken by people in the general society reflected their lack of appreciation of the importance of exercise and PA. Consequently, the social norms around exercise and PA, and people’s level of awareness of the value of being physically active, are likely to affect the level of encouragement and support they offer to those who are endeavouring to become physically active (more in section 5.3.3.1).

In summary, while religious influence was mostly perceived to be a positive influence in undertaking and maintaining PA/exercise, social and cultural attitudes toward PA as being of less importance than social obligations and housework, combined with the lack of early physical activity training during childhood had an undesirable effect on Saudi women's levels of PA.

5.3.3 Theme 3: Encouragement and support to undertake exercise and PA

The encouragement and support received by Saudi women from their social surroundings and their HCPs were perceived to have a notable effect on women's PA levels. The theme of encouragement and support for exercise and PA consists of two subthemes: (i) social encouragement and support; (ii) Healthcare professionals' education, encouragement, and support.

5.3.3.1 Social encouragement and support

Generally, most participants felt that their families were very supportive of their decision to become physically active. However, some participants reported that their families discouraged them from undertaking exercise and PA. For example:

"By God, they encourage me. Even my husband encourages me. I mean, I didn't walk today. [he would say] Get up and walk, like this. I mean, even my children, not just the girls, even the boys" (Nawal, 45 years old: did not attend CR).

"Even my children and their father are stopping me. Don't tire yourself. I say, let me. I feel happy when moving" (Hajar, 58 years old; did not attend CR).

The above quotes demonstrate the difference in the families' perception of the importance of exercise and PA for women after being diagnosed with CAD and highlight the existence of a misconception around the safety of exercise for women suffering from heart disease.

Other participants stated that they needed their husbands' and children's permission and support to leave the house and engage in outdoor exercise or PA, something that was not always granted:

"Husband's mood (laughs). Sometimes, no, don't go out. Honestly, (laughs)" (Malak, 53 years old; did not attend CR).

“Even the mothers who are like us, we cook, get up, and work, we don't have time to come [to CR centre or gym]. By God, if I would come to play sports, the people at home will snort at me [expressing disapproval]” (Sameerah, 60 years old, did not attend CR).

These quotes suggest the low importance placed on rehabilitation by some families. Husbands and children’s preferences for Saudi women staying at home and attending to their needs were seen to supersede Saudi women ‘playing’ or participating in exercise and PA. The word playing, expressed by the participant in Arabic and translated verbatim, suggests a perception of the triviality of exercise in comparison to attending to the household and family needs. The women’s priorities have been discussed earlier (section 5.3.2.2) and thus, having husbands and adult children dependent on Saudi women is likely to diminish their chances of going out and being physically active.

In addition, the nature of the perceived encouragement and support varied among the participants. While some family members encouraged the women by accompanying them on walks, others played a less active role in supporting the participants or were ‘neutral’ towards women’s decision to be physically active. For example:

“They encourage me. We made a group [WhatsApp group] for us sisters and brothers, and we encourage each other” (Farah, 38 years old; attended CR).

“One of my children drives me and sits down. Seldom that he walk with me. I mean, I go and come and he is just watching me” (Hajar, 58 years old; attended CR).

“No, it’s normal, they do not encouraged me, nor otherwise, they just leave it as it goes [they do not interfere]” (Malak, 53 years old, did not attend CR).

The above quotes demonstrate the variation in the type of encouragement and support received by the participants. While Farah’s family actively encouraged her and used social media to constantly remind each other to engage in PA, Hajar’s children only supported her by driving her to where she wanted to walk, without trying to motivate her by participating in her PA. Lastly, Malak expressed her family’s attitude towards her desire to be physically active as indifferent, they merely let her do what she wanted without support or objection.

In addition, to further understand the nature of the social encouragement and support received by the women, participants were asked about having an

exercise companion. Only a few participants said they had steady and reliable partners who engaged with them in their activity time. Where there was little engagement, this was due to time conflicts, differences in activity preferences, especially between daughters who may like to go to the gym and mothers who just liked to walk outside, or because family members were inactive. In the following quotes, three participants discuss having exercise companions or reasons for not having them:

"*My daughters. We go for a run in the morning at 5:30. I wake them up and we pray and go out, I say, come on, let us go for a walk for half an hour and go back home" (Noha, 64 years old; attended CR).*

"I have one of my daughters, one of my daughters always loves to go to the gym, always. Sometimes, she tells me Mom, come register here, yes, you go, and I will just go out [in the outdoors] and take a walk here. I won't go there [the gym]. For years, she goes, she does not abandon sports, the gym" (Alia, 65 years old; attended CR).

"No, she likes it [going for a walk in the mall or outdoors], but she also works, the same thing, so our time has become a little difficult (to coordinate)" (Zahra, 66 years old; did not attend CR).

5.3.3.2 Healthcare professional education, encouragement and support

Data analysis identified differences in the perceived level of encouragement and support received from HCPs between Saudi women who were referred to and attended CR and those who were not. Participants who had access to a CR programme spoke highly of the physiotherapists' support and encouragement during the programme, whilst participants who did not have access to CR did not express receiving a similar level of encouragement from their cardiologists. Most participants who were treated in the hospital that lacked a cardiac rehabilitation programme stated that they either did not receive any exercise or PA education or that the education received was insufficient in-depth (in terms of type, intensity, frequency and duration of PA per week); some participants reported wanting to have more detailed educational clinic sessions where they would receive an in-depth explanation and have their questions answered:

"There is no one like (physiotherapist name). She is a balm on wounds. If your intention is that you cannot, she encourages you" (Noha, 64 years old; attended CR).

“They did not talk to me about it, whether I walked or not, they did not tell me, frankly” (Sameerah, 60 years old, didn’t attend CR).

“Briefly yes when you see the doctor, definitely, they must have said [to be physically active]. I don't remember but they must have said it but like having like a professional session or setting and explaining and no, no, not that kind. Like you were mentioning. That they should have a clinic, where we should be, the patient should be explained for something. No, that is not there “ (Dalia, 52 years old; attended CR).

The above quotes show that participants who attended cardiac rehabilitation praised the physiotherapist for the encouragement and support provided when undertaking and maintaining exercise during the sessions. On the other hand, participants who did not attend CR expressed their frustration with the level of education provided about exercise and PA received from their cardiologist. Sameerah stated that no one asked her about her PA levels at all, whilst Dalia believed they must have advised her to be more physically active. However, she inferred that this was brief and lacked a detailed explanation of how to achieve such a goal. This highlights the need for detailed health education sessions dedicated to educating Saudi women who have been diagnosed with CAD regarding the importance of PA to improve their cardiac health and well-being, and the characteristics of the PA they ought to undertake, along with frequent follow-ups. The current routine cardiac appointments do not allow the time for this, as stated by the healthcare professional (more in chapter Six, pages 131,132).

Moreover, some participants, who were followed up in a cardiology clinic at the hospital not offering a CR programme, reported that out-patient appointments were often months away, possibly due to the increasing number of patients and the limited number of physicians:

“Every week I do [CR session]. On Monday and on Wednesday, and I run on the Corniche[1] every day” (Noha, 64 years old; attended CR).

[1] Corniche: A road built on a ledge (cliff), especially along water (a river, sea, etc) Thesaurus. 2024. *Definition of Corniche*. [Online]. [Accessed 15/05]. Available from: https://www.powerthesaurus.org/corniche/definitions

“For a long time, I did not go to see my heart [check on my heart], God willing, in two weeks, two months, I have a heart appointment” (Khulood, 73 years old; Didn’t attend CR).

The above quotes highlight that cardiologist follow-up appointments are not as frequent for PA monitoring as weekly CR visits. This further emphasises the need for a specialised health education clinic run by educated HCPs that would not be, perhaps, as busy as physicians’ clinics, to conduct exercise and PA education sessions for individuals diagnosed with CAD.

Interestingly, regardless of the level of encouragement and support participants received, some participants expressed high confidence in HCPs, stating that whatever the doctors and physiotherapists say must be in their best interest:

“They [healthcare professionals] advise me. They want the best for the patients. Is it correct or not? Do they want people to get sick when they are healthy and well? I will do this thing [whatever they tell me]. It is in my best interest. They will not do anything that harms me, thank God. It is in the people’s interest” (Danah, 63 years old, attended CR).

“Yes, of course, of course. I mean, the doctor who is the treating physician, won't give you advice and tell you to do this thing unless it is for your general interest and your health interest” (Nawal, 45 years old; did not attend CR).

The above quotes demonstrate the trust participants have in HCPs, regardless of whether they attended a cardiac rehabilitation programme or not.

To summarise, a few participants expressed their family’s discouragement of their engagement in PA, however, most participants reported receiving different types and degrees of family support to become more physically active. For some participants, family members encouraged them by undertaking PA with them. For others, family members facilitated ways for them to be physically active without participating in the PA (e.g. provision of transport to CR sessions and PA-friendly spaces). However, some families were just neutral and did not interfere in the women’s decision to be physically active. Therefore, this demonstrates the need to involve the family of individuals diagnosed with CAD in the exercise and PA health education sessions provided for their loved ones. Regarding Healthcare professionals' support, participants who have attended CR appreciated the level of support and encouragement received from physiotherapists and CR staff to help them perform the prescribed exercises,

whilst those who did not attend CR felt that they did not receive enough education and support from their treating physicians (cardiologists).

5.3.4 Theme 4: Facilitators for engaging in and adhering to exercise and PA

Participants reported several factors that they perceived helped facilitate to their starting and adhering to a regular exercise and PA programme. The theme facilitators for engaging in and adhering to exercise and PA comprises of two subthemes – (i) perceived benefits, and (ii) willpower and determination.

5.3.4.1 Perceived benefits of exercise and PA

Many participants were motivated to engage in exercise and PA. When asked about what motivated them to become more physically active, most women reported that it was the potential advantages/positive health benefits of being physically active that acted as a facilitator. For example, having more energy and living a longer and better quality of life:

“What motivates me is my health. I want to always be fine” (Farah, 38 years old, attended CR).

“Of course you love your body, you want to live more. And then there are other reasons also you have a family. And also when you want to live, you want to live a quality life. You don't want to live a miserable life. So there are so many reasons. You have responsibilities, you have, it makes you feel that, of course, you love your body, you want to live longer. Of course, that's the main reason” (Dalia, 52 years old; did not attend CR).

The quotes suggest that the desire to be healthy, to live longer, and to enhance the quality of life were the main reasons participants decided to become physically active. The expected health improvements were the most expressed persuader for undertaking exercise and/or PA among the participants in this study. This could be attributed to the acknowledgement of the importance of exercise after being diagnosed with CAD, which was shared by most participants:

“Oh. Well, the best treatment is exercise. Better than these drugs and better than everything. I encourage exercise, I mean, whoever loves, who has a heart disease, I encourage them to exercise” (Noha, 64 years old, attended CR).

“Exercising gives you, as you say, support for the future, support for vitality, support for wellness, for health” (Nawal, 45 years old, did not attend CR).

The above quotes suggest that participants believed that being physically active was important and that it had and would continue to have desirable effects on their cardiac health and well-being. While some participants spoke generally about the overall health and quality-of-life improvements, others were more specific about how they felt when being physically active. For example, some participants reported feeling more ‘energised’, had regular heartbeats, had better blood sugar and blood pressure control, memory and sleep improvement, and even improved mental well-being:

“If I get up and walk, I have more energy to work at home and take care of the kids. I have more energy, more vitality, and more activity” (Farah, 38; attended CR).

“Exercise is good. It regulates the heartbeats; it circulates the blood in the body. Even your memory improves” (Nawal, 45; did not attend CR).

“Even my mood is relaxed. Psychologically you would be happy” (Manal, 62; dropped out of CR).

The above quotes indicate that participants attributed several positive health changes to being more physically active. This was noted similarly between those who attended a CR programme and those who did not. However, some participants, who did not have access to CR services and exercised on their own, wished to have the opportunity to exercise under healthcare professionals’ supervision and guidance.

Participants reported that exercising under observation would make them feel safer and more assured that they would not hurt or endanger themselves whilst exercising. Therefore, exercising under observation would encourage women diagnosed with CAD to become physically active:

“If I had been provided with these things, first thing there are doctors, if anything would happen to me they are there. There is attention. As you said, there is a doctor, for example, who specialises in these diseases for us, heart patients. I could have continued [exercising]. I might have continued, maybe after that, I would have the courage to do it at home” (Sameerah, 60 years old; did not attend CR).

“That's a wonderful thing [having exercise instructors]. That will be super. Yeah, that will be super really. It will really help all the patients” (Dalia, 52 years old; did not attend CR).

The above quotes highlight the importance of exercising under the supervision of specialised HCPs, as it increases participants' confidence in their ability to perform the exercises correctly and safely to gain the desired health benefits and avoid possible complications. After supervising women who have been diagnosed with CAD for a few sessions, the HCP may decide it is safe for them to continue exercising from home, with regular follow-ups to ensure the women are adhering to the prescribed exercises.

Another perceived benefit of undertaking exercise and/or PA reported by the study participants was enjoyment. Participants stated that engaging in an enjoyable activity persuaded them to continue being physically active. Several activities, and aspects of the activities that they enjoyed, were mentioned and included: outdoor walking, walking in the mall, meeting new people, and dancing:

“And do you believe that walking outside gives you positive energy? It absorbs negative energy from humans. The fresh air and it opens your lungs, and you see people. Walking in the open air is very excellent for humans”. “of course, it is nice to walk on the Corniche and smell the air, and your lungs open. Your breathing will be healthy and normal in the open air (outdoors), unlike when you are at home, there is a difference” (Nawal, 45 years old; did not attend CR).

“I mean, it is enough that you are in a mall, you will walk around and be happy for sure” (Malak, 53 years old; did not attend CR).

“Yesterday, I told them that my body feels tired. Get up and play for me, let me dance”. “I will even play songs and dance. This is exercise” (Manal, 62 years old; dropped out of CR).

There is variation in what participants enjoyed about being physically active. Thus, HCPS need to understand what women diagnosed with CAD enjoy about being physically active and encourage them when the activity meets the universal PA recommendations, to both take up and adhere to their favourite PA. This is likely to motivate more women to become physically active. Socialisation was one aspect of PA that many participants enjoyed about the type of PA they chose to engage in. For example:

“The gym I went to, not many people went there, you know? So it was boring, so I didn't continue” (Sameerah, 60 years old; did not attend CR).

Often, there was a lack of opportunity for socialisation, making women lose interest and discontinue the activity. Lastly, losing weight was also reported as a perceived advantage of being physically active and therefore acted as a facilitator to continue with the exercise and/or PA programme/regimen. Some participants were concerned about their body image and thus mentioned losing weight and having slimmer bodies as their main goals for becoming physically active, not cardiac health. Also, some participants stated that being overweight is one reason their HCPs emphasised they should exercise and go on a diet to lose excess weight. The following quotes exemplify the issue of weight in relation to exercise and/or PA:

“Because even before I did, before I get ill, I didn’t like being fat, so if I got lazy I gain weight, so I go on a diet and walk. That’s why I got the machine [treadmill]”
“They told me to walk, move more, and lose weight, yeah, this weight reduction, I mean, I lost weight by a small percentage. I couldn’t do exercise, frankly. I couldn’t, not even walk. I couldn’t walk to the point where I would burn [calories], you know? I get tired” (Malak, 53 years old, did not attend CR).

“I had this desire. I wanted to wear, and buy wedding dresses [evening dresses], I want, you know? I had a different goal. Not for my heart, or to maintain my health or, no” (Sameerah, 60 years old, did not attend CR).

In the above quotes, the participants are affirming that the main reason they have exercised in the past and used the treadmill was not out of concern for the health of their heart, but rather it was to lose weight and gain a better appreciation for their body figure. Malak also mentioned the emphasis of the HCPs on her to walk for the purpose of burning calories and losing weight, which she could not achieve. Unlike being physically active for a healthy heart, having weight reduction as a goal for being physically active is likely to get women frustrated and quit if they fail to realise the set goal.

It is noteworthy that the reported perceived benefits - health improvement, enjoyment, and weight loss, are situated differently on the continuum of time. While enjoyment is an immediate or short-term benefit that participants can achieve almost instantly when starting their PA, health improvement is a long-term goal that requires consistency and perseverance and is likely to involve

turning PA into a lifestyle. Weight loss, on the other hand, falls in between short and long-term goals and can be achieved over periods of variable length. The difference in the effort and persistence needed to achieve the set goals is likely to have variable effects on the sense of gratification and steadiness of the motivational state among the participants (Strecher et al., 1995), and consequently, the adherence to exercise and PA.

5.3.4.2 Willpower and Determination

Many participants discussed the importance of having a strong inner conviction rather than relying on others' encouragement for them to be physically active. These participants felt that their inner strength comes from within, and when they can summon this inner power, nothing can stop them, and if they fail to do so, no one can effectively encourage them. For example:

"By God, there is nothing, there is nothing preventing me except that it means I must work hard, diligently, and persevere. And I need determination. I need determination and strong determination" (Nawal, 45 years old; did not attend CR).

"I mean, even if they spoke, for example, and told you to exercise or, if you don't have a will and you don't want to improve, then no matter what they say to you, you won't listen to their words. But if you are internally convinced, convinced that if you exercise, you will be healthy, then you should support yourself, and you won't need support from anyone" (Farah, 38 years old; attended CR).

"If I am convinced of the decision on my own, I will do it, no matter what happens, God willing, I mean, of course, I am speaking about myself, so the conviction must be from within. If you are convinced of this thing, you must do it. If this thing is for your benefit, then it is necessary to do it" (Toqa, 47 years old; dropped out of CR).

The above quotes clearly highlight the importance of willpower and perseverance for the participants to engage in PA and strive to make it their lifestyle. It is imperative to understand participants' locus of control and what motivates them more. Contrary to the previous theme that discussed the role of social and professional support in encouraging Saudi women diagnosed with CAD to be physically active (section 5.3.3), which motivates individuals with an external locus of control, focusing on the inner power and self-determination, indicates that individuals have an inner locus of control (Rotter, 1966; Biondo

and MacDonald, 1971). While leveraging the family, friends and healthcare professionals' support to stay physically active is a good thing, this support is not guaranteed to last. On the other hand, relying on one's inner strength is more likely to result in perseverance and sustainable effort, as it keeps control over the behaviour (staying physically active) in the individual's own hands.

Interestingly, the participants Farah and Toqa clearly connect both facilitators for engaging in exercise and PA's subthemes together, (Perceived benefits of exercise and PA and Willpower and Determination) stating that if she (the participant) believed exercise and PA were favourable to her health, this would fuel her willpower and determination, which in turn motivates her to be physically active.

In summary, the perceived benefits of exercise and PA (overall health improvement, enjoyment and losing weight), along with willpower and determination, were the most frequently reported participants' motivators for starting and continuing to be physically active.

5.3.5 Theme 5: Barriers to undertaking and adhering to exercise and PA

Participants also discussed the challenges they faced when trying to become physically active. Several perceived barriers hindered the participants' ability to undertake and adhere to a regular exercise and PA programme/regimen. These barriers are grouped and constructed into four subthemes: (i) physical environment, (ii) physical ability, (iii) time, and (iv) psychological readiness.

5.3.5.1 Physical environment

The most discussed barriers to being physically active were related to environmental factors. Whilst most participants reported feeling that there were outdoor areas where people could undertake brisk walking (walkways, corniche, between the houses, etc.), the hot weather reportedly hindered their ability to engage in and enjoy outdoor PA, as well as maintain their physical activity levels. For example:

"We have facilities, thank God, we have a Corniche. No, we have, thank God, but our problem is the weather" (Manal, 62 years old; dropped out of CR).

“ It is like I told you, it's only the weather that hinders our efforts. It is, it discourages us from going but you see when the weather is good everybody is out. You go out, you, everybody is down to go to the Cornish, you see so many people around” (Dalia, 52 years old; did not attend CR).

In the above quotes, the participants emphasised the weather’s negative effect on their ability and willingness to exercise outdoors, irrespective of the availability of exercise facilities. This is understandable as the eastern province of Saudi Arabia is a coastal region where the weather in the summer is humid with a temperature that can reach more than 40°C (**Figure 4.1**) (El-Shaarawi and Al-Masri, 1996). Thus, the hot weather was mentioned by every participant. However, some participants perceived it as discouraging, whilst others either saw it as beneficial for exercising or just thought of ways to avoid it, by exercising indoors or choosing cooler times to go out (e.g. early morning, at night). In the following quotes, three participants are narrating their ways of staying active despite the heat and the humidity:

“People protest against the heat, I mean. The heat is tiring, we can't, let's wait until the winter, and other people do not. I tell them whenever you move your body, and feel the heat and sweat, this is the benefit of exercising. The body gets more benefit in summer, more than winter” (Noha, 64 years old; attended CR).

“I try as much as I can in the humidity, that I don't get out, because sometimes it makes it very difficult to breathe and I cannot, I mean, I get tired, so I take a walk in the house, I do exercises in the house, and I don't go out” (Farah, 38 years old, attended CR).

“ Instead of practising late in the afternoon, I practice at dusk. At dusk, I practice now in the summer, at the end of the day, even if it is hot, but not like when it’s sunny” (Hajar, 58 years; attended CR).

The above quotes corroborate the idiom *“Where there is a will, there is a way”.* When the individual is firm about their decision to be physically active, nothing can dissuade them. The three participants were CR attendees, and each found a way to stay active during the summer.

In addition to the weather, transportation was another factor of the physical environment that was perceived to hinder the women’s ability to become physically active and to maintain their physical activity levels. Some participants

expressed having difficulty with transportation and thus were not always able to go to designated walking areas at a distance or even attend their CR sessions. The following quotes are examples of transportation issues:

“I prefer to go to the Corniche, but I do not always have someone to take me, you know?” (Hajar, 58 years old; attended CR).

“No, I did not complete it [CR programme] because I did not have a car. I didn't have it” (Toqa, 47 years old, dropped out of CR).

The above quotes highlight that a lack of transportation can interfere with participants' ability to stay physically active, as one participant stated that she liked to exercise at the corniche[1], but doesn’t always have someone to drive her there, which might reduce her ability to maintain her physical activity levels. While the other had to drop out of the CR programme due to transportation issues.

Moreover, a few participants mentioned the cost of gym subscriptions as an obstacle to becoming and maintaining their physical activity levels. Most participants didn’t prefer going to the gym, as some disliked being restricted by the gym schedule, whilst others expressed their preference for walking on their own without using machines. Nonetheless, some stated that the monthly subscription fees were overpriced and could not be afforded by all:

“As I told you, currently the weather. And because I cannot go to the gym, for example, because of my financial circumstances” (Toqa, 47 years old; dropped out of CR).

“I feel that my time is wasted if I go to the gym, I like at home and I go out and walk and that's it” (Aalia; 65 years old; attended CR).

“No, it is working out on the machines, I do not prefer it” (Zahra, 66 years old; did not attend CR).

The previous quotes indicate that while some participants disliked going to the gym, because they felt it wasted their time or they simply disliked machine exercising, some participants wished to attend, but could not afford the monthly subscription. Among those who were bothered by the subscription cost, one participant had a brief experience with a government-run sports club designating some days for women to come and exercise for free. The event was terminated shortly after due to a lack of organisation, thus she suggested trying it again in different government-run clubs:

“If I demand, I mean if I have the right to demand, I demand that they open a club in every area, women’s club”. “I demand that the state open women's clubs for us, and not far, that every region has a club. This thing is our right, the right of women” (Morooj, 58 years old; attended CR).

In summary, government-run clubs established across the Kingdom of Saudi Arabia could dedicate time to provide exercise and PA opportunities for women in the community at a minimal fee, as a way of providing affordable access to women-only professional training.

5.3.5.2 Physical ability

Participants also expressed that physical difficulties challenged their capability to engage in exercise and PA. Fatigue and pain were generally mentioned. Conditions, such as diabetes, hypertension, osteoarthritis, rheumatism, disc prolapse, and joint pain of any sort, were specifically reported by some participants as reasons for not exercising, whilst one participant mentioned how frequent insomnia episodes affected her body and energy levels throughout the day:

“I have rheumatism. Rheumatism alone is difficult. It is all pain in the joints, so it is difficult for one to do 150 minutes a week. Do you understand me?” (Toqa, 47 years old; dropped out of CR).

“Both of my legs hurt me, not just one. This is the one that had an operation, and the second one that I fell down, fell in the kitchen, so what can one do. I mean, it is like a broken plate, it can't be fixed” (Khulood, 73 years old; did not attend CR).

In the quotes above, Toqa expressed her suffering from rheumatism, and Khulood had both legs injured and only moved around using a four-legged walker. Such cases require CR specialists to prescribe suitable exercises for the women and to follow up with them closely. Toqa had the opportunity to visit the CR clinic but did not continue the programme due to transportation difficulties, whereas Khulood did not have access to CR services. Remarkably, some participants perceived their physical complaints and symptoms as temporary challenges, whilst others expressed these as being long-lasting obstacles. For example:

“I can't go to the medics (cardiac rehabilitation), I can't. I am telling you because I went and got tired, rheumatism is what made me tired, I can't, and God, I wish

I had continued with them. On the contrary, when I moved, I felt comfortable in my heart. I felt happy while moving. I wasn't panting or anything when I exercised, but my problem, as I told you, is rheumatism" (Manal, 62 years old; dropped out of CR).

"Fatigue, body fatigue, because I have diabetes and hypertension and feel tired, so I stop for a day or two and then I go back to exercising" (Noha, 64 years old; attended CR).

The above quotes clearly highlight differences in the way participants dealt with their physical pain. Noha perceived it as a temporary issue, rested for a couple of days and went back to exercising, whilst Manal dropped out of the CR programme due to an episode of rheumatism in her hands. When asked if the CR specialists have changed the exercise for her to another that does not trigger her upper limb rheumatism, she simply stated that she stopped going altogether:

"No, I did not go [to the CR clinic], I did not go" (Manal, 62 years old, dropped out of CR).

The age factor was also mentioned by some participants. While to some, age was just a number, others felt it negatively affected their strength, as well as their desire to make an effort. For example:

"It does not matter if you are old or young, and there is no age limit, old age or young age" (Noha, 64 years old; attended CR).
"No, no, no, on the contrary. Every year that passes, I feel as if I have grown 5 years older" (Sameerah, 60 years old, did not attend CR).

The above quotes demonstrate the difference of opinion between the participants regarding the perceived limitation of age. Despite Noha being older than Sameerah, Noha felt that age did not matter when someone wanted to be physically active, whereas Sameerah was pessimistic, feeling that she was ageing quickly and did not think she could be more physically active in the future because of that. This could possibly be explained by the difference in access to CR. Noha had attended CR, where she received encouragement and support from CR staff, had the opportunity to exercise under observation, and felt reassured of her safety and progress, while Sameerah did not have access to CR and therefore had, at best, received abstract advice regarding exercise and PA.

5.3.5.3 Time

Lack of time was mentioned by many participants as a reason for not engaging in exercise and PA, which was partially discussed earlier in relation to the sociocultural influences 5.3.2.2). While some of the housewives felt that they did not have time to exercise, especially if they did not have a domestic worker to help with housework, the employed participants expressed having two jobs, housekeeping as well as their other full-time job, leaving them with little to no time for themselves. The following quotes are examples of participants discussing their daily routine and how to find time to be physically active:

“If I am busy, I have work at home. For example, I have cooking and laundry. This means that there is something at home that keeps me busy. This means that if I have work, you certainly do not have time to go out or exercise because you will be busy. But if I'm not busy at any time, I exercise” (Alia, 65 years old; attended CR, housewife).

“When I did not have a maid, I didn't have the physical, Hmm, strength to do so much. Like I had to really make an effort. But now it is much easier” (Dalia, 52 years old; did not attend CR, employed).

“Now the housemaids have come, so the housemaids have come, which means a great burden on the housewife and the daughters has been lifted” (Nawal, 45 years old; did not attend CR, retired).

The above quotes suggest that housework takes a lot of the participants’ time, irrespective of their employment status. However, some participants were able to manage their time and find the opportunity to engage in exercise and PA. Others needed the help of a domestic worker to finish the housework, with enough remaining time and energy to get physically active.

5.3.5.4 Psychological readiness

Psychological and emotional difficulties were also discussed by a few participants. Depression, sadness, excessive anxiety, and negative thoughts were reported as barriers that prevented some women from becoming physically active. For example:

“No, by God, I don’t do exercises, I do nothing but sit at home. You know, after the death of my husband, I had difficult circumstances” (Manal, 62 years old; dropped out of CR).

“I am also the type of person who worries a lot. I mean, I exaggerate things. I mean, my son is tired and I did not sleep because he has an appointment, you see. I am the type that a lot, this excessive anxiety also maybe has an impact.

You see, I don't worry about my health; I worry about those around me. This, this is what makes me tired" (Sameerah, 60 years old, did not attend CR).

"Things that make it difficult are the negative thoughts. Oh, I'm tired. I can't. I have a heart problem, so that I do not get up, this is the difficulty if you feel that it is difficult" (Farah, 38 years old; attended CR).

In these quotes, the participants described grief, anxiety and negative thoughts as emotional challenges hindering their ability to become and continue to be physically active. While Farah was describing negative thoughts as a potential difficulty she must overcome, Manal and Sameerah have let their psychological distress interfere with their ability to engage in PA and would possibly need psychological support to get physically active. Moreover, boredom, mood swings and a lack of desire or interest were also mentioned by some participants as reasons for not being physically active. For example:

"But it depends on the mood, as an effort it is easy for the body, but the mood is sometimes due to the living circumstances, the responsibility, and home, you know what I mean? Although we are supposed to allocate time for ourselves, but sometimes it is over, you psychologically shut down" (Malak, 53 years old, did not attend CR).

"I have no passion for doing sports. Maybe in the days ahead I will change, I don't know" (Sameerah, 60 years old; did not attend CR).

"No, it is not difficult, it is easy. But it depends, I am the bored type [I get bored easily]" (Danah, 63 years old; attended CR).

However, some participants chose not to succumb to these negative emotions and strived to control them. For example:

"I mean, what should I tell you? What prevents me sometimes is laziness, but I control it, thank God. I do not keep listening to myself that I am tired, I do not want to walk, I don't want to, you know?" (Abeer, 57 years old; did not attend CR).

The above quotes suggest that just like challenges to physical ability, psychological challenges are also perceived by some participants as temporary hindrances that could be overcome. Moreover, it is important to note the connection between some facilitators and barriers to the uptake of and adherence to exercise and PA. Women who perceive their physical or emotional difficulty as a temporary hindrance to be overcome are likely to have

willpower and determination to help them to undertake and adhere to exercise and PA until the physical and/or emotional issues resolve. Additionally, for women to fight the overshadowing effect of boredom on their ability to get physically active and persevere in their efforts, they need to enjoy the physical activity they perform.

In summary, some participants perceived certain elements of the physical environment, specifically the weather, transportation, and the cost of gym subscription, as disadvantageous to their decision to become and to maintain their physical activity levels. Others recognised negative influences, which included a lack of time, pain and physical symptoms, boredom, lack of interest and other psychological constraints that limited the women's ability to undertake and/or maintain exercise and PA regimens.

5.4 Adherence to and maintenance of exercise and PA

Overall, participants did not report any variation between the factors that affected their ability to uptake exercise and PA or adhere to them. For example, as discussed earlier in (section 5.3.5.1), many women spoke about exercising only when the weather was nice, suggesting that the hot weather may be challenging for some women to start getting physically active in the summer, and may also hinder the ability of others to continue with exercising after starting outdoor exercises during the nice weather. Nonetheless, a few participants discussed encountering challenges that prevented them from adhering to their prescribed or chosen form of exercise and PA, forcing them to discontinue their exercise and PA regimen. For example:

"No, I did not complete it [CR programme] because I did not have a car. I didn't have it" (Toqa, 47 years old, dropped out of CR).

"I can't go to the medics [cardiac rehabilitation], I can't. I am telling you because I went and got tired, rheumatism is what made me tired, I can't, and God, I wish I had continued with them. On the contrary, when I moved, I felt comfortable in my heart. I felt happy while moving. I wasn't panting or anything when I exercised, but my problem, as I told you, is rheumatism" (Manal, 62 years old; dropped out of CR).

"The gym went to, not many people went there, you know? So it was boring, so I didn't continue" (Sameerah, 60 years old; did not attend CR).

The above quotes demonstrate challenges to maintaining a physically active status that were faced by the participants. Two of the participants were referred to the CR programme but did not complete their prescribed sessions, whilst the third stopped going to the gym. The reported reasons for not adhering to exercise and PA were exacerbation of an underlying medical condition, transportation issues, and lack of enjoyment and boredom.

5.5 Inductive themes mapping to TDF

This study was underpinned by the theoretical domain framework (Cane et al., 2012) due to its extensive and in-depth approach to explaining the different possible factors that influence behavioural change (Mosavianpour et al., 2016; Phillips et al., 2015) (more in section 3.5.1). The data was analysed using framework analysis, whereby an inductive-deductive approach was used, and inductive analysis was carried out first (more in section 4.8). Next, the identified themes from this analysis were mapped to the corresponding TDF domains. The overarching themes and the corresponding TDF domains are presented in **Table 5.2**.

Table 5.2 Summary of the overarching themes and the corresponding TDF domains

Theme	Evidence	Corresponding TDF domain/s
Knowledge gap	Participants lacked knowledge and understanding about what is considered the characteristic of the physical activity that is safe for them to undertake while being advantageous toward their cardiac health. Participants were unaware of the specific recommendations of physical activity and/or exercise post-diagnosis of coronary artery disease. Despite acknowledging that exercise and/or physical activity are important for cardiac health, participants' knowledge about the physical activity that is suitable for their condition is limited and lacks the necessary details regarding the type, intensity, frequency and duration of exercise and PA.	Knowledge.
Religious and cultural influences	The Islamic religion's encouragement of exercise and PA was positively expressed by participants. However, Saudi women gave less priority to being physically active compared to housework and social obligations. Saudi women also reported difficulty in developing the habit of exercising due to a lack of exercise culture during their early childhood years, which meant they were not brought up to engage in physical activity. This created challenges for Saudi women who were diagnosed with CAD to be physically active, i.e. a lack of previous history (forming a habit) of physical activity.	Social influence, Social and professional role, and identity, intention, emotions.

Encouragement and support to undertaking and maintaining exercise and PA	Participants' expression of family support was overall positive in varying degrees. However, participants who attended cardiac rehabilitation and had contact with physiotherapists and cardiac rehabilitation specialists appreciated the level of support and encouragement they had received, while those who did not attend cardiac rehabilitation felt that they had not received enough education, encouragement and support from their treating physicians (cardiologists).	Social influence and reinforcement.
Facilitators for engaging in and maintaining exercise and physical activity	Saudi women's perception of the benefits associated with physical activity positively influenced their willingness to take up and continue to undertake physical activity. The overall health improvement, enjoyment and losing weight were expressed by the participants as advantages of being physically active and, thus, along with willpower and determination, were reported as positive motivators for being physically active.	Knowledge, Beliefs about consequences, Intention, Goals, Optimism, and Emotions.
Barriers to undertaking and maintaining exercise and physical activity	Certain elements of the physical environment, specifically the weather, transportation and the cost of gym subscription, were reported as challenges to becoming physically active. Other reported factors were related to participants' physical abilities (pain and other symptoms), psychological readiness (sadness, lack of interest, boredom), and lack of time, all of which were stated to affect women's ability to undertake and/or maintain exercise and PA.	Environmental context and resources, beliefs about capabilities, skills, and Memory, attention and decision processes.

5.6 Conclusion

This chapter discussed the findings obtained through conducting semi-structured interviews with sixteen Saudi women diagnosed with CAD from two settings, with and without access to cardiac rehabilitation. The data were analysed using an inductive-deductive approach, which resulted in identifying five main themes and subsequent subthemes. The inductive analysis helped in identifying religious and socio-cultural factors that influenced the perception and attitude of women towards exercise and PA, thus corresponding with the first objective, while the deductive approach and mapping to TDF theoretical domain enabled identifying the barriers and facilitators for the uptake of and adherence to exercise and PA among Saudi women who have been diagnosed with CAD, and therefore answered the second objective. The next chapter discusses the findings identified from the analysis of the semi-structured interviews conducted with the HCPs responsible for the treatment and follow-up of Saudi women diagnosed with CAD.

Chapter 6 Findings Part 2: Healthcare professionals

6.1 Introduction

This chapter presents the findings related to answering the following research objectives:

7) To identify healthcare professionals' perspectives on the barriers and facilitators experienced by Saudi women, diagnosed with CAD, to the uptake of and adherence of exercise and PA.
8) To explore healthcare professionals' perceived role in promoting/encouraging and delivering exercise and PA programmes to Saudi women diagnosed with CAD.
9) To explore potential perceived changes to provided services/programmes that could improve the uptake of and adherence to exercise and PA among Saudi women diagnosed with CAD.

This chapter starts by providing a description of participant demographics and critically discusses the findings related to HCPs' general perception of the level of PA undertaken by Saudi women diagnosed with CAD. Next, the themes identified from data analysis are presented, discussed and mapped onto TDF domains. Supporting quotes from the interview transcripts are provided to support each theme and subtheme.

6.2 Participants demographics

Sixteen healthcare professionals responsible for the treatment and follow-up of Saudi women diagnosed with CAD agreed to take part in this study and were interviewed. Six HCPs were recruited from a hospital that offers a CR programme and ten HCPs from a hospital that did not provide CR services. The majority of the HCPs (n=9) interviewed were cardiologists. Other HCPs interviewed included physiotherapists (n=5) and cardiothoracic surgeons (n=2). Participant demographics are presented in Table 6.1. (More information about the recruitment of HCPs is provided in Sections 4.5, 4.6.1).

Table 6.1 Participants demographics:

Pseudonym	Profession	Nationality	Setting
Fatimah	Physiotherapy specialist	Saudi	Hospital 1*
Amin	Cardiologist	Saudi	Hospital 1
Ameer	Cardiologist	Saudi	Hospital 2**
Murtadha	Cardiologist	Saudi	Hospital 1
Wala	Cardiologist	Saudi	Hospital 2
Reem	Cardiologist	Saudi	Hospital 2
Wejdan	Physiotherapy technician	Saudi	Hospital 1
Fawaz	Cardiologist	Yemeni	Hospital 2
Nezzar	Cardiologist	Saudi	Hospital 1
Akram	Cardiologist	Egyptian	Hospital 2
Moayed	Physiotherapist and cardiac rehabilitation specialist	Saudi	Hospital 1
Majed	Cardiologist	Egyptian	Hospital 2
Nojood	Physiotherapy specialist	Saudi	Hospital 2
Bodoor	Physiotherapy specialist	Saudi	Hospital 2
Jamal	Cardiothoracic surgeon	Egyptian	Hospital 2
Fareed	Cardiothoracic surgeon	Pakistani	Hospital 2

* Hospital offers CR services

** Hospital does not offer CR services

6.3 HCPs' perception of the uptake of and adherence to physical activity among Saudi women diagnosed with CAD

There was a perception among the majority of doctors interviewed - cardiologists and cardiothoracic surgeons, that Saudi women who had been diagnosed with CAD and referred to them were generally physically inactive and physically deconditioned. In contrast, physiotherapists working in CR expressed more satisfaction with the current level of PA of Saudi women diagnosed with CAD. CR staff stated that the PA level differed from one woman to another, but the majority tended to respond well to the physiotherapists' instructions. For example:

"They [Saudi women] are deconditioned. They do not have anything [medical conditions], but they are just deconditioned. They do not do any physical activity, so once they climb one flight of stairs, they will complain [of fatigue/tiredness]" (Murtadha, cardiologist: Hospital 1).

"No, they [Saudi women] are not [physically] active. It's not meeting the recommendation for activity post-cardiovascular events" (Ameer, cardiologist: Hospital 2).

"I have seen here, the patients start to be, to focus on the exercise or changing their lifestyles after they reach a point that is, what I can say, Hmm, more serious to them, or to, to their health. Whenever they feel that, their case is very serious. They are convinced to start the programme or to continue that. But before this specific point, they cannot continue in any programme" (Fatimah, physiotherapist working in CR: Hospital 1).

The above quotes highlight differences between physicians' and physiotherapists' perceptions of and satisfaction with the levels of PA exerted by Saudi women, in general, and specifically post-diagnosis of CAD. Whilst doctors expressed concerns that Saudi women were not meeting the recommended levels for exercise and PA (WHO, 2024c), physiotherapists working in the CR clinic were more positive about Saudi women's uptake of exercise and PA. This might be attributed to the fact that most of the interviewed physicians were working in a hospital that did not offer CR services, and therefore had only seen women who did not have access to a CR programme or received practical support to exercise. CR attenders are likely to receive extensive health education about exercise and PA and consequently be more aware of the benefits of exercise and the risk of physical inactivity than those who did not attend CR. However, the few physicians working in the other setting expressed the same concern. Alternatively, this could be due to

physiotherapists having closer contact with Saudi women diagnosed with CAD in a setting designed to encourage individuals to exercise and, therefore, have seen more women respond well to instructions and become motivated to exercise.

6.4 Identified themes

Using a framework analysis approach, four themes were identified through data analysis of the semi-structured interviews conducted with the HCPs. The main themes and subthemes are presented in **Figure 6.1**.

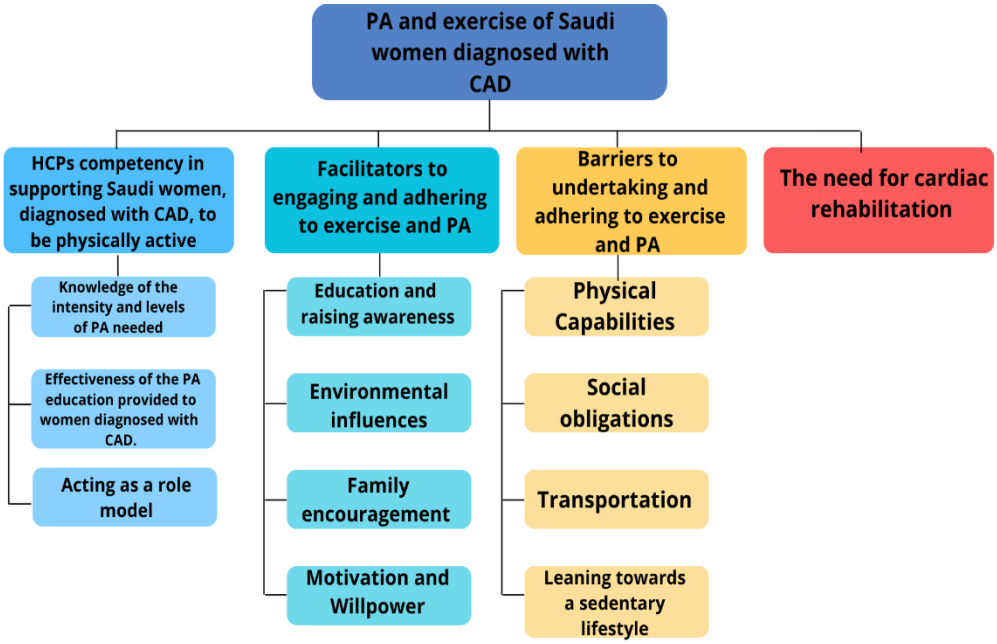

Figure 6.1 Themes and subthemes that were identified from the analysis of HCP's interviews.

6.4.1 Theme 1: HCPs' perceived competency in supporting Saudi women diagnosed with CAD to be physically active

To support women who have been diagnosed with CAD in engaging in exercise and PA, HCPs must be aware of the importance of exercise and PA for women who have been diagnosed with CAD and be well informed about the international recommendations for exercise and PA among individuals with CAD. Additionally, they must feel competent in their role in providing effective PA education to women and have the confidence to assume his responsibility.

Lastly, acting as a positive role model is important to encourage women who have been diagnosed with CAD to become physically active (Alahmed and Lobelo, 2019). This theme consists of three subthemes: (i) HCPs' knowledge of the intensity and levels of exercise and PA needed to improve cardiac health among Saudi women diagnosed with CAD, (ii) perceived effectiveness of the PA education provided to women diagnosed with CAD and (iii) acting as a role model.

6.4.1.1 HCPs' knowledge of the intensity and levels of exercise and PA needed to improve cardiac health

All of the HCPs interviewed recognised the important role that exercise and PA can play in improving the health outcomes of individuals who have been diagnosed with CAD and emphasised that Saudi women diagnosed with CAD must engage in exercise and PA immediately after receiving the diagnosis. For example:

“It [exercise and PA] is very important. First of all, it will improve weight reduction. It will improve the diabetic control. It will improve the hypertension control. It will improve the lipid control. It will improve the cardiac output and the cardiac circulation. And in addition to the physical effect, it has a social impact that means that to they will feel a bit healthier and happier if they are doing the exercise “ (Amin, cardiologist: Hospital 1).

“If the patient is diagnosed as [with] coronary artery disease, from day one, before the procedure, but she's stable, she can start the exercise directly” (Moayed, physiotherapist working in CR: Hospital 1).

In addition, HCPs were aware of the consequences of being physically inactive among individuals diagnosed with CAD and the adverse effects of physical inactivity:

“It [not undertaking Exercise and PA] will lead to more weight, more risk factors, worsening of diabetes, worsening of hypertension, more weight gain, more cardiovascular events, strokes, and more heart failure, more cancer, more poor quality of life or, worsen mental status and condition” (Ameer, cardiologist: Hospital 2).

“Number 1 that [not undertaking Exercise and PA] increases the incidence of thrombosis, whether venous or arterial thrombosis, decrease the fitness of the lungs which affects badly on the lungs, increases the body weight which is more impact on the heart, decreases the muscle power. Psychologically and mentally; more depression, the patient will feel helpless that he cannot walk or

cannot help. It is a load on the community, and the surroundings, the relatives, and family members. So not doing exercise it is extremely risky, honestly" (Jamal, cardiothoracic surgeon: Hospital 2).

The above quotes demonstrate that participants acknowledged the important role of exercise and PA in the secondary prevention of CAD's morbidities and subsequent complications. However, some participants were unaware of the specific recommendations for exercise and PA to be undertaken by individuals with CAD. Some physicians self-doubted their knowledge of the subject, whilst others chose not to follow the international guidelines in an attempt to customise the guidelines according to the women's conditions and needs. The following quotes exemplify this issue:

"The standard recommendation, 20 min daily, 5 days, sorry, 40 min daily for 5 days a week. 40 minutes of activity, moderate activity, 5 days a week. This is the standard recommendation for a patient who can tolerate [it]" (Amin, cardiologist: Hospital 1).

"For me, I recommend per day actually, I say first, almost, minimum, 3 hours to 6 hours per week" (Jamal, cardiothoracic surgeon: Hospital 2).
"20 min per day at least 4 days per week. I, the guideline, I don't remember. Is it true?" (Fawaz, cardiologist: Hospital 2).

Based on the above quotes, it is evident that some HCPs, mainly doctors, reported recommendations that were not congruent with the international guidelines, tending to underestimate or overestimate the duration of exercise and PA that women, diagnosed with CAD, should be aiming for per week to improve their health outcomes. The WHO recommends a minimum of 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity physical activity per week (WHO, 2020; WHO,2024c). Therefore, increasing the active time is acceptable when tolerated. However, if the women do not tolerate the increased duration, they are likely to feel frustrated and may quit exercising. On the other hand, some participants reported that they did not provide specific recommendations to their patients but instead instructed them to be physically active as tolerated. For example:

“No guidelines, actually, just see the status of each patient and recommend them. As much as they can you know, tolerate or comply with” (Fareed, cardiothoracic surgeon: Hospital 2).

“Actually, what we recommend to the patients, is whatever they can do, because when you make it more difficult, they will not do it at all. But if they can in general, 20 min per day, whatever they can do in their usual walk, no problem, that’s the minimum at least” (Wala, cardiologist: Hospital 2).

The above quotes suggest that some physicians do not share the minimum recommended levels of exercise and PA, in terms of intensity, frequency and duration, with their patients out of fear that some women will not engage in any PA if they perceive the minimum recommendation as difficult for them to achieve. Encouraging individuals diagnosed with CAD to exercise as tolerated, break the recommended duration into short sessions, and gradually increase the required intensity is likely to make it easier for individuals diagnosed with CAD to be physically active and motivate them to adhere to exercise and PA. However, this is still concerning as cardiologists and cardiothoracic surgeons are the sole source of information for women who do not have access to a CR programme, physiotherapists and CR specialists. Thus, if the physicians do not provide Saudi women, diagnosed with CAD, with sufficient and accurate information regarding the specific recommendations for them to follow, they are likely to retain inadequate knowledge of the subject and fail to gradually meet the international recommendations for improving cardiac health and wellbeing. Regarding the intensity of exercise and/or PA undertaken, all HCPs reported recommending moderate-intensity PA. However, their explanation of how women could distinguish moderate-intensity PA from light or vigorous-intensity PA was slightly vague. Words like ‘brisk walking’ and ‘jogging’ were used. However, none of the HCPs reported simple and objective instructions provided to women so that they were able to recognise the intensity level of their chosen type of PA, for example, the talk test, in which the ability to talk but not able to sing whilst undertaking the activity indicates a moderate-intensity level of the activity (HHS, 2018). For example:

“..if she is walking, walking is considered low intensity. But maybe jogging, for example, is considered moderate intensity. Swimming is also a moderate intensity. Treadmill, for example, like with more work, more than 4 METs is considered moderate intensity. So it depends on the exercise, which she wants to exercise” (Ameer, cardiologist: Hospital 2).

“I just asked them, they just walk the usual steps, that they like walking in the mall or no, they go for a walk, like they are meant to go to walk with fast steps” (Wala, cardiologist: Hospital 2).

The above quotes demonstrate that the explanations of moderate-intensity PA provided to women diagnosed with CAD by their HCPs are rather vague and open to interpretation. Informing Saudi women diagnosed with CAD about objective techniques like the talk test can help them choose an appropriate PA with the recommended level of intensity when they wish to exercise to improve their cardiac health and well-being.

In summary, on questioning, many HCPs were found not to provide Saudi women, diagnosed with CAD, with enough detail regarding the duration and intensity of the PA they should undertake weekly to improve their health outcomes. This is consistent with the findings from the women’s interviews, as a knowledge gap was identified as a theme (section 5.3.1).

6.4.1.2 Perceived effectiveness of PA education provided to women diagnosed with CAD

For HCPs to consistently provide effective PA education for Saudi women diagnosed with CAD, they need to acknowledge that educating these women is part of their role and be confident in encouraging them to become physically active (AlMarzooqi and Saller, 2022). HCPs acknowledged that they had a significant role in educating Saudi women, diagnosed with CAD, about the value of undertaking and adhering to an exercise and PA programme, by explaining the benefits of exercise and/or PA in primary and secondary prevention of CAD and encouraging women to incorporate them into their lifestyle. For example:

“Our role starts in the community first, and then in the hospital, this is my belief. We have to do campaigns maybe if it help people to increase awareness about the risk factors, or how to control the risk factors, from the beginning, how to, to keep away from any of the of this, diabetes and hypertension” (Moayed, physiotherapist in CR: Hospital 1).

“I think as a surgeon, what we say is more effective, so counselling them and showing them some images of patients who, not of patients but the surgical procedure itself, makes an impact on them. So, I think we can be good ambassadors in promoting physical activity” (Fareed, cardiothoracic surgeon: Hospital 2).

However, HCPs differed in the way they assumed the role of supporting Saudi women diagnosed with CAD to be physically active. For example:

“I'm asking in general. I don't go in details, to be honest. I should go in details and encourage more exercise or more walk. But I usually just ask a general question. Are you exercising, walking, etc? How many days? And I address the barrier sometimes when they have osteoarthritis. I told them just, you can use upper limbs. you can do swimming, in case you don't, you cannot walk or you cannot do treadmill exercises. So, I just address the barriers for not doing exercise, but in general, I don't go in details (Ameer, cardiologist: Hospital 2).

“As I told you, follow-up in the virtual clinic, we follow up with them at discharge, and phase 3 programme, we can also repeat the dose of the programme after discharge, after phase 2, this is as a way to encourage the patient more. Once we do the post-discharge test and we said it to the patient, you're, your level is good now or you're maintain your level so you can go up more. So what do you prefer? We discuss with the patient, what do you prefer from the exercise activity? Swimming you will go to the gym to do, aerobic exercise, or you have your activity in your home? And also, as you know, now you can download any application in your mobile, and they can give you a programme, a good programme for you, so continue on this, and we discuss with the patient, which suitable programme for her” (Moayed, physiotherapist in CR: Hospital 1).

The above quotes highlight the differences in the extensiveness of PA education and support offered to Saudi women diagnosed with CAD by cardiologists in outpatient clinics compared to physiotherapists in CR programmes. Cardiologists were found to ask briefly if the women exercised, what barriers they encountered and suggested solutions to these barriers, which may not be applicable or preferred by the patient. Physiotherapists specialised in CR, engaged in a comprehensive and detailed discussion of the different choices of exercise and PA available for their patients to be able to maintain or improve their cardiac health during their exercise sessions and virtual follow-up appointments. CR staff took into consideration the women’s tested physical capacity and their exercise preferences before prescribing an exercise regimen tailored to their specific needs. Prescribing exercises chosen by the trainees and compatible with their cardiopulmonary fitness increases trainees' safety and adherence to the exercise regimen (Teixeira et al., 2024). Moreover, some physicians reported that in some cases, they were not able to

assume the responsibility alone and needed the support of personnel specialised in cardiac rehabilitation to support them in this role. For example:

“It depends on the patients. Some patients, yes, I'm feeling confident if they are low risk; some patients, if it is a complicated high risk or having high for example a left ventricular dysfunction, it will be not easy to describe for them or prescribed for them exercise. It needs to be collaboration with a cardiopulmonary specialist or someone who is expert in the exercises” (Ameer, cardiologist: Hospital 2).

“I think a cardiac rehabilitation programme when there is a specific time and specific clinic and someone following up with the patients, and there is a whole team, doctor, pharmacist, someone from nutrition, someone from community health or public health and someone from the nursing, and administrative personnel responsible for patients’ files, so it like a whole system” (Akram, cardiologist: Hospital 2).

The above quotes suggest that complicated cases require an advanced level of experience and specialisation in cardiac rehabilitation that cardiologists felt they lacked. Other doctors expressed that the responsibility for risk factor control and secondary prevention of CAD should not fall solely on cardiologists and called for a multidisciplinary team approach to work with individuals diagnosed with CAD to promote their health outcomes. This was perceived similarly by physicians of the hospital that offer a CR programme and the one that does not. For example:

“[I wish to see] More centres for cardiac rehabilitation, more people who qualified for cardiac rehabilitation. I mean fully licensed, who are qualified and have degrees for example. Because I think the people who have degrees in this speciality are very rare. For example, in the eastern province, I don't know any cardiologists who have done a fellowship in cardiac rehabilitation” (Murtadha, cardiologist: Hospital 1).

Similarly, there appeared to be variation in HCPs' confidence levels regarding their ability to help and support Saudi women, diagnosed with CAD, to uptake and adhere to exercise and PA. Most interviewed HCPs stressed that women must be convinced of the need to change their behaviour and have the willpower and determination to implement changes in their PA levels. However, physiotherapists working in the CR programme, who supervise women exercising two to three times per week, appeared to have more confidence in

their ability to persuade women to become more physically active than cardiologists, who see women briefly in their clinic once a month or every couple of weeks. For example:

“Unfortunately, we are encouraging them [Saudi women, to undertake exercise & PA], but the response [from them] is very poor. It is not a matter of encouraging, it is a matter of attitude of the social, and our community [referring to lack of exercise as a social habit]. The attitude of ladies not to do an exercise, not to do even an effort other than simple household activity [means ladies do not want to exert any effort other than doing simple household chores]” (Amin, Cardiologist: Hospital 1).

“Yeah, if the patient commits with me, yeah, I have confidence to encourage the patient to believe on how to save themselves from coronary artery disease” (Moayed, physiotherapist: Hospital 1).

Physicians often discuss several issues with the women during their periodic clinic visits, which include medications, lab results, diet and exercise. Therefore, the time dedicated to discussing exercise and PA is limited compared to a whole CR session that is entirely dedicated to the discussion and practice of exercise and PA. For example:

“Yes, it very difficult. The response is difficult. It is not a matter of five minutes in the clinic will change the habit and the nature; it's difficult. It needs a programme and attendance, but a clinic visit five minutes you greet them, it is necessary to move, it is necessary to walk, [make a sound that indicates disapproval]. The information will not stick” (Fawaz, cardiologist: Hospital 2).

“Of course the clinic is busy, not every patient I will tell her, but this is what I emphasise to them. I always encourage daily activity. Summer, it's hot, go to the mall and walk there. Whenever this subject come up I will encourage the [physical] activity, maybe a lot of time [occasions] there will be no time [to discuss PA] but sometimes, if the patient ask I will tell her” (Nezzar, cardiologist: Hospital 1).

In addition to the limitation of the clinic time, outpatient appointments are not frequent enough to follow up on the subject compared to the standard CR sessions of three times a week (Simon et al., 2018). Therefore, cardiologists in the hospital with access to CR services gave some information and referred individuals diagnosed with CAD to CR, where they will extensively discuss exercise and PA habits with the CR staff. On the other hand, physicians working in the hospital that does not offer a CR programme suggested having other

specialists focus on educating women about the issue of exercise and PA so that individuals diagnosed with CAD can have ample time to learn about the topic. For example:

“Yeah, usually, post, I mean, MI [myocardial infarction] with post coronary artery disease care, we teach the patients, for example, regarding medications, regarding the diet and regarding exercise. And we usually do inpatient referral for cardiac rehabilitation department” (Murtadha, cardiologist: Hospital 1).

“we could advise the patient, but the outpatient appointments and the schedule of the visits will not be, I think, enough to communicate with the patient. So, if, if someone dedicated to apply the cardiac rehabilitation programme and concentrate on one issue like apply to physical exercise or minimizing the risk, and have, yeah, concentration on this issue, the benefit will be greater with pure physician treating cardiac issue. It has a greater impact” (Akram, cardiologist: Hospital 2).

Regardless of the availability of CR programmes, doctors stressed the need for the involvement of medical personnel, who focus solely on exercise and PA, in educating Saudi women diagnosed with CAD. This ensures women have enough time to understand the topic and ask questions, which is likely to increase the uptake of and adherence to exercise. Whilst this is available in hospitals that offer CR programmes through specialised physiotherapists, it is of concern that women treated in hospitals are not offered CR services and are only seen by physicians in outpatient clinics.

In summary, HCPs reported differences in their ability to deliver PA education to Saudi women diagnosed with CAD and in their confidence in assuming the educator role. Physicians interviewed believed that they should not be solely responsible for educating Saudi women, diagnosed with CAD, about the importance of exercise and PA, and stressed the importance of involving other staff specialised in exercise and PA education and training. Compared to physicians, physiotherapists specialised in CR appear to be more confident in supporting Saudi women, diagnosed with CAD, to engage in exercise and PA and were able to prescribe tailored exercises that suited the women's fitness level, as well as their preferences.

6.4.1.3 Acting as a role model

Another aspect of encouraging women diagnosed with CAD to become more physically active is leading by example, as HCPs are often viewed by the public as role models (Alahmed and Lobelo, 2019). HCPs discussed the possibility of their own physical activity levels influencing their patients positively, if they were indeed physically active or not. Whilst some participants acknowledged that HCPs are role models to whom the patients look up, others rejected the idea of having an impact on Saudi women diagnosed with CAD, and their decision to become more physically active. For example:

"When the patient sees you in a good shape, he is, he can, he is convinced to you with your words. He is trusting that you are telling the truth because he's seeing you as a model. For me, I'm, I'm trying to be this one. I'm trying to be committed to physical activity, so when I explain something to the patient, either regarding physical activity or dieting, he is trusting me because he is seeing me doing this to myself first. This is what I hope to, the patient also get this image" (Majed, cardiologist: Hospital 2).

"No. Not affect them [my exercising] actually, they have their own beliefs, they have their own thinking, they have their own circumstances, they have their own health problems for example the patient who is having osteoarthritis in knee, she will not do exercise whatsoever you will tell her. She will not walk even" (Amin, cardiologist: Hospital 1).

In the above quotes, HCPs who reported being physically active themselves comfortably acknowledged the possibility of influencing their patients to engage in exercise and/or PA. On the other hand, other HCPs, who did not report being physically active, belittled or denied the influence they exerted over their patients' PA levels. Interestingly, reflecting on the effect their PA habits have on individuals diagnosed with CAD, one HCP realised she needed to adopt a more physically active lifestyle to improve her well-being and that of her patients:

"Sometimes. I cannot say that I am ideal example for the patients. I have to encourage myself to encourage the patients" (Fatimah, physiotherapist: Hospital 1).

To conclude, some HCPs lacked the knowledge and/or confidence needed to support women diagnosed with CAD to become physically active. Others dismissed the importance of being a positive physical fitness example to whom individuals diagnosed with CAD can look up. Therefore, they did not feel that they could act as role models for Saudi women diagnosed with CAD.

6.4.2 Facilitators to engaging in and adhering to exercise and PA among women diagnosed with CAD

Understanding the factors that can motivate or discourage Saudi women, who have been diagnosed with CAD to take up and maintain exercise and/or PA enhances HCP's endeavours in supporting them to become more physically active (Garcia et al., 2022). Therefore, one of the objectives of this study was to explore HCPs' perceptions of the factors that could encourage Saudi women diagnosed with CAD to exercise and/or undertake and adhere to PA. This theme has four subthemes: (i) education and raising awareness, (ii) environmental influences, (iii) family encouragement and support, and (iv) motivation and willpower.

6.4.2.1 Education and raising awareness:

"*Knowledge is Power" (John Bartlett, 1919)*

HCPs stressed that educational attainment was an important factor influencing Saudi women's PA levels and their readiness to change behaviour and become physically active after a cardiac event. Participants felt that the more educated the women were, the more active they would be. In addition to women's academic achievement, HCPs also acknowledged the importance of exercise and PA-related health education that Saudi women received from their HCPs post CAD diagnosis. For example:

"Both. Social status and patient education, level of education and also the healthcare team education of the patient about the importance of cardiac rehabilitation and exercise post-MI and post being diagnosed with coronary artery disease" (Murtadha, cardiologist: Hospital 1).

"Well, definitely education. The more private schools like they do physical education class, but not all the public schools have it, I do not think [so]"
"Because the younger you start and the younger they get into exercise, and not just exercise, into sport. So like, if they get them into football, they get them into tennis. All of this is considered kind of like a aerobic exercise. That's all to do with running, jumping, all of this. So if they get, women into this at a younger

age and they're more likely to carry on when they get older" (Reem, cardiologist: Hospital 2).

In the above quotes, participants highlighted the impact of the women's level of education on their willingness to exercise and become more physically active. Reem specifically referred to learning physical education at school from a younger age, which she believed makes it easy for women to engage in PA when they are older. This echoes what some women mentioned during their interviews in Chapter 5 (section 5.3.2.3). However, this is not something HCPs can change. Thus, providing health education for women who have been diagnosed with CAD and raising general community awareness about the importance of exercise and PA for women after a cardiac event is an important part of HCPs' role in the secondary prevention of CAD. In the following quotes, participants discuss ways to raise awareness about the importance of exercise and PA:

"National programme, it raises awareness and educates the patients and the healthy people, through brochures, through scientific seminars, lectures in school and governmental institutes, universities and other gatherings, to raise the awareness, this is the first phase" (Akram, cardiologist: Hospital 2).

"Campaigns inside the hospital, campaigns on the malls about the effect and benefits of walking and doing exercise for female with coronary artery disease, and this in fact will have positive effect usually" (Jamal, cardiothoracic surgeon: Hospital 2).

HCPs emphasise the importance of educating individuals diagnosed with CAD, as well as the general community, about the importance of exercise and PA in promoting positive health outcomes after a cardiac event. Various means of health education were suggested, including community campaigns launched by the Ministry of Health or hospitals, lectures and seminars or brief health education sessions in hospital settings or shopping malls, and distributing printed health information, e.g. pamphlets and brochures. All of these suggestions, although feasible, cannot be achieved by one HCP alone and needs to be planned at an organisational (hospital or ministry) level. Mass media was also mentioned by several participants as a channel to be utilised for raising awareness and educating people about the importance of exercise and PA for individuals diagnosed with CAD. For example:

“Not only that, it should be from the media. It should be by internet, should be by and the TV channels. Not only this thing, not only just the form the hospital. I think should come from upper authorities. And there should be national programme to improve the attitude of people towards improving activity and doing exercise” (Amin, cardiologist: Hospital 1).

“Media and TV are playing a major role. We are only seeing a part of the society and not all society. Should, we should reach all, all individuals in society through the media” (Ameer, cardiologist: Hospital 2).

HCPs perceived mass media, including social media, internet and television channels, to have better reach for the whole community and, therefore, was considered a great tool for promoting the uptake of and adherence to exercise and PA among individuals diagnosed with CAD. However, other participants warned against the possible negative effects of inaccurate information that can be found, for example, on social media and unreliable internet websites:

“Yeah, it is important, especially that because the social media, you can find the right information and you can find the wrong information. So, it's important every now and then to emphasise on the right information. So, everyone should aware” (Wala, cardiologist: Hospital 2).

“The family commitments, in fact, till now, the family commitments and the personal fear of the patient and the wrong beliefs that walking or exercise is against cardiac disease. But to change, the major challenge is from the media, the social media and WhatsApp, and YouTube and the people, the very close friends who they advise their, each other don't walk, just rest your heart and do not do any exercise activity, this is our problem” (Jamal, cardiothoracic surgeon: Hospital 2).

The above quotes highlight two important points. The first point is that the misconception of the need to rest and avoid exercising after being diagnosed with a cardiac disease persists in Saudi communities. The second point is that HCPs believe social media can be a double-edged sword. Therefore, to eliminate the misconception of the risk of exercising and utilise the media effectively, women diagnosed with CAD, as well as the general community, should be referred to appropriate and trusted media channels to ensure they have access to reliable, evidence-based health information.

6.4.2.2 Environmental influences

HCPs discussed the role that the physical environment played in encouraging Saudi women, who have been diagnosed with CAD, to become more physically active. Participants reported that exercise and PA-promoting facilities were generally available and increasing in number in the geographical area. This was perceived as an important factor enabling people in general, and Saudi women, diagnosed with CAD specifically, to engage in exercise and PA. This point is exemplified in the following quotes:

"Look around, for example the number of gyms open for female are doubled now. Number 2, in the social wise, the municipalities are opening walking areas and physical activity areas whether in the corniche, inside the cities, in every city there is a walking region and exercise region. In every city, you will find places for physical fitness" (Jamal, cardiothoracic surgeon: Hospital 2).

"Actually, the women they have all the facilities to do that exercise. Any woman like to do exercise even at home she can do exercise at home. Nothing can prevent her. Some people are claiming that females are not freely going to street. They can do exercise at home, they can do exercise at the parks. Nobody can prevent anybody in our society" (Amin, cardiologist: Hospital 1).

The above quotes suggest that HCPs believed PA-encouraging facilities and exercise venues are abundantly available. Access to exercise-friendly spaces and the possibility to exercise at home create plenty of opportunities for anyone willing to become more physically active. Examples of the facilities mentioned included gyms and clubs, shopping malls, and walkways, e.g. the corniche. Another element of the physical environment that could promote or deter exercise and PA was the weather, which is discussed in the following quote:

"In general, the population in Gulf countries we are not active due to hot environment. Even me, even me I do not walk. The day before yesterday, we went to the corniche and my colleagues got up and moved and walked. I refused and lay on my back on the grass and told them; go and when you come back wake me up. It's hot" (Fawaz, cardiologist: Hospital 2).

The above quote illustrates that the weather in the region is too hot for people, men and women alike, to exercise outdoors. However, with the availability of indoor spaces for PA, participants dismissed the effect of weather as a barrier to engaging in exercise and/or PA. This point is highlighted in the following quotes:

“I ask them to go and walk in the malls in summer during daytime. In the winters, people usually get out and go to the Cornish, so weather is not much of a hindrance, if they want to walk, there are a lot of indoor places where they can walk” (Fareed, cardiothoracic surgeon: Hospital 2).

“Choose the suitable exercise for you. You want to go walking in the mall, now there is a lot of malls, they are air-conditioned and you can walk there. You want to walk on the beach, you want to bring a stationary bike in your home, you can do it, treadmill, you have a swimming pool, so you can use it, you have, you watch on the YouTube, aerobic exercises programme so you can do it. And it's not about the weather, If it's hot or not, sometimes, I mean we have only 3 months that's hot weather, not good to walk in the outside. And we have 9 months of good weather” (Moayed, physiotherapist: Hospital 2).

The above quotes underline that during the summer, indoor and air-conditioned spaces are suitable choices that allow women, diagnosed with CAD, to become more physically active. Brisk walking in shopping malls or even at home can help individuals diagnosed with CAD stay physically active. Gyms were also considered to be a good choice for indoor sports. However, one HCP discussed the importance of considering the cost and affordability of gym subscriptions:

“But on the level of doctors, we recommend opening more gyms, more clubs for practicing, with affordable prices. The problem is that all prices are very high, and this I think one of the major problems” (Majed, cardiologist: Hospital 2).

The above quote suggests that the cost of gym subscriptions may not be affordable for all women, and thus, availability alone will not encourage women to subscribe. Having government-run clubs available for individuals diagnosed with CAD free of charge or at a nominal price can encourage more women who have been diagnosed with CAD to join. Nonetheless, public outdoor areas are available during the nice weather, and shopping malls are air-conditioned and open for everyone, all year round. Moreover, women diagnosed with CAD are also encouraged by HCPs to get a treadmill or simply walk at home if they do not have the opportunity to go out. The following quote exemplifies this point:

“If we want to simplify it, anyone can do, to stay physically fit, at least 8,000 to 10,000 steps per day. So anyone can do it. Even if you have a small room, you will get dizzy, but you can do it if you want to. So we're talking about sophisticated things like gym, but if we want just to stick to the basics, they can, even if you have a small room, they can walk around, you can do it. And this is

really free. You just have to, you just have to use your legs, that's it. And now all the mobiles have programmes just to count the steps. So it's not really hard if you want to just the simple stuff, yes, it is there. You don't have to pay for the gym or anything" (Wala, cardiologist: Hospital 2).

The above quote speaks of the simplicity of being physically active and how it can be achieved at home without equipment. HCPs also accentuated willpower as the way to overcome any barrier to becoming and staying physically active, including the discouraging weather. For example:

"Some people now started to go to the gym or do like, dedicate gym room inside the home, so they don't go outside. So I believe that everybody can find solutions for them to suit their lives" (Wala, cardiologist: Hospital 2).

"The one who wants to do exercise, if the weather is hot, they can do it at home. They don't need to run. Actually, they can do aerobic. They can do at home in one room, they can do a lot of exercise but who is doing? Weather is not preventing anyone from doing the exercise" (Amin, cardiologist: Hospital 1).

The above quotes demonstrate the participants belief that if someone is determined to exercise, they will find a way to manage any barrier preventing them from exercising. Nonetheless, one participant mentioned the need for street designs to be walking-friendly to encourage people to walk, which is still absent in Saudi Arabia:

"We have to add the community, media, support each other, and support them by doing group exercise. By opening more clubs and more gyms, decrease the prices of these gyms. For the malls, to open the malls for longer times than before, just to, and even to do more special places for exercise, like, for example, cycling on the corniche, to design in the streets special areas for walking" (Jamal, cardiothoracic surgeon: Hospital 2).

In the quote above, the participant suggested, among other things, designing the streets in a way that facilitated commuting on foot safely. The lack of walking-friendly streets goes hand in hand with the lack of exercise culture in Saudi Arabia (discussed more in section 5.3.2.3). Therefore, it is important to consider the safety of pedestrians on the streets so that more people choose to travel small distances on foot instead of completely relying on cars.

In summary, HCPs viewed environmental factors as facilitators to being more physically active, stressing the abundance of outdoor and indoor exercise facilities. This is also seen in the findings from Saudi women's interviews, as

most participants confirmed the availability of outdoor areas to undertake PA. However, most Saudi women complained about the hot weather, transportation difficulties and the high cost of gym subscriptions, which made it difficult for them to avail themselves of such facilities. Therefore, while HCPs considered the physical environment as a facilitator to engaging in exercise and PA, it was generally perceived as a barrier by Saudi women diagnosed with CAD (see more in section 5.3.5.1).

6.4.2.3 Family encouragement and support

Social encouragement has been recognised in the literature as a facilitator to being physically active (Jones et al., 2021; Tunsi et al., 2023). All HCPs reported that the role of the family, in supporting women who have been diagnosed with CAD, was a motivator for these women to engage in exercise and PA. The following are exemplary quotes:

“The community and family. Family has a very important role to support the female doing more exercise, to encourage their mothers and their husbands. And it's very important, as a family member” (Jamal, cardiothoracic surgeon: Hospital 2).

“Also, so the family members encouragement also will make them also to practice more, to get encouraged not to be shy” (Akram, cardiologist: Hospital 2).

The above quotes demonstrate participants' acknowledgement of the importance of having family support in motivating women diagnosed with CAD to stay physically active. Consequently, some of the interviewed HCPs stressed the importance of raising family awareness of the importance of exercise and PA for individuals diagnosed with CAD. For example:

“If they, if one or 2 family members coming with the patient, maybe half of them can respond to their families. Yeah. So yeah, maybe the son or husband or daughter could encourage her to minimise her risk. If she will not respond to the doctor, she will respond to them” (Akram, cardiologist: Hospital 2).

“We ask [the patients] the first session to bring the family, to talk with them, this is from clinic, and to increase awareness, yes, we do campaign, as I said before, to increase the awareness of the community” “All the patients says, the family says you're a cardiac patient just now you did your procedure, so just

rest. And they take rest maybe 2, 3, 4 months" (Moayed, physiotherapist in CR: Hospital 1).

The above quotes highlight the importance of involving the family in the education sessions provided for women, post CAD diagnosis, and in explaining the role of exercise and PA in preventing further complications. Educating the family about the benefits of exercise and PA and the risk of physical inactivity for individuals with CAD is likely to increase their support of their loved ones' uptake of and adherence to exercise and PA and allay any misconceptions about individuals diagnosed with CAD needing to rest and avoid exercising.

6.4.2.4 Motivation and Willpower

"If you really want to do something, you'll find a way. If you don't, you'll find an excuse." (Jim Rohn)

HCPs perceived that the most significant facilitator for engaging in exercise and PA was motivation and willpower. If available, HCPs reported that willpower can be a strong motivator, or an obstacle, to taking up and/or adhering to an exercise and PA regimen. The following quotes exemplify this point:

"if they're not convinced about doing it [exercise and PA], nobody can convince them. I could only advise. So it's up to them at the end because it's their life" (Reem, cardiologist: Hospital 2).

"I think there is no excuse so far. If you will, if you have the wish, you will find the way to do it [exercise and PA]" (Majed, cardiologist: Hospital 2):

In the above quotes, participants acknowledged the importance of deciding to become more physically active and the need to have willpower and perseverance to follow through on their exercise and PA regimen. This mirrors findings from the Saudi women's interviews reported in chapter five, as "willpower and determination" was identified as a subtheme under facilitators to becoming more physically active (see section 5.3.4.2). However, HCPs perceived willpower to be a stronger facilitator than the other facilitators. For example, family support was discussed as a facilitator to being physically active among Saudi women diagnosed with CAD, however, lack of family support was not expressed as a barrier to engaging in exercise and PA. On the other hand, willpower was perceived to be essential, and thus, the lack of willpower was

reported as a barrier to the uptake of and adherence to a regular exercise and PA regimen.

6.4.3 Barriers to undertaking and adhering to exercise and PA

Participants discussed several challenges they felt Saudi women generally faced, including those diagnosed with CAD, when deciding to become more physically active. This theme is composed of four subthemes: (i) physical capabilities, (ii) social obligations, (iii) transportation, (iv) leaning towards a sedentary lifestyle.

6.4.3.1 Physical Capabilities

Most participants stressed the physical limitations that women diagnosed with CAD faced when deciding to become more physically active. Co-morbidities like osteoarthritis and knee pain were mentioned by several of the interviewed HCPs and were attributed to the advanced age of women when they first developed CAD, compared to men. The following quotes discuss this issue:

“But the main issue that I'm facing is, that knee pains, because usually they are post menopause, more than 60 years old, obese, they will have osteoarthritis and they are overweight. So they will say that we cannot walk, we are, now having knee pains, like, they, they have done, most of them” (Ameer, cardiologist: Hospital 2).

“They have their own health problems, for example, the patient who is having osteoarthritis in the knee, she will not do exercise whatsoever you will tell her. She will not walk even” (Amin, cardiologist: Hospital 1).

The above quotes suggest that osteoarthritis and other co-morbidities are very common among Saudi women diagnosed with CAD and are often perceived as reasons for not exercising. Moreover, age and obesity were frequently mentioned by participants as factors that affect women’s capability to exercise. Thus, in the following quotes, participants discussed how they address these issues and how they advise women who are advanced in age, obese and/or suffer from the aforementioned co-morbidities to stay physically active:

“Usually, they say we have knee problems, we have osteoarthritis, we cannot do exercises. I tell them okay, so you can use your upper limbs, your arms to do some exercise, you can swim. This is will help you. But usually they don't, they don't do it even when I instruct them” (Ameer, cardiologist: Hospital 2).

“They need to be reassessed by their rheumatologist. For example, they can adjust, for example, they usually use swimming for people who have osteoarthritis. So adjust their exercise according to their needs” (Murtadha, cardiologist: Hospital 1).

The above quotes illustrate that swimming was considered a suitable alternative to walking or jogging for women complaining of knee pain. However, unlike brisk walking, swimming required learning. Women may not necessarily know how to swim, and therefore, they were unlikely to consider the doctors’ advice. This highlights the need to prescribe an exercise that is suitable for the woman's underlying condition, skills, and preference, to encourage uptake of and subsequent adherence to a regular exercise and PA regimen. This was stated by one of the physiotherapists working in the CR programme:

“That's why I believe the most one that can do cardiac rehabilitation very well is the physiotherapist. Because they can solve all the physical, all the problem that maybe stand or interfere with the, any problem interfere with the physical activity. Sometimes patient come with rheumatoid, or osteoarthritis or old injury so we can't or maybe sometimes stroke, cause you know, there's a relation between coronary artery disease and stroke, especially the risk factors, so every time we put an exercise prescription, an exercise programme, we put an exercise specially for the patient according to their problem. So that's why I told you there's no standardised programme. For every patient, we design a programme, as they need” (Moayed, physiotherapist: Hospital 1).

The above quote implies the importance of a physiotherapist with a CR background prescribing suitable exercises for women diagnosed with CAD, especially those who have comorbidities that the cardiologists may not necessarily have exercise expertise to prescribe for.

6.4.3.2 Social obligations

Most participants perceived that one reason women in Saudi societies are not active is their commitments around caring for the family, which often leaves them little time for their own pursuits. The following quotes discuss this topic:

“but unfortunately most of our women, they say we don't have time for this. So, we recommend at least with the husband to have around like 30 min walking in a mall for example” (Fareed, cardiothoracic surgeon: Hospital 2).

“And another factor that I, that, I can include, that female patients have more responsibilities at their home so they cannot, they cannot continue the [cardiac rehabilitation] programme” (Fatimah, physiotherapist in CR: Hospital 1).

The above quotes demonstrate the general perception among HCPs that women in Saudi societies have little spare time to engage in exercise and PA. HCPs stated that women had more responsibilities at home, and they have observed and known women who missed their outpatient appointments and CR sessions due to family commitments. Being responsible for their family's welfare and prioritising them above their own needs is likely to limit their free time and, therefore, their ability to become more physically active. However, it is important to note that attending outpatient appointments and CR sessions involves going somewhere, which needs more spare time to commute and to attend the appointment or the exercise session. Thus, some women who have been diagnosed with CAD may not have time to attend the CR session in the hospital but will have just enough time to exercise at home. This point is clarified in the following quotes:

“Some of them, yes, they tell us from the beginning that, they have to do the exercise at home. They will, they will, follow the instructions without attendance” (Fatimah, physiotherapist in CR: Hospital 1).

“For me, I am trying to do my own gym inside the house so that I don't waste time with transportation” (Wala, cardiologist: Hospital 2).

These quotes suggest that some women who do not attend their CR sessions may have difficulty commuting to a distant place but may be able to find time that they can maximise by exercising at home rather than wasting most of it on the move. Also, the issue might be a lack of means for transportation rather than a lack of time (More in section 6.4.3.3). Therefore, it is important to fully understand what hinders the ability of women diagnosed with CAD to be physically active in order to address the issue. Additionally, one participant emphasised the need for flexibility in scheduling exercises when encouraging women diagnosed with CAD to be physically active, as it could be difficult to have a fixed daily exercise schedule:

“Because as we know, all of us we have responsibilities even if you said to me 30 min daily I'll tell you okay, 30 min, that means I will take a meal before, an hour, and then I will take shower after, half an hour, so it is 2 hours daily for the exercise. But you can make 3 or 4 or 5 days weekly. They can take a rest for

Friday because, you know, with their family, you are busy with your friends, so this is OK. They'll choose what they are preferring but stay active. This is what we have to do" (Moayed, physiotherapist in CR: Hospital 2).

The above quote stresses the necessity of providing women diagnosed with CAD with the liberty to schedule their physically active time according to their preference and what fits into their daily or weekly routine, as long as they are determined to remain active. Allowing them to schedule their exercise sessions flexibly around their other commitments will likely motivate them to commit to getting physically active as well as supporting adherence to a regular PA regimen.

6.4.3.3 Transportation

HCPs also discussed transportation difficulties as a barrier to being physically active. In the following quotes, HCPs confirmed that some Saudi women, diagnosed with CAD, had mentioned facing transportation challenges when trying to go to exercise-friendly places:

"When I tell them to go and walk inside the mall, they, some of them will say I don't have transportation to go to the mall" (Wala, cardiologist: Hospital 2).

"Some patients from the villages, for example, they say we do not have access, no one is taking us for the gym" (Murtadha, cardiologist: Hospital 1).

The above quotes show that for some Saudi women who wish to engage in exercise and PA outside of their homes, transportation might be a reason for their inability to achieve their goals. Women in Saudi Arabia were allowed to drive in 2018 (Al-Arabiya, 2017). Yet, many of the women interviewed in this study and female HCPs, spoke of women who could not drive and still depend on their husbands, children, or chauffeurs to drive them to places they need to go. Nonetheless, one participant believed only a small number of women faced transportation difficulties:

"I mean, we can say 10-20% do not have transportation, approximately, I mean, it's a small percentage" (Wejdan, physiotherapist: Hospital 1).

6.4.3.4 Leaning towards a sedentary lifestyle

Another barrier that the participants perceived leads to physical inactivity is leaning towards a sedentary lifestyle. Participants mentioned the tendency for resting, using available means of transportation for moving, and all other

luxuries and services made people, including women diagnosed with CAD, prefer comfort and being sedentary and dislike engaging in PA. The HCPs interviewed reported that a sedentary and less active lifestyle has become the social norm. The following quotes discuss this issue:

“I think currently the barriers are the sedentary life and the overall laziness, more than to be honest, the cultural issues” (Nezzar, cardiologist: Hospital 1).

“We are very lazy people because we have plenty of cars, plenty of luxury services. This has to be changed, but it is difficult in fact” (Ameer, cardiologist: Hospital 2).

The quotes above highlight the effect of technological advancement on people’s lives. All the machines and smart gadgets around us have made people embrace a more sedentary lifestyle. Therefore, HCPs stressed the importance of making the activity fun and interesting to make it more enjoyable for women, diagnosed with CAD, to engage in and continue without losing interest and feeling bored, e.g. group exercising.

“I think for some people, exercise is still, I mean, for them it's boring. So I think group activities sometimes, you know, will motivate some patients who are not motivated. I mean will improve compliance” (Murtadha, cardiologist: Hospital 1).

“Yeah, we started to do it, but this is still short, in short sample. But we piloted I mean. But, but I think, yeah, one, it will be very beneficial, if for example sometime we have 2 patients at the same time or 3 patients at the same time, so they see each other and they talk to each other about the problem and how they solve it and encourage each other. This is a good way. Sometimes there's negative things. But let's focus on the positive” (Moayed, physiotherapist: Hospital 1).

The quotes indicate the participants' agreement on the positive effects of group exercise in improving women’s adherence to an exercise or PA regimen and making the regimen entertaining, especially when it involves different forms of exercise, e.g. dancing. CR staff reported starting a small trial of group exercise to see what effect this had on their patients. The interviewed physiotherapist reported that group exercise appeared to be a good way to encourage discussion among individuals diagnosed with CAD, and to motivate them to become physically active. Indeed, the international research literature would support that group exercise and discussions have beneficial effects on cardiac

health (Cobb et al., 2006; Hare et al., 1995). Although the physiotherapist referred to the presence of some negative effects of group activities, possibly discouraging each other, if two or more participants are not motivated to get physically active. However, Moayed did not elaborate on the negative effects and chose to focus on the positive results, which suggests that the positive results outweigh the negative mishaps.

In conclusion, HCPs reported that they perceived that Saudi women's physical capabilities to exercise, social obligations, lack of transportation, a lack of motivation and the tendency towards a sedentary lifestyle hindered the ability of Saudi women, diagnosed with CAD, to become physically active.

6.4.4 The need for cardiac rehabilitation

The participants discussed their views on potential changes to the services/programmes currently provided that could improve the uptake of and adherence to exercise and PA among Saudi women diagnosed with CAD. All participants emphasised the importance of CR and the need to have multiple programmes in the region to serve all individuals who have been diagnosed with CAD. For example:

"If I said, if for a grade from 10 over 10, I said the 100 over 10. Of course, we must have cardiac rehabilitation. It is one of the major deficiencies in our community. Major. Especially that the incidence of coronary artery disease, you cannot imagine how the percentage and the number of cases with coronary artery disease. Cardiac rehabilitation can make a difference in a community like the eastern province or in Saudi Arabia in general" (Jamal, cardiothoracic surgeon: Hospital 2).

"Yes, 100%. If we can have a cardiac rehab programme, I think the compliance of physical activity will go up" (Fareed, cardiothoracic surgeon: Hospital 2).

"It's mandatory. I used to work in some hospital which has cardio-pulmonary rehabilitation. It's underutilised, but it's clearly recommended in the guidelines because it's improving, it shows clear improvement in mortality, improves the quality of the life, reduces the hospitalisation. So cardiopulmonary rehabilitation is mandatory" (Ameer, cardiologist: Hospital 2).

The above quotes indicate that the interviewed HCPs highly recommend having CR programmes in the region. Because there are only a few CR centres in Saudi Arabia that have recently been established, there were not many

suggestions for changes to the provided programmes. However, there were barriers to attending CR programmes experienced by individuals diagnosed with CAD. Two women who participated in this study (Manal and Toqa) attended the CR programme but dropped out. The women reported medical comorbidities (Rheumatism) and transportation difficulties as their reasons for not completing the CR sessions (see chapter 5, pages 110 and 112). But the HCPs did not recommend potential solutions to these barriers. Instead, they recommended some improvements to the CR clinic. For example:

“We think about increasing the size of the clinic, to accept more, more patients, and we would like to have a telemetry, to make, to make a group, we can name as group therapy. It's actually that's a group therapy. But, one of the patients, exercise together, 4 or 6 together, they can encourage each other, and they can see their vital signs in front of them” (Fatimah, physiotherapist working in CR: Hospital 1).

“I see, as service, for example, we have the machine that measures the heart rate and saturation, if it were more advanced, for example, as a screen being placed on the patient to monitor more. I mean, this is possible as a development for the clinic. I mean, we have, for example, the form that we created to take information from the patient; if it were electronic, it would be better than having it in paper form. We currently have it as a paper form in the clinic” (Wejdan, physiotherapist in CR: Hospital 1).

In the above quotes, the participants suggested expanding the clinic to accommodate more individuals diagnosed with CAD, and other small-scale changes to the CR services, which could improve the programme experience for Saudi women diagnosed with CAD. However, these suggestions do not address the barriers to attending or adhering to the CR experienced by those who were referred to the programme but did not enrol or complete their prescribed session. This is likely because they believed providing better machines is easier to implement than, for example, providing transportation services to and from the CR centre. However, one CR staff member who participated in the study reported not surveying the reasons why individuals referred to the CR programme were not attending and/or completing the CR programme or engaging in PA. The following quote highlights this issue:

“There is no checklist, there's no surveys. I think if you take surveys monthly for this type of patients, you can solve the problem, you can focus on the why they

are not active, is it about transportation? Is it not the, the belief of exercise? Is it the family support, and so no. I think we have to activate the surveys, activate the follow-up clinic like even if it's virtual, activate the group therapy, it is good, group discussion is good, and focus on the campaign, even if it's recorded on social media and so on. Yeah, we hope this will increase the physical activity". (Moayed, physiotherapist working in CR: Hospital 1).

The above quote underlines the need for conducting periodic surveys with individuals diagnosed with CAD to determine the effectiveness of the provided CR service and recognise areas for improvement. Moreover, one participant mentioned that existing CR programmes were underutilised. Therefore, referral to CR programmes was discussed with the participants to understand the referral strategies within and between hospitals:

"Actually, we are referring them from admission. When they are admitted, we are referring them, and if not referred during admission, we are referring them during OPD" (Amin, cardiologist: Hospital 1).

"Yeah, usually, post, I mean, MI with post coronary artery disease care, we teach the patients, for example, regarding medications, regarding the diet and regarding exercise. And we usually do inpatient referral for cardiac rehabilitation department" (Murtadha, cardiologist: Hospital 1).

The above quotes suggest that the CR referral strategy within the hospital, which has an established CR programme, was effective. Cardiologists confirmed referring all individuals diagnosed with CAD before being discharged from the hospital or during their first follow-up appointment at the latest. However, physicians working in the other hospital, which did not offer a CR programme, provided contradicting views about the possibility of referring CAD patients to other hospitals that provided CR services:

"No, we can refer but the problem, the referral centre should be, should accommodate all the population, because if you are going to say that this area only one rehabilitation centre, so it will not accommodate all the patients. That's why its better to be in each hospital. Because any hospital with cardiac patients, yes. Otherwise you have to refer most of your patients to others centres and then again it will be difficult for them to go and we will go back to the same obstacles, it will be useless" (Wala, cardiologist, Hospital 2).

"No, because they do not accept them" "Yeah, they've already got their own patients" (Reem, cardiologist: Hospital 2).

“Actually, I start, this is a personal issue from my side and from Mr.(…..), one of the good physical therapists in the Eastern region, and he is accepting our patients, on a personal basis (Jamal, cardiothoracic surgeon: Hospital 2).

The above quotes highlight a lack of referral of patients from other hospitals to available CR centres. Most participants did not refer their patients to existing programmes in the region for different reasons, including lack of collaboration between the hospitals, unavailability of vacancies in the existing programmes, and assumption of patient refusal due to the distance between the CR setting and their homes. However, the last quote refutes these reasons except for the lack of collaboration, as Jamal had personal connections with one of the CR specialists in the other hospital and thus was able to refer his patients regularly. Lastly, in the following quote, one HCP suggested ways to overcome the lack of CR programmes and ensure women diagnosed with CAD receive the utmost in education, support and care:

“We can hire dedicated cardiac rehab professionals, we can have part of the physical therapy programme, we can set up a regime for post-procedure cardiac rehab and refer patients to them immediately after the procedures” (Fareed, cardiothoracic surgeon: Hospital 2).

In the above quote, the participant proposed employing physiotherapists working in the general physiotherapy department to educate and support women diagnosed with CAD regarding the importance of PA and prescribe them with an individualised exercise programme. However, the physiotherapists, who did not have any working experience with CR programmes, felt unprepared for such a task. For example:

“If we don't have the sub-speciality we are referring, but I didn't refer a patient for, with cardiac problem to, to another hospital I mean, but if we did, don't have the sub-speciality to deal with some specific cases, we are referring them to another hospitals” (Nojood, physiotherapist: Hospital 2).

“I didn’t deal with any case. It was only one of the curriculum cardiopulmonary, but we didn't deal with any patient not as a student or intern or as a staff now”
“Everyone wants the best for the department, but as a cardiac subtitle, or let's say specialty, I think you have to have lots of steps before you deal with a patient who has a cardiac problem so it's critical. Why not? We can learn and implement it, but, for me, I will not deal with such cases, I mean, I think they are

critical. And every person has their field of Interest, and it is not my interest". (Bodoor, physiotherapist: Hospital 2).

The above quotes suggest that basic physiotherapy knowledge of exercise was not perceived to be enough for physiotherapists to deal with individuals diagnosed with CAD. Specific training on CR was required. Therefore, investing in CR staff training is essential even in hospitals that do not offer CR services, as long as they have a cardiology department and accept individuals diagnosed with CAD. This was confirmed by one technician with an associate degree in physiotherapy after an experience of more than a year working in the CR clinic:

"I really loved this field because many told me that cardio may be difficult because you did not study it. On the contrary, with experience, I have now had a year and a half of experience with cardio, and I love it, and I feel that I learned it quickly. I mean, even when I come to talk to the patient, I give them information. I mean, I feel like even if I did not come across this information before, but it's something easy. I mean, I felt that with practice, cardio would be easy" (Wejdan, physiotherapist in CR: Hospital 1).

In summary, HCPs believed CR to be essential for the secondary prevention of CAD, and all individuals diagnosed with CAD should have access to CR services.

6.5 Inductive themes mapping to TDF

Similar to the women's findings, the data collection and analysis for HCPs' interviews were underpinned by the theoretical domain framework (Cane et al., 2012). The approach to data analysis was inductive-deductive (Atkins et al., 2017; Creswell, 2013). The data was analysed inductively first, and then the identified themes were mapped to the corresponding TDF domains (see Table 6.2 Summary of the overarching themes and the corresponding TDF domains:

Table 6.2 Summary of the overarching themes and the corresponding TDF domains:

Theme	Evidence	Corresponding TDF domain/s
HCPs' competency in supporting Saudi women diagnosed with CAD to become more physically active.	Many participants lacked competency in supporting women diagnosed with CAD to be physically active. These participants did not share enough accurate information regarding the recommendations for exercise and PA for individuals diagnosed with CAD, and some lacked confidence to deliver effective education and therefore stressed the need to involve exercise and PA-specialised HCPs in the process of educating Saudi women diagnosed with CAD. Also, some participants denied having a personal effect on the level of PA undertaken by individuals with diagnosed CAD and rejected the concept of being a positive physical fitness role model for them.	Knowledge, Skills, Social/Professional Role and Identity, Beliefs about Capabilities.
Facilitators to engaging in exercise and/or PA	Learning what motivates Saudi women diagnosed with CAD to uptake exercise and PA helps healthcare professionals better support them to be physically active. HCPs' perceived health education and raising the awareness of women diagnosed with CAD as well as the community, as the most important facilitators for Saudi women diagnosed with CAD to be physically active. Other acknowledged facilitators include the availability of exercise and PA-friendly facilities in the environment, family support and encouragement, and, more importantly, self-motivation and willpower.	Knowledge, Beliefs about Consequences, Environmental Context and Resources, Social influences, Intention, Goals.

Barriers to undertaking exercise and PA	Participants acknowledged several barriers affecting the ability of Saudi women diagnosed with CAD to become physically active. Osteoarthritis, knee pain, and other hindrances to women's physical capabilities of being physically active were the most discussed. Other barriers include family and social obligations, leaving women little time for themselves, lack of transportation to exercise-friendly areas, and overall laziness and the tendency toward a sedentary lifestyle.	Beliefs about Capabilities, Intention, Goals, Social Influences, and Environmental Context and Resources.
The need for cardiac rehabilitation programmes	The participants emphasised the need for several cardiac rehabilitation programmes in the area so that all individuals diagnosed with CAD could access CR services. The process of referring Saudi women diagnosed with CAD to CR programmes in other hospitals was not clear. To compensate for the lack of enough CR programmes, some participants suggested involving the physiotherapists working in the general physiotherapy department in educating Saudi women diagnosed with CAD regarding Exercise and PA. However, the physiotherapists felt unprepared for such a task.	Environmental context and resources.

6.6 Conclusion

This chapter discussed the findings obtained through conducting semi-structured interviews with sixteen healthcare professionals (cardiologists, cardiothoracic surgeons, and physiotherapists) responsible for the treatment and follow-up of Saudi women diagnosed with CAD from two hospitals with and without a cardiac rehabilitation programme. The data were analysed using an inductive-deductive approach informed by the theoretical domain framework. Four main themes and subsequent subthemes were identified and mapped onto the relevant TDF domains. The following chapter presents the process of mapping the study's findings presented in chapters five and six into the behavioural change wheel to identify a potential intervention to promote PA among Saudi women diagnosed with CAD.

Chapter 7 Identifying a potential intervention to promote uptake and/or adherence of exercise and physical activity among Saudi women diagnosed with CAD

7.1 Introduction

This study followed the guidance of the MRC framework for the development and evaluation of complex interventions, which encourages the use of theoretical foundations to achieve behavioural change. Therefore, the findings of the qualitative study, presented in chapters five and six, were mapped into the BCW to identify intervention components to promote exercise and PA among Saudi women, diagnosed with CAD, which is the final objective of this study.

This chapter explains the process of developing a potential behavioural change intervention designed to promote exercise and PA among Saudi women who have been diagnosed with CAD. It starts by discussing how the MRC framework was used to guide the development of the intervention components (Skivington et al., 2021b). Next, the identified barriers to undertaking exercise and PA were integrated into the COM-B model and the behavioural change wheel (BCW) to identify appropriate intervention strategies for each barrier. After that, the Behaviour Change Techniques (BCTs) suitable for these intervention strategies were selected to bring about the change in the target behaviour, i.e. exercise and PA. Finally, the proposed intervention components are presented through the visual illustration of a logic model.

7.2 The MRC framework for the development and evaluation of complex interventions

There are a few interventions that can be considered simple (Craig et al., 2008). Most interventions are complex due to the multiple elements and components required for the intervention's success (Craig et al., 2008; Guise et al., 2014). A complex intervention is not necessarily complicated, (i.e. difficult to achieve), rather, its considered complex for having multiple layers of factors interacting together including the different intervention components, the multiple outcomes, the necessary expertise, the degree of flexibility in the desired behaviour and the need for organisational involvement (Craig et al., 2008; Skivington et al.,

2021b). Lifestyle modification often calls for implementing complex interventions. Encouraging Saudi women, diagnosed with CAD, to take up and adhere to exercise and PA requires careful consideration of all factors involved in achieving the desired goal. While the numbers of conducted educational sessions or distributed brochures are easy to document, other factors like women's motivation or the rapport with the HCPs and their effect on exercise and PA adherence are hard to assess. Moreover, the actual adherence to exercise and PA is difficult to ascertain without devices that can objectively measure the duration and intensity of the activity (e.g. pedometers, accelerometers, and electronic watches and applications that measure the steps and heart rate). Therefore, promoting PA among women diagnosed with CAD requires a complex intervention and aspects of complexity must be reflected upon to design an intervention that is likely to be effective. For example, HCPs should encourage women diagnosed with CAD to use electronic watches to monitor their exercise and PA and not to rely on subjective reports of exercise and PA. This enables HCPs to provide tailored feedback and advise, if necessary, on adjustments to the set goal.

Drawing on available evidence and behavioural change theories is known to increase the effectiveness of the designed intervention (Craig et al., 2008). Nonetheless, the designed behavioural change interventions may work in one setting and fail in another. The latest version of the MRC framework for developing and evaluating complex interventions focuses on the interaction between the intervention and its context (Skivington et al., 2021b). The sociocultural system in which Saudi women live can influence the applicability and impact of a given intervention. Therefore, the MRC framework was adopted as a guide to identify behavioural change intervention components that promote the uptake of PA among Saudi women diagnosed with CAD. Also, the latest version of the MRC framework (Skivington et al., 2021b), similar to the previous versions of the MRC's frameworks for developing and evaluating complex interventions, promotes the use of appropriate theoretical frameworks as the foundation for designing or identifying complex interventions (Skivington et al., 2021b; Craig et al., 2008). However, the newest framework stresses the role of theory as a core element in all phases of complex intervention research (Skivington et al., 2021b). Thus, using the TDF as a basis for data collection

and analysis, and the BCW guide in designing behavioural change intervention, fits well with the MRC guidance (Skivington et al., 2021b; Michie et al., 2014a; Cane et al., 2012).

The MRC guide (2021b) consists of four phases: development or identification of the intervention, feasibility, evaluation, and implementation (Skivington et al., 2021b). The process is iterative, and core elements of context, programme theory, financial resources, engagement of stakeholders, key doubts or issues, and the need for modifying the intervention should be reconsidered in every phase. For this study, only the first phase of the framework, identification of the possible intervention components through the BCW guide, was undertaken. The intervention components will be a provisional plan which will need further development with relevant stakeholders in a subsequent study. Through discussion with stakeholders and policy makers, the intervention components will be prioritised with consideration of the other core elements, e.g. financial resources, and the need for modification of the plan to be practical and applicable in the context of Saudi Arabia. However, this final step is beyond the scope of this PhD study but is intended to be undertaken in a future study after the completion of this PhD project. In addition, its imperative to draw from existing literature to reduce the complexity of the intervention.

7.3 Using the BCW to identify intervention components appropriate for achieving the desired behaviour change

7.3.1 Understanding the behaviour

To change a given behaviour, it is imperative to understand the behaviour in question and identify the desired change. This study was underpinned by the TDF, which is regarded as a more detailed version of the COM-B model (West et al., 2020). The latter is also connected to the BCW and is considered a first step in the BCW framework for understanding behaviour. Thus, information collected and analysed using TDF-informed tools fits smoothly into the COM-B model and BCW (More details about the TDF, COM-B, and BCW can be found in 3.5.1, 3.5.2, and 3.5.3 respectively).

According to the BCW (2014a), four steps to understanding the target behaviour should be undertaken:

1. Define the problem.
2. Select the target behaviour.
3. Describe the target behaviour in great detail.
4. Identify what needs to be changed to achieve the behavioural change (Michie et al., 2014a).

By defining the problem, the researcher clearly describes the behaviour that needs to be changed and who needs to change it, i.e. the target population. Next, the researcher should specify what the target population needs to do to achieve the desired behaviour. Subsequently, a detailed description of the target behaviour is developed, which clarifies how the target population should perform the target behaviour and what support is needed for them to achieve it (e.g. education, resources). Additionally, describing the target behaviour in detail makes the intervention easily reproducible in other similar settings. Lastly, the researcher selects possible solutions to be implemented to help the target population achieve changes in the target behaviour. This last step should be based on theoretical or research foundations that associate these potential solutions with the desired outcome (Skivington et al., 2021b; Michie et al., 2014a). Therefore, using the BCW, which is based on psychological theories that have been useful in changing modifiable behaviour, increases the likelihood of achieving the desired outcome(s). The BCW's four steps are applied to the problem of lack of exercise and PA among Saudi women diagnosed with CAD in the following sections (7.3.1.1-7.3.1.4) to identify intervention components to promote PA among Saudi women diagnosed with CAD.

7.3.1.1 Step 1: Defining the problem in terms of the behaviour and the population involved

The problem to be addressed was the lack of exercise and PA among Saudi women, who have been diagnosed with CAD. Based on the research evidence, regular, moderate intensity exercise and PA are known to reduce CAD morbidity and mortality and improve the quality of life of individuals diagnosed with CAD (Vasankari et al., 2021; Anderson et al., 2016a). Therefore, an increase in the uptake and subsequent maintenance of exercise and PA by the aforementioned population group is desired.

7.3.1.2 Step 2: Selecting the target behaviour

The target behaviour is increasing the uptake of and adherence to exercise and PA by Saudi women diagnosed with CAD. However, this can be vague. The women may not know how to start exercising and how much exercise and PA is desired. Also, women may be unaware of the type of activity recommended. The target behaviour must be described in detail to ensure that appropriate solutions are chosen and the desired outcomes are achieved.

7.3.1.3 Step 3: Specifying the target behaviour in detail

In this step, the target behaviour is described in terms of what, who, what to do differently, where, how often and with whom. Regarding what needs to be performed differently, there can be several things that can lead to achieving the target behaviour. For our provisional plan, brisk walking was chosen based on the findings of the interviews conducted with Saudi women who have been diagnosed with CAD. However, other forms of moderate-intensity PA can be performed, e.g. Swimming, gardening, etc.

Table 7.1. Specifying the target behaviour in detail:

What is the problem?	Lack of exercise and PA
What is the target behaviour?	Increasing the uptake of and adherence to exercise and physical activity.
Who needs to perform the behaviour?	Saudi women who have been diagnosed with CAD.
What do they need to do differently to achieve the target behaviour	Undertake brisk walking (or any other form of moderate-intensity PA).
Where will they need to do it?	Anywhere (home, gyms, parks, etc.).
How often do they need to do it?	A minimum of 150 minutes per week.
With whom do they need to do it?	Alone or with an exercise companion/instructor.

7.3.1.4 Step 4: Identify what needs to be changed to achieve the desired behaviour - Linking the findings from the qualitative study to the COM-B model

After explicitly describing the target behaviour, reflections on what needs to be changed in the target population or the environment around them to enable them to achieve the target behaviour must be considered. Our behaviours do not occur in a vacuum, separated from the surroundings (context) (Michie et al., 2014a). Everyone's behaviour is affected by the context in which the behaviour occurs and other behaviours of the same individuals or others (Michie et al., 2014a). Therefore, for the target population to achieve the desired behaviour, it is imperative to recognise the factors that may affect the performance of the target behaviour as perceived by the target population themselves. Several barriers and facilitators to both the uptake and adherence to exercise and PA were identified through interviews with Saudi women diagnosed with CAD and their HCPs. Using the COM-B model, the barriers identified in this empirical study were linked to one of three elements: capabilities, opportunities, and motivation, all of which are needed for the behaviour change to occur. The COM-B elements are further classified into two sub-elements (more details in section 3.5.2). As discussed earlier, the themes and subthemes identified in this PhD study are TDF-informed. The links between each TDF domain and the elements of the COM-B model have already been established in previous research (Figure 7.1) (Atkins et al., 2017, p. 11), which was used to introduce the study data into the COM-B model.

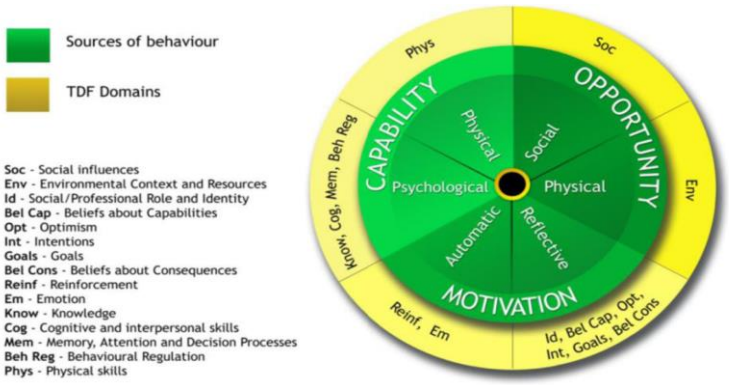

Figure 7.1 Illustration of how to link TDF domains to the COM-B elements (Atkins et al., 2017, p. 11)

In **Table 7.2**, 20 barriers and facilitators to the uptake of and adherence to exercise and PA among Saudi women diagnosed with CAD were identified from the empirical findings of this qualitative study. These factors are presented and linked to the COM-B model elements in Table 2. Identifying the COM-B element linked to a specific barrier or facilitator helps in understanding what

modifications are needed for a change in the desired behaviour to be seen. For example, some HCPs assumed that Saudi women diagnosed with CAD were physically inactive because they were unmotivated to take up and subsequently adhere to a regular exercise and PA regimen. However, the empirical findings from this study revealed that Saudi women perceived that they did not receive enough information regarding the characteristics of the PA (type, intensity, frequency, duration) to be performed per week. Thus, using the BCW guide, the factors affecting the uptake and adherence to exercise and PA, which were identified in the empirical study, were aligned with the relevant TDF domain and COM-B element. Identifying which of the COM-B elements need to be targeted increases the likelihood of the suggested solutions ameliorating the barriers to or enhancing the facilitators for both taking up and adhering to regular exercise and PA and consequently promoting regular exercise and PA regimen among the target population. In this potential intervention, the suggested solutions were derived from the findings of Saudi women diagnosed with CAD and their HCPs. For example, many women who participated in the study reported that rheumatism and knee pain were their reasons for not being physically active. The HCPs interviewed confirmed that exercise type and intensity can be adjusted to accommodate the women's needs, e.g. swimming as an exercise can be suggested as this is known not to strain the knees. Therefore, HCPs, particularly physiotherapists and exercise trainers, should support women diagnosed with CAD to exercise by discussing with them which exercises are compatible with their other health conditions.

Table 7.2 The identified themes and subthemes linked to the elements of the COM-B model

The themes and subthemes identified by women with CAD and their HCPs	TDF Domain	COM-B elements	Suggested solutions (s) to achieve the change and rationale
Theme: Knowledge gap (Saudi women diagnosed with CAD)			
Type and intensity of the physical activity Duration and frequency of exercise and PA	Knowledge	Psychological Capability	HCPs should provide Saudi women, diagnosed with CAD, with tailored information and advice on the type, intensity, duration and frequency of the PA to be undertaken. **Rationale:** Women who participated in the study stated that they did not receive information regarding the characteristics (the type, intensity, duration and frequency) of the PA they ought to perform weekly.
Theme: HCPs' competency in supporting Saudi women diagnosed with CAD to be physically active			
HCPs' knowledge of the characteristics (the type, intensity, duration and frequency) of exercise and PA needed for Saudi women diagnosed with CAD Effectiveness of the PA education provided to	Knowledge	Psychological capability	Chiefs of cardiology, cardiothoracic surgery and physiotherapy departments should arrange for periodic PA counselling training by experts in PA counselling and make it mandatory for all HCPs involved in the care of individuals, diagnosed with CAD, to attend. The training aims to improve both HCPs' knowledge regarding the characteristics (the type, intensity, duration and frequency) of the recommended exercise and PA programme for

The themes and subthemes identified by women with CAD and their HCPs	TDF Domain	COM-B elements	Suggested solutions (s) to achieve the change and rationale
women diagnosed with CAD.			women diagnosed with CAD, and their competency in providing effective PA education to encourage individuals diagnosed with CAD to adopt the desired behaviour. **Rationale:** Some HCPs who participated in the study were not sure about the characteristics (the type, intensity, duration and frequency) of exercise and PA recommended for women diagnosed with CAD, and others reported they sometimes lack the expertise to provide effective PA education. Coombes et al. (2021) suggest using the 5 As behaviour change framework (Assess, advise, agree, assist, arrange) to guide HCPs in providing PA counselling, especially for HCPs reporting a lack of time to address the issue of PA and exercise (Coombes et al., 2021).
Acting as a role model	Beliefs about capabilities	Reflective motivation	Chiefs of cardiology, cardiothoracic surgery and physiotherapy departments should encourage HCPs to be involved in campaigns dedicated to encouraging women diagnosed with CAD to engage in exercise and PA, to become exercise companions and role models. Also, the departments should arrange for walking groups involving HCPs and individuals diagnosed with CAD.

The themes and subthemes identified by women with CAD and their HCPs	TDF Domain	COM-B elements	Suggested solutions (s) to achieve the change and rationale
			Rationale: Many HCPs reported the need for PA campaigns, and one suggested that HCPs walking with the patients was a great way to encourage them to become physically active.
Theme: Religious and sociocultural influences			
Islamic influence	Social and professional role and identity	Reflective motivation	Not applicable. Islamic influence was perceived as a facilitator.
Women's cultural attitude towards being physically active	Social and professional role, and identity,	Reflective Motivation	During the clinic visit, physicians should advise women diagnosed with CAD to engage in PA and exercise by demonstrating the beneficial effect of exercise on cardiac health and overall well-being. E.g. improvement in the lab results **Rationale:** Women who participated in the study reported the perceived benefits of PA as facilitators to being physically active.

The themes and subthemes identified by women with CAD and their HCPs	TDF Domain	COM-B elements	Suggested solutions (s) to achieve the change and rationale
Lack of exercise culture during early childhood	Emotions	Automatic Motivation	Forming an exercise habit makes exercising an automatic response to certain environmental cues (Hagger, 2019). However, before developing a habit, the behaviour had likely started as goal-driven with conscious intention to perform the behaviour, which with repetitive performance became automatic process (Hagger, 2019). Providing incentives can motivate women to uptake exercise and PA, and with time, form the habit of exercising. During the clinic visit, physicians should encourage women diagnosed with CAD to engage in exercise and PA by providing incentives. e.g. reducing the dose of certain medications. **Rationale:** Some HCPs stated that informing individuals diagnosed with CAD about the possibility of reducing the dose of certain medications encouraged them to exercise.
Encouragement and support to undertake physical activity and exercise			

The themes and subthemes identified by women with CAD and their HCPs	TDF Domain	COM-B elements	Suggested solutions (s) to achieve the change and rationale
Social encouragement and support	Social influence	Social opportunity	HCPs should aim to raise family awareness of the importance of exercise and PA for women diagnosed with CAD by encouraging their attendance at the OPD appointments and CR sessions and involving them in PA education sessions. **Rationale:** Many women and HCPs spoke about the importance of family support and the positive effect of having family members attend the clinic session on encouraging women diagnosed with CAD to be physically active.
Healthcare professional education, encouragement and support	Reinforcement	Automatic Motivation	HCPs should provide support and positive reinforcement for women diagnosed with CAD to engage in exercise and PA. This can best be accomplished after providing HCPs with PA counselling training. **Rationale:** Women reported trusting HCPs to have their best interests and would give them the best advice.
Theme: Facilitators for engaging in physical activity and exercise			

The themes and subthemes identified by women with CAD and their HCPs	**TDF Domain**	**COM-B elements**	**Suggested solutions (s) to achieve the change and rationale**
Perceived benefits of exercise and PA	Beliefs about Consequences and Emotions	Reflective Motivation and Automatic Motivation	• HCPs should provide Saudi women diagnosed with CAD with information about the health benefits of exercise and PA on cardiac health and overall well-being • Physiotherapists and exercise trainers should aim to provide an enjoyable exercise experience for women diagnosed with CAD, e.g. choosing an exercise type that the women enjoy, group, as opposed to individual exercise. **Rationale:** Women reported the benefits they perceived from undertaking exercise and/or PA, namely health benefits, weight loss and enjoyment; in relation to the type of exercise and the social context as facilitators to being physically active
Willpower, motivation and Determination	Intentions and Goals	Reflective Motivation	• HCPs should provide Saudi women diagnosed with CAD with information about the health benefits of undertaking exercise and PA on cardiac health and overall well-being • During the clinic visit, physicians should advise women diagnosed with CAD to engage in exercise and PA by demonstrating the beneficial effect of exercise on cardiac health and overall well-being, e.g. improvement in the lab results

The themes and subthemes identified by women with CAD and their HCPs	TDF Domain	COM-B elements	Suggested solutions (s) to achieve the change and rationale
			• During the clinic visit, physicians should encourage women diagnosed with CAD to engage in PA and exercise by providing incentives. e.g. reducing the dose of certain medications. **Rationale:** Women reported the health benefits they could gain from undertaking exercise and/or PA as their main motivator, therefore, providing them with information about the positive effect of exercise and PA on cardiac health and demonstrating the effect exercising had on their lab results is likely to motivate them to start and continue to be physically active. Also, HCPs stated that informing individuals diagnosed with CAD about the possibility of reducing the dose of certain medications encourages them to exercise.
Education and raising awareness	Knowledge	Psychological capability	Not applicable. Besides the lack of knowledge regarding exercise and PA identified - addressed earlier (page 159), women's previous education and academic achievement cannot be changed.
Theme: Barriers to undertaking physical activity and exercise			

The themes and subthemes identified by women with CAD and their HCPs	**TDF Domain**	**COM-B elements**	**Suggested solutions (s) to achieve the change and rationale**
Physical environment	Environmental context and resources	Physical opportunity	The government should establish more exercise-friendly facilities at a community level that suit the needs of women diagnosed with CAD. E.g. parks, clubs and affordable gyms. **Rationale:** Some women spoke about needing nearby exercise facilities that they could access easily, especially indoor facilities and affordable gyms.
Physical ability	Beliefs about capabilities	Physical capability	Physiotherapists and exercise trainers should educate and train women, diagnosed with CAD, to perform exercises that are tailored to their physical capabilities and needs. **Rationale:** Some women, diagnosed with CAD, suffer from medical and comorbid conditions that prevent them from performing their usual exercises, e.g. brisk walking. HCPs suggest training these women to perform alternative exercises, which are tailored to their needs and do not aggravate their medical/comorbid conditions.

The themes and subthemes identified by women with CAD and their HCPs	TDF Domain	COM-B elements	Suggested solutions (s) to achieve the change and rationale
Time	Environmental context and resources	Physical opportunity	Physiotherapists and exercise trainers should educate and train women, diagnosed with CAD, to perform simple and effective exercises at home and break the daily exercise session into smaller 10-minute bouts, which makes them easier to accomplish. **Rationale:** Many women complained of a lack of time, preventing them from going out and exercising. In Bakhshayeh et al. (2021), the majority of the participants felt home-based CR saved their time, in addition to being simple and useful, with the expectation of receiving training from HCPs prior to performing exercises at home (Bakhshayeh et al., 2021).
Social obligations	Social/ professional role and identity	Reflective Motivation	During the clinic visit, physicians should persuade women diagnosed with CAD to engage in exercise and/or PA by demonstrating the beneficial effect of exercise on cardiac health and overall well-being. E.g. improvement in the lab results. **Rationale:** Women who participated in the study reported the perceived benefits of PA as a facilitator to being physically active.

The themes and subthemes identified by women with CAD and their HCPs	**TDF Domain**	**COM-B elements**	**Suggested solutions (s) to achieve the change and rationale**
Transportation	Environmental context and resources	Physical opportunity	• The Ministry of Health should provide community-based cardiac rehabilitation programmes. • The Ministry of Health, in collaboration with hospital administration, should offer transportation services to and from CR centres. **Rationale:** Many women complained of transportation difficulties preventing them from attending CR sessions or accessing exercise facilities. Offering transportation to hospital-based programmes and bringing CR programmes to the community is suggested to minimise the effect of the problem. Nathanail et al. (2022) concluded that community-based programmes, if offered in combination with hospital-based sessions (hybrid programme) increase participant attendance rate (Nathanail et al., 2022).
Psychological readiness/ Leaning towards a sedentary lifestyle	Emotions	Automatic Motivation	Physiotherapists and exercise instructors should aim to arrange for an enjoyable exercise experience for women diagnosed with CAD, e.g. choosing an exercise type that the women enjoy, group as opposed to individual exercise.

The themes and subthemes identified by women with CAD and their HCPs	TDF Domain	COM-B elements	Suggested solutions (s) to achieve the change and rationale
			Rationale: Women reported having fun and enjoying the exercise as motivators to being and staying physically active. HCPs suggested group exercising as a way of combining socialisation with exercise, which they believe provides enjoyment and social support to women diagnosed with CAD and will encourage adherence to exercise sessions. Group exercise is also an effective exercise modality suggested in the literature (Cobb et al., 2006).
The need for cardiac rehabilitation	Environmental context and resources	Physical opportunity	The government and the Ministry of Health should increase the number of hospital-based CR centres. **Rationale:** Many of the women who participated in the study were not referred to a CR programme or had access to CR services. HCPs working in the hospital setting that did not offer such services, emphasised the need for more CR centres to cover individuals diagnosed with CAD. The need for more hospital-based CR services in Saudi Arabia is also reported in the literature (Tunsi et al., 2023).

7.3.2 The feasibility and effectiveness, and priority of the proposed solutions

After linking TDF-informed themes to the elements of the COM-B model, 14 potential solutions to ameliorate the barriers and enhance the facilitators for engaging in exercise and PA among Saudi women, who have been diagnosed with CAD, were proposed in **Table 7.2**. These are potential intervention components based on the empirical findings of this study to promote PA among Saudi women diagnosed with CAD. However, some of these solutions may not be applicable or practical. Additionally, implementing all proposed interventions simultaneously may not be feasible or effective. Therefore, the APEASE criteria are suggested to help researchers select and prioritise the appropriate interventions for changing the target behaviour (Michie et al., 2014b). The APEASE criteria are a six-step guide presented in Table 7.3 (Michie et al., 2014b).

Table 7.3 The APEASE criteria

Acceptability:	Is this intervention going to be well-received by the target population and other involved parties (women diagnosed with CAD, healthcare professionals, hospital administrators, etc.)?
Practicality	Is it easy to implement the intervention in the intended context and with the available means and resources?
Effectiveness	Is the intervention likely to achieve the target behaviour?
Affordability	Can the financial resources necessary to implement the intervention be allocated?
Spill-over effect	Does the intervention affect, positively or negatively, other behaviours among the target group besides the target behaviour, or have any effect on other untargeted groups?
Equity	Is the intervention likely to change positively or negatively the difference between the privileged and unprivileged societal groups?

Michie et al (2014) guide focuses on the effectiveness of the intervention first, as there is no point in implementing an intervention that is unlikely to be effective. However, the guide helps intervention designers to be aware of the other criteria that could deem certain interventions unfeasible. Therefore, the

intervention plan will be shared with the stakeholders to discuss the intervention components and their applicability in the real-world setting using the APEASE guide, and prioritise the intervention components for implementation (Michie et al., 2014a). The involvement of the stakeholders in this step is imperative, for elements like acceptability, practicality, and affordability to be rated correctly and based on evidence. However, as mentioned earlier, this is beyond the scope of this PhD research study and, thus, will be undertaken in a future study post PhD journey.

Nonetheless, some of the solutions that many participants suggested were clearly not easily applicable in the 'real' setting or translatable into an intervention. For example, providing community-based CR programmes and offering transportation services from and to CR centres are overall promising interventions. However, they are difficult to achieve, as they require, in addition to time, multi-level organisational approvals and financial resources, which make them low on practicality and affordability scales. On the other hand, providing information to Saudi women diagnosed with CAD regarding the type, intensity, frequency and duration of PA is much easier to achieve. This can be implemented instantly and requires affordable resources without needing organisational involvement, thus making it a highly practical and affordable intervention component. Consequently, the four intervention components that require extensive financial resources and governmental or ministerial agreements, namely establishing more exercise-friendly facilities at a community level that suit the needs of women diagnosed with CAD, increasing the number of CR centres, establishing community-based CR programmes and offering transportation services to and from CR centres were excluded from the provisional plan of promoting PA among Saudi women diagnosed with CAD. Some of these solutions, however, are suggested in Chapter Eight (section 8.5)- implications of the research on policy and practice. Finally, it is important to note that the successful execution of some intervention components may only be feasible after another intervention component has been implemented. For example, women diagnosed with CAD need their HCPs to provide them with information regarding the type, intensity, duration and frequency of the PA to be performed per week. However, some HCPs need training on how to deliver effective PA counselling. Therefore, the latter component needs to be implemented for the first to be feasible.

7.3.3 Linking the relevant COM-B elements to intervention functions

Ten intervention components were included in the provisional intervention plan aimed at promoting the uptake of and adherence to exercise and PA among

Saudi women diagnosed with CAD. In a subsequent research project, these intervention components will be presented and discussed with relevant stakeholders to prioritise and further develop this provisional intervention plan for implementation in real-world settings. Depending on the associated COM-B element, each intervention component is linked to one or more intervention functions suggested by the behaviour change wheel (Michie et al., 2014a). The intervention functions, as described by Michie and colleagues (2014a), are wide-ranging strategies that can be used to change behaviour (Michie et al., 2014a). The BCW identifies nine intervention functions, namely: education, persuasion, incentivisation, coercion, training, restriction, environmental restructuring, modelling, and enablement (Michie et al., 2014a). Six intervention functions were found useful to be adopted for promoting PA among Saudi women diagnosed with CAD (Table 7.4).

Table 7.4 Identifying intervention functions according to the COM-B element

The intervention component	The COM-B element	The intervention function
HCPs should provide Saudi women diagnosed with CAD with tailored information and advice on the type, intensity, duration and frequency of the physical activity to be undertaken.	Psycho-logical capability	Education Enablement
Heads of cardiology, cardiothoracic surgery and physiotherapy departments should arrange for periodic PA counselling training by experts in PA counselling and make it mandatory for all HCPs involved in the care of individuals diagnosed with CAD to attend. The trainings aim to improve both HCPs' knowledge regarding the characteristics of the recommended PA and exercise for women diagnosed with CAD, and their competency to encourage individuals diagnosed with CAD to adopt new behaviour.	Psycho-logical capability	Education Enablement
Chiefs of cardiology, cardiothoracic surgery and physiotherapy departments should encourage HCPs to be involved in campaigns dedicated to encouraging	Reflective motivation	Persuasion

women diagnosed with CAD to engage in exercise and PA, to become exercise companions and role models. Also, the departments should arrange for walking groups involving HCPs and individuals diagnosed with CAD.		
During the clinic visit, physicians should advise women diagnosed with CAD to engage in PA and exercise by demonstrating the beneficial effect of exercise on cardiac health and overall well-being e.g. improvement in the lab results	Reflective Motivation	Persuasion
During the clinic visit, physicians should encourage women diagnosed with CAD to engage in exercise and/or PA by providing incentives. e.g. reducing the dose of certain medications.	Automatic Motivation	Incentivisation
HCPs should provide support and positive reinforcement for women diagnosed with CAD to engage in exercise and PA.	Automatic Motivation	Incentivisation
HCPs should aim to raise family awareness of the importance of exercise and PA for women diagnosed with CAD by encouraging their attendance at the OPD appointments and CR sessions and involving them in PA education sessions.	Social opportunity	Enablement
Physiotherapists and exercise trainers should aim to provide an enjoyable exercise experience for women diagnosed with CAD, e.g. choosing an exercise type that the women enjoy, group, as opposed to individual exercise.	Automatic Motivation	Persuasion Modelling
Physiotherapists and exercise trainers should educate and train women diagnosed with CAD to perform exercises that are compatible with their health condition.	Physical capability	Training Enablement

Physiotherapists and exercise trainers should educate and train women diagnosed with CAD to perform simple and effective exercises at home and break the daily exercise session into smaller 10-minute bouts, which makes them easier to accomplish and could likely improve adherence to a regular exercise and/or PA regimen.	Physical opportunity	Training Enablement

7.4 Identifying the Behaviour change techniques (BCTs)

The final step in designing an intervention is identifying the behavioural change technique(s). BCTs are the ingredients mixed to create an intervention (West et al., 2020; Michie et al., 2013). An intervention can be composed of one or more BCTs.

BCTs must be observable and can be replicated in other settings (Michie et al., 2014a). Clearly defining and describing the intervention in BCT components facilitates the implementation of the intervention by the different people involved and ensures the intervention can be accurately transferred and applied in other settings (Michie et al., 2013). Further information about the BCTs is provided in section 3.5.4. The BCTs taxonomy application lists the most frequently used BCTs for each intervention function. The intervention designer can then choose the BCT most suitable for the target behaviour. A list of the most frequently used BCTs for the six intervention functions chosen to promote PA among Saudi women who have been diagnosed with CAD is presented in **Table 7.5**, along with the rationale for choosing them. The BCTs chosen for the potential PA promoting intervention are shaded in green.

Table 7.5 Most frequently used BCTs for chosen intervention functions:

The intervention type	The most commonly used BCTs	Included/excluded/rationale
Education	5.3 Information about social and environmental consequences	Excluded. The overall social norms and lifestyle in Saudi Arabia promote physical inactivity as social gatherings usually include sitting, talking and eating meals high in fat and sugar and involve little to no movement for the whole time (Almaqhawi, 2022). The participants did not perceive any social implication of physical inactivity. Therefore, this BCT is unlikely to promote PA among the target population.
	5.1 Information about health consequences	Included. Providing information about the health consequences is relevant, applicable and useful.
	2.2 Feedback on behaviour	Excluded. Providing feedback on behaviour is irrelevant to educating women about the PA recommendations, but it will be included in the training interventions.
	2.7 Feedback on outcome(s) of behaviour	Excluded. Providing feedback on outcome(s) of behaviour is irrelevant to educating women about the PA recommendations, but it will be included in the training interventions.
	7.1 Prompts/cues	Included. Putting up posters promoting PA among women diagnosed with CAD in the cardiology clinic can remind HCPs to educate women about PA and facilitate delivering the information to the women as well as raising women's awareness of the importance of exercise and PA for their health and wellbeing.
	2.3 Self-monitoring of behaviour (HCPs)	Included. Adding a section about PA education to the patient OPD records for the HCPs to complete.

Persuasion	9.1 Credible resources	Included. Cardiologists explain to women diagnosed with CAD the effect of PA on their vital signs, oxygen saturation, and lab results, along with the possibility of reducing the number of certain medications/doses for physically active women
	5.3 Information about social and environmental consequences	Excluded. The participants did not perceive any social implication of physical inactivity and therefore, this BCT is unlikely to promote PA among the target population.
	5.1 Information about health consequences	Included. HCPs explain to women that being physically active improves their blood sugar and reduces their cholesterol levels, in addition to reducing the number of future cardiac events and hospitalisations.
	2.2 Feedback on behaviour	Excluded. Providing feedback on behaviour is irrelevant here, but it will be included in the training intervention.
	2.7 Feedback on outcome(s) of behaviour	Included. Providing feedback on the outcome of behaviour, e.g. HCPs should provide feedback regarding improved vital signs and lab results, which could persuade women to continue being physically active.
Training	6.1 Demonstration of behaviour	Included. Physiotherapists or exercise trainers demonstrate to women diagnosed with CAD how to perform individually prescribed exercises correctly.
	4.1 Instruction on how to perform the behaviour	Included. Physiotherapists or exercise trainers instruct women diagnosed with CAD on how to perform individually prescribed exercises correctly.
	2.2 Feedback on behaviour	Included. Physiotherapists or exercise trainers provide feedback to women diagnosed with CAD regarding their exercise performance.
	2.7 Feedback on outcome(s) of behaviour	Included. Physiotherapists or exercise trainers provide feedback to women diagnosed with CAD regarding their vital signs and oxygen saturation while exercising

	2.5 Monitoring of outcome(s) of behaviour without feedback	Excluded. Giving feedback encourages women diagnosed with CAD to continue exercising.
	2.3 Self-monitoring of behaviour (women)	Included. Instruct women diagnosed with CAD to record their PA at home using a smartwatch or a step-counting app.
Enablement	6.1 Demonstration of behaviour	Included in the training intervention.
	3.1 Social support (unspecified)	Included. Arrange for women in group exercise to be in pairs as exercise buddies to encourage each other to be physically active.
	3.2 Social support (practical)	Included. Ask the women's family (husbands and children) to encourage the women to exercise and to exercise with them.
	1.1 Goal setting (behaviour)	Included. Agree with women diagnosed with CAD on a daily walking goal or a few weekly sessions to reach 150 min. of moderate-intensity PA per week.
	1.3 Goal setting (outcome)	Excluded. There is no specific outcome as outcomes vary according to the woman's condition. The goal is to meet PA weekly recommendations.
	12.5 Adding object to the environment	Excluded. Not applicable. Adding objects that can enable women diagnosed with CAD to be physically active (e.g. exercise machines, smart watches, etc.) requires financial resources.

	1.2 Problem solving	Excluded. Impractical and time-consuming. Physicians cannot perform this with every woman diagnosed with CAD during the clinic time. It can perhaps be applied with women who are referred to a CR programme or to other specialised and less crowded clinics, e,g, health education clinics run by health educationists. However, for women diagnosed with CAD who are only followed by cardiologists in the OPD, this is unapplicable.
	1.4 Action planning	Included. Encourage women diagnosed with CAD to plan to engage in PA (e.g. brisk walking) at a particular time (e.g. after morning prayer) on specific days of the week to develop the habit of exercising.
	2.3 Self-monitoring of behaviour	Included in the training intervention.
	12.1 Reconstructing the physical environment	Excluded. Not applicable. Reconstructing the physical environment needs municipal and governmental involvement. Small-scale reconstruction of the hospital environment would not be helpful either, as different departments (labs, pharmacy) are already situated at a distance from OPD clinics, which requires individuals diagnosed with CAD to walk.
	1.5 Review behaviour goal(s)	Included. For women who are unable to meet the weekly PA recommendation, HCPs should encourage starting with less duration and aiming for a gradual increase with follow-up.
	1.7 Review outcome goal(s)	Excluded. There is no specific outcome as outcomes vary according to the woman's condition. The goal is to meet the weekly recommendations of PA (behaviour).
Incentivisation	2.2 Feedback on behaviour	Included in the training intervention.
	2.7 Feedback on outcome(s) of behaviour	Included in the training intervention.

	2.1 Monitoring of behaviour without feedback	Excluded. Giving feedback encourages women diagnosed with CAD to continue exercising.
	2.5 Monitoring of outcome(s) of behaviour without feedback	Excluded. Giving feedback encourages women diagnosed with CAD to continue exercising.
	2.3 Self-monitoring of behaviour	Included. Instruct women diagnosed with CAD to record their PA at home using a smartwatch or step-counting app and encourage them to self-reward with something they enjoy. For example, if the woman achieves her weekly goal, she can reward herself by booking a massage session.
Modelling	6.1 Demonstration of the behaviour	Included. HCPs should engage in PA initiatives and walk beside women diagnosed with CAD to act as role models for individuals diagnosed with CAD.

After analysing the most commonly used BCTs for each intervention type, BCTs found irrelevant to the intervention or the target population, impractical or inapplicable were excluded. 14 BCTs were found suitable for achieving the target behaviour (5.1 Information about health consequences, 7.1 Prompts/cues, 2.3 Self-monitoring of behaviour, 9.1 Credible resources, 2.7 Feedback on outcome(s) of behaviour, 6.1 Demonstration of behaviour, 4.1 Instruction on how to perform the behaviour, 2.2 Feedback on behaviour, 2.7 Feedback on outcome(s) of behaviour, 3.1 Social support (unspecified), 3.2 Social support (practical), 1.1 Goal setting (behaviour), 1.4 Action planning, 1.5 Review behaviour goal(s)).

7.5 Intervention's potential modes of delivery

After selecting the appropriate BCTs for the intervention, the last step is to decide on the mode of delivery (Michie et al., 2014b). BCTs can either be implemented face-to-face or remotely, individually or in a group. The choice of the mode of delivery must be practical, affordable and effective. Therefore, in a future research project, this step will be further discussed with the key stakeholders.

7.6 Development of a logic model

7.6.1 The purpose of using a logic model

The MRC guide for developing a complex intervention stresses six core elements that should be reflected upon during all four phases of developing an intervention (Skivington et al., 2021b). One of these core elements is to develop, refine and retest programme theory (Skivington et al., 2021b). The role of programme theory is to describe clearly how the developed or identified intervention is expected to realise the desired outcome, and thus increase confidence in the potential success of the intervention (Skivington et al., 2021b; Savaya and Waysman, 2005). However, programme theories are not always explicitly stated (Leeuw, 2003; Savaya and Waysman, 2005). To clearly present the programme theory, a relatively simple visual illustration is needed to help the reader understand what resources are going to be utilised by the programme implementers, the way these resources will be utilised, and what short and long-term outcomes are expected (Savaya and Waysman, 2005; Bisset and Gilman, 2016; Skivington et al., 2021b). A logic model framework is recommended to be used for this purpose (Savaya and Waysman, 2005; Skivington et al., 2021b). A logic model is a simple diagram that describes the sequence of changes the programme prompts and therefore functions as a road map that helps in envisioning the participants' progress toward the desired outcome (United Way of America, 1996; Kellogg Foundation, 2004).

7.6.2 Logic model structure

As discussed earlier, the intervention to promote PA among Saudi women diagnosed with CAD presented in this study is a provisional plan and will be further developed and enhanced with key stakeholder involvement, in the future, to fit the 'real-world' setting. Therefore, the logic model currently presented is a preliminary model following the basic logic model components, and further entities may be added after the discussion with the relevant stakeholders. The purpose of this initial model is to clearly explain and simply

illustrate the intervention components to the stakeholders (United Way of America, 1996). The simplest form of a logic model illustrates the intervention in four basic stages: Inputs or resources, processes or activities, outputs and outcomes (Funnell and Rogers, 2011; United Way of America, 1996), while some guides add a fifth component: impact (Kellogg Foundation, 2004). The basic form of the logic model simply describes, in a linear sequence of change, how the intervention is expected to lead to the desired outcome and thus was chosen to visually present the provisional plan to promote PA among Saudi women diagnosed with CAD to the stakeholders and policy makers.

Figure 7.2. The basic components of logic models (Funnell and Rogers, 2011; United Way of America, 1996).

In addition, there are three identified approaches to logic models to choose from: Theory-Approach Models, Outcomes-Approach Models, and Activities-Approach Models (Kellogg Foundation, 2004). Outcomes-based approaches focus on describing the outcomes expected from the programme in detail. The outcomes in these models are classified into short-term, long-term, and impact, according to a specific time frame. Therefore, outcome-based models are ideal for programme evaluation. On the other hand, activities-based approaches focus on describing the implementation process of the programme by drawing a map of how the resources are used to implement the planned activities. This approach is recommended for programme monitoring. Lastly, theory-based approaches focus on the underlying programme theory (Kellogg Foundation, 2004). Although all logic models are based on a theory, theory-based approaches demand that the theory of change used in designing the programme or the intervention be highlighted. A theory-based model's main purpose is to illustrate how and why the intervention is expected to work (Kellogg Foundation, 2004). Therefore, this approach is recommended for the planning and designing stage of the intervention, before the implementation and evaluation of the programme. For the aforementioned reason, a theory-based approach was considered the most appropriate for the current stage of proposing a provisional intervention to promote PA among Saudi women diagnosed with CAD. The logic model is presented in **Figure 7.3**.

7.6.3 Description of the Component of the Theory-Approach Logic Model

The theory-approach logic model consists of the four basic components of the basic model, in addition to the assumptions and impact (Kellogg Foundation, 2004). The different components are further described below.

7.6.3.1 Resources and Inputs

Resources or inputs describe all elements needed to be operated to implement the chosen interventions or programme (Kellogg Foundation, 2004). This includes financial resources, human power and any other hospital (organisational), community or governmental resources that are available to be used toward executing the programme. e,g. human resources and personnel, leaflets and brochures, rooms, clinics, and technical resources like laptops and mobile phones.

7.6.3.2 Activities

The activities describe the way the programme or the intervention employs the available resources to reach the desired outcome (Kellogg Foundation, 2004). In this study, the strategies proposed to promote exercise and PA among Saudi women diagnosed with CAD are based on the identified barriers to PA and exercise from the interviews conducted with the women and their healthcare professionals. These barriers were linked to various TDF domains, as the TDF informed the data collection and analysis for this PhD study. The TDF domains were later introduced into the COM-B model and the BCW to identify effective behavioural change interventions. Lastly, each intervention is linked to various behavioural change techniques to choose from. These BCTs are the strategies to be implemented to reach the desired behaviour (See **Table 7.5**).

7.6.3.3 Outputs

The remaining three components, outputs, outcomes, and impact are the result of the intervention or programme implementation. Outputs being the first one, signify the direct product of the applied strategies (Kellogg Foundation, 2004), and include types and numbers of the provided services to the target population.

7.6.3.4 Outcomes

Outcomes are the desired behavioural change in the target population. Outcomes are divided into short-term and long-term, with short-term outcomes

being achievable within one to three years and long-term outcomes within four to six years (Kellogg Foundation, 2004).

The outcomes of the PA intervention involve changes in knowledge and the practice of PA among women diagnosed with CAD, as well as the social attitude towards the importance of PA for individuals diagnosed with CAD.

7.6.3.5 Impact

Impact is the optimal and longest-term goal expected to be achieved within seven to ten years of implementing the intervention (Kellogg Foundation, 2004). The foreseeable impact of the successful implementation of this potential PA intervention is the reduction in cardiac events and mortality rates among Saudi women diagnosed with CAD, and the improvement of their overall quality of life. However, a subsequent study will need to be undertaken with the key stakeholders to further develop the intervention before implementation in a real-world setting.

7.6.3.6 Assumptions and external factors

In the assumptions field, the researcher or programme planner describes the status that has led to designing the intervention and the reasons why the chosen strategies are expected to work, thus highlighting the theory of change based on which the programme or the intervention was designed (Kellogg Foundation, 2004). As described earlier, the PA-promoting intervention components were derived from the use of TDF, COM-B model, BCW, and BCTs.

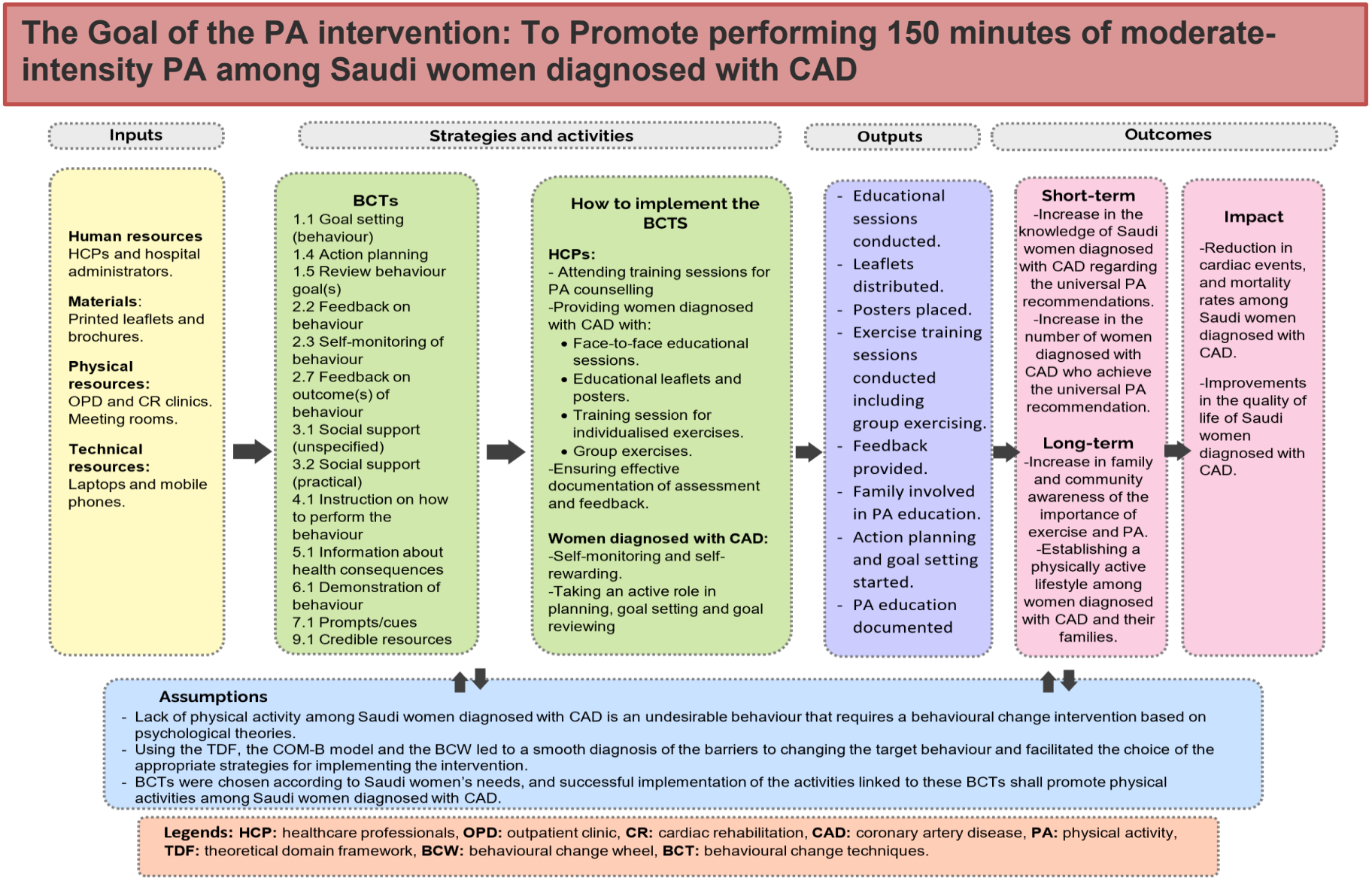

Figure 7.3. Logic model for a proposed plan to promote PA among Saudi women diagnosed with CAD.

7.7 Conclusion

This chapter has described the process of following the MRC guide for developing complex interventions to identify a potential behaviour change intervention to promote PA among Saudi women diagnosed with CAD based on the empirical study findings. The study findings were collected and analysed using the TDF and thus were easily introduced into the COM-B model to identify the elements that need to be addressed. Next, the BCW helped select the appropriate intervention functions and the BCTs were chosen as the specific strategies to implement these functions. The process was finally illustrated in a theory-based logic model, highlighting the programme theory behind the potential behavioural change intervention. The illustrated intervention, however, is provisional and will be further developed with the involvement of key stakeholders in a future study before being implemented in a real-world setting.

Chapter 8 Discussion

8.1 Introduction

This research project was undertaken to explore the attitudes, beliefs, barriers, and facilitators to the uptake of and adherence to exercise and physical activity among Saudi women diagnosed with coronary artery disease (CAD). To address this aim, six objectives were set:

1) To identify the attitudes and beliefs toward the uptake of and adherence to exercise and physical activity among Saudi women diagnosed with CAD.
2) To identify the barriers and facilitators to the uptake of and adherence to exercise and physical activity among Saudi women diagnosed with CAD.
3) To identify healthcare professionals' perspectives of the barriers and facilitators experienced by Saudi women diagnosed with CAD in taking up and adhering to exercise and physical activity.
4) To explore healthcare professionals' perceived role in promoting/encouraging and delivering exercise and physical activity programmes to Saudi women diagnosed with CAD.
5) To explore potential perceived changes to the provided services/programmes that could improve the uptake of and adherence to exercise and PA among Saudi women diagnosed with CAD.
6) To map the study's findings to the capability, opportunity, motivation and behaviour (COM-B) model, in order to identify intervention components and a potential intervention aimed at improving the uptake and maintenance of exercise and PA among Saudi women diagnosed with CAD.

The first two objectives were achieved through semi-structured interviews with Saudi women diagnosed with CAD. The third, fourth and fifth objectives were achieved through semi-structured interviews conducted with the HCPs treating and following up with Saudi women who have been diagnosed with CAD. The findings from both groups of participants were analysed using a framework analysis approach (Ritchie et al., 2014), informed by the TDF and presented in chapters five and six respectively. For the final objectives, the data informed by the TDF were introduced into the COM-B model, BCW and BCTs to identify PA-promoting intervention components and develop a proposed plan to increase the uptake of and adherence to a regular exercise and PA regimen among

Saudi women diagnosed with CAD. The plan was visually illustrated using a logic model (chapter seven, **Figure 7.3**)

This chapter discusses the study findings obtained from both Saudi women who have been diagnosed with CAD and their HCPs. It starts with a synthesis of the findings from both datasets, highlighting the similarities, explaining the differences and presenting the unified main findings. The main synthesised findings are then presented and discussed in light of the wider literature. Next, the study's contribution to the body of knowledge is discussed, including the policy and practice implications of the study's findings. Following that, the strengths and limitations of the study are discussed, and the future research recommendations are outlined. Research rigour, reflexivity and awareness of the researcher's stance, opinions and inclinations concerning the research problem throughout the research journey are documented and presented in this chapter. Finally, the plan to disseminate the findings and the concluding remarks constitutes the last part of this chapter.

8.2 Synthesis of the study's findings

The findings obtained from Saudi women diagnosed with CAD and their healthcare professionals provided a profound account of the Saudi women's experience with exercise and/or PA after being diagnosed with CAD, from the perspective of the two groups, which can be used to develop a behaviour change intervention designed to promote the uptake of and adherence to a regular exercise and PA regimen among Saudi women diagnosed with CAD (more in chapter 7). The purpose of synthesising the findings is to compare the findings between the two study groups, underline similarities and differences and summarise the main findings. This allows for in-depth contemplation and discussion of the meaning of the findings and how they compare to the existing literature, which will be presented in the following section. The data analysis was carried out separately for each group and was presented in chapters five and six. However, both datasets were obtained through semi-structured interviews guided by schedules informed by the TDF (Cane et al., 2012) and analysed using framework analysis (Ritchie et al., 2014). Framework analysis was used to analyse the data because it facilitates an orderly and systemic analysis of the data using the TDF domains as predetermined themes, while allowing flexibility to include any emergent findings and approach the analysis in an inductive-deductive strategy (Ritchie et al., 2014) (More details in sections

3.8 and 4.8). Similarly, the framework synthesis approach was considered appropriate to be used to synthesise, summarise and highlight the main findings of the study because it aligns well with the method of data analysis used to identify these findings, as framework synthesis originated from framework analysis and follows the same five steps, which were described previously in chapter four (section 4.8).

To synthesise the findings from the two datasets, the first step was familiarisation, which started during the data collection, management and analysis of the datasets. The second step was choosing the thematic framework, which was based on the TDF domains with flexibility to add emergent data to the framework (Brunton et al., 2020). The next step is indexing and charting. In this step, all the themes and subthemes from both datasets were written down and explained, and exemplar quotes were provided. Finally, in the last step, the similar themes from both datasets were linked together, compared and contrasted, and the new data synthesised and explained. The data is jointly displayed in **Table 8.1**. This table illustrates how the findings from both groups relate to each other, but does not present new findings. The new synthesised findings are discussed in relation to the existing literature in Section 8.3.

Table 8.1 Synthesis of the findings

Findings from interviews with Saudi women diagnosed with CAD	Related findings from the interviews with HCPs	Similarities and differences	Synthesis	Evidence
Key TDF Domain(s): Knowledge and skills				
Theme: Knowledge Gap. a. Type and intensity of the physical activity. b. Duration and frequency of the physical activity.	Theme: HCPs' competency in supporting Saudi women diagnosed with CAD to be physically active: a. HCPs' knowledge about the intensity and levels of exercise and PA needed. b. Effectiveness of the PA education provided to women diagnosed with CAD. c. Acting as a role model.	Though most Saudi women diagnosed with CAD acknowledged the importance of exercise and PA after being diagnosed with CAD, they lacked knowledge of the characteristics (Type, intensity, duration, and frequency) of the recommended PA per week. Most interviewed HCPs recognised this knowledge gap among women	**Knowledge gap:** Participants lacked knowledge and understanding of the characteristics (Type, intensity, duration, and frequency) of the PA they should undertake per week to be considered physically active. While acknowledging the importance of exercise and PA	*"No, they didn't tell me anything. I mean, when I asked doctor (...) she told me that if anything makes you tried, don't do it. I asked her, I told her do I walk? I mean I feel myself getting tired, but I don't know what the instructions for after the catheterization are" (Maymoonah, 72, did not attend CR)* *"No, they didn't tell me, but I finished with them (CR programme) and that's it, I mean it was maybe a month and something, I spent*

		diagnosed with CAD. HCPs expressed various reasons for their inability to provide sufficient PA education (lack of time, knowledge, and expertise), as well as their inability to act as a positive role model for these women.	post-diagnosis of CAD, participants' knowledge about the physical activity that is suitable for their condition is limited and lacks the necessary details regarding the type, intensity, frequency and duration of exercise and PA.	*there. Maybe a month and a half" (Dannah, 63, attended CR)* *"Of course the clinic is busy, not every patient I will tell her, but this is what I emphasise to them. I always encourage daily activity. Summer, its hot, go to the mall and walk there. Whenever this subject comes up I will encourage the [physical] activity, maybe a lot of time [occasions] there will be no time [to discuss PA] but sometimes, if the patient asks I will tell her" (Nezzar, cardiologist, hospital 1)*
Key TDF Domain(s): Social influence, Social and professional role, and identity				
Theme 2: Religious and socio-cultural influences.	Barriers to undertaking and adhering to exercise and PA:	Saudi women discussed the importance of being physically active compared to their	**Socio-cultural customs:** Saudi women prioritise social	*"The circumstances of the house and the housework. Sometimes I have circumstances, I go outside, sometimes my sister-in-law*

a. Islamic influence. b. Women's cultural attitude towards being physically active. c. Lack of exercise culture during early childhood.	Subtheme: Social obligations.	other responsibilities and stated that caring for the family and fulfilling social obligations take priority over exercise and PA. HCPs corroborated this and categorised social obligations as one of the challenges women face when trying to become physically active.	obligations and taking care of the house and family over being physically active. Also, the women reported difficulty in developing the habit of exercising, which is something they did not learn from a young age.	*had a baby, I mean, stuff. Sometimes my daughters also bring the children to me. Everyone has their excuse, what can one do?" (Danah, 63, attended CR)* *"Sure, sure. I mean getting used to something and learning at a young age is like engraving on stone. If we had got used to it [physical activity] from childhood, like prayer, how did we get used to it since we were children, the same thing" (Sameerah, 60, did not attend CR).*
Key TDF Domain(s): Social influences				
Theme 3: Encouragement and support to undertake exercise and PA.	Facilitators for engaging in and adhering to exercise and PA among women diagnosed with CAD:	Having supportive family and friends is important for women diagnosed with CAD to start and continue	**Social and professional support:** HCPs expressed social and family	*"They [my siblings] encourage me. We made a group [WhatsApp group] for us sisters and brothers, and*

a. Social encouragement and support. b. Healthcare professional education, encouragement and support.	• Family encouragement and support.	being physically active. Women discussed the various levels of support received from their families. HCPs also recognised the importance of social support and expressed it as a facilitator for engaging in and maintaining exercise and PA. The perception of HCPs' support also varied among the women. Many women were not satisfied with the support they had received from HCPs.	support to be a facilitator for being physically active. Overall, women spoke positively about receiving family support. However, professional support was more appreciated among those who attended cardiac rehabilitation than those who did not.	*we encourage each other" (Farrah, 38, attended CR).* *"They [my children] always tell me, oh, do this, do that, this exercise is good for this, this exercise is good for legs, this exercise is good for the heart, I mean, exercises, so they tell me about it and I do it" (Alia, 65, attended CR).* *"There is no one like [a physiotherapist's name]. She is a balm on wounds. If your intention is that you cannot, she encourages you" (Noha, 64, attended CR)* *"I don't know. They did not tell me anything, but I myself I walk and go. Maybe they told me and I forgot. For a long time I did not go to see my heart [to check on my heart at the doctor's clinic]"*

				(Khulood, 73, did not attend CR).
Key TDF Domain(s): *(group of TDF domains participants associate with facilitating PA)* **Beliefs about consequences, Intention, Goals, Optimism, Emotions, Knowledge, and Environmental context and resources**				
Theme 4: Facilitators for engaging in and adhering to exercise and PA. a. Perceived benefits of exercise and PA. b. Willpower and determination.	Facilitators for engaging in and adhereing to exercise and PA among women diagnosed with CAD: a. Education and raising awareness. b. Environmental influences. c. Family encouragement and support. d. Motivation and Willpower.	Saudi women and their HCPs expressed many factors as enablers for being physically active. Both groups agreed upon willpower. Women talked about the short, intermediate and long-term benefits of PA as important facilitators for engaging in and maintaining exercise and PA. Unlike HCPs, Saudi women did not perceive their educational status to affect their PA level.	**Facilitators:** Saudi women diagnosed with CAD spoke about the perceived benefits of PA (health benefits, enjoyment, and weight loss) along with willpower and determination as their main motivators to be physically active. HCPs also discussed the role of willpower, education and raising awareness,	*"Exercising gives you, as you say, support for the future, support for vitality, support for wellness, for health" (Nawal, 45, did not attend CR).* *"Because even before I did, before I get ill, I didn't like being fat, so if I got lazy I gain weight, so I go on a diet and walk. That's why I got the machine [treadmill]" (Malak, 53, did not attend CR).* *"The gym I went to, not many people went there, you know? So it was boring, so I didn't continue" (Sameerah, 60 years old;*

		Family support was discussed in a separate theme and was not labelled as a facilitator nor a barrier, as this varied among participants and their families. However, contrary to the HCPs, the women perceived the physical environment (hot weather, expensive gyms) as a barrier to exercise and PA.	and the physical environment (availability of walkways, corniche[1] and shopping malls) as perceived enablers for exercise and PA.	*did not attend CR).* *"Lack of, education, lack of awareness. I think is the main factor. If they're aware of the benefits of exercise I think a lot more people will start getting active" (Fareed, cardiothoracic surgeon, Hospital 2).* *"The percentage of obesity in the old generation, those who are about 50, more than the percentage in the youth, 20s and 30s. You did not notice this? I noticed it. The parents are overweight, and the children are, MashaAllah, all of them, they go to the gym and exercise. Education for sure" (Fawaz, cardiologist, Hospital 2).*
Key TDF Domain(s): *(group of TDF domains participants associate with hindering PA)*				

Environmental context and resources, beliefs about capabilities, social influences, intention, memory, attention and decision processes.				
Theme 5: Barriers to undertaking and adhering to exercise and PA. a. Physical environment. b. Physical ability. c. Time. d. Psychological readiness.	Barriers to undertaking and adhering to exercise and PA. a. Physical Capabilities. b. Social obligations. c. Transportation. d. Leaning towards a sedentary lifestyle.	Many factors were perceived by the two participant groups as barriers to being physically active. Both women and HCPs agreed on the physical ability (pain and comorbidities) as a barrier to engaging in exercise and PA. Social obligation and consequent lack of time is another barrier, which was also highlighted in a separate theme in women's findings, as it was stressed by many participants. Some women discussed psychological	**Barriers to being physically active:** Participants acknowledged several barriers affecting the ability of Saudi women diagnosed with CAD to become physically active. The physical ability and the existence of comorbidities was the most discussed. Certain elements of the physical environment; weather, transportation and the cost of a gym subscription were reported as	*"I have rheumatism. Rheumatism alone is difficult. It is all pain in the joints, so it is difficult for one to do 150 minutes a week" (Toqa, 47, dropped out of CR).* *"It's only the weather that hinders our efforts. It is it discourages us to go but you see when the weather is good everybody is out" (Dalia, 52, did not attend CR).* *"When I tell them to go and walk inside the mall, they, some of them will say I don't have transportation to go to the mall" (Wala, cardiologist, Hospital 2).* *"We are very lazy people because we have plenty of cars, plenty of luxury*

		capabilities and emotional stability as barriers. HCPs perceived the preference for comfort and leading a sedentary lifestyle as hindrances to women's ability to be physically active. Lastly, while women expressed the environment as a challenge to their uptake of PA, especially because of the hot weather. HCPs perceived it as a facilitator and believed many indoor settings are available for being physically active in hot weather. However, they discussed transportation issues	challenges to becoming physically active. Other reported factors included lack of time, participants' psychological status and their tendency toward rest and comfort.	*services. This has to be changed, but it is difficult in fact" (Ameer, cardiologist, Hospital 2).*

		which might prevent women from reaching these facilities.		
Key TDF Domain(s): Environmental context and resources				
	The need for cardiac rehabilitation	Most HCPs stressed the need for more CR centres to help women diagnosed with CAD achieve and maintain a physically active status. Women diagnosed with CAD, however, did not mention the need for CR, as those who did not have access to CR were unaware of the existence of such services.	**The need for cardiac rehabilitation services:** The HCPs emphasised the need for several cardiac rehabilitation programmes in the local area so that all individuals diagnosed with CAD could access CR services.	*"If I said, if for a grade from 10 over 10, I said the 100 over 10. Of course, we must have cardiac rehabilitation. It is one of the major deficiencies in our community. Major. especially that the incidents of coronary artery disease, you cannot imagine how the percentage and the number of cases with coroner artery disease. Cardiac rehabilitation can make a difference in a community like the eastern province or in Saudi Arabia in general (Jamal, cardiothoracic surgeon, hospital 2)".*

8.3 The main study findings in light of the existing literature

8.3.1 Knowledge gap and educational needs

Despite acknowledging the importance of exercise and PA for individuals diagnosed with CAD, the analyses found that Saudi women diagnosed with CAD were not aware of the universal recommendation of PA that women diagnosed with CAD must undertake. Not knowing what is recommended in terms of type, intensity, duration and frequency of PA means the women are unlikely to meet the recommendations for PA and to become physically active. Literature investigating PA knowledge, rather than the practice, is scarce (Tenbult et al., 2023). Tenbult et al. (2023) investigated the information needs of individuals who have been discharged from the hospital after having a cardiac event and found that 38.3% of the total sample and 36.2% of the women within the sample needed information about PA (Tenbult et al., 2023). The study also showed that 38% of the sample used the Internet to search for information regarding PA (Tenbult et al., 2023). This indicates that discharge education does not always fulfil the knowledge needs of individuals diagnosed with CAD. Another study investigated the educational needs of individuals with CAD over six months post-discharge and revealed that almost 70% of the sample needed education regarding exercise and PA at discharge; however, the percentage decreased to around 45% six months later (Svavarsdóttir et al., 2023). This highlights the importance of regularly educating individuals diagnosed with CAD regarding PA in every encounter with HCPs to improve the retention of knowledge.

The healthcare professionals in this study varied in their level of competency and confidence in delivering effective PA education for individuals diagnosed with CAD. A survey conducted on primary healthcare physicians in Saudi Arabia showed that the majority of the respondents acknowledged that promoting PA is their responsibility as physicians; however, only 21.8% had received appropriate training about PA counselling, and only 5.4% were knowledgeable about the PA recommendations (Alahmed and Lobelo, 2019). Unfortunately, this survey was limited to primary healthcare physicians, who are mainly general and family physicians, and did not include secondary HCPs such

as cardiologists, cardiothoracic surgeons, hospital nurses and CR staff. Also, no study targeting the cardiovascular team was found in the literature.

Svavarsdottir and colleagues (2023) stressed the importance of training HCPs to provide education and counselling starting during their undergraduate studies and continuing throughout their postgraduate and professional practice years (Svavarsdóttir et al., 2023). Moreover, while HCPs are viewed as role models among the public, only 27.1% of the physicians were physically active by achieving the weekly PA recommendation (Alahmed and Lobelo, 2019). The concept of being a role model was investigated in this PhD study. The participating HCPs had contradicting views of the influence their PA behaviour and physically active lifestyle had on the PA behaviour and lifestyle of individuals diagnosed with CAD.

Intervention components to fulfil the educational needs of Saudi women diagnosed with CAD regarding exercise and PA were suggested in the previous chapter (**Figure 7.3**). Provision of face-to-face educational sessions, distribution of leaflets, and placement of posters explaining the recommended PA types, intensity, frequency, and duration to be performed by women diagnosed with CAD in cardiology and CR clinics were recommended to increase knowledge and understanding on the desired behaviour and thus expected to promote PA and increase adherence to regular exercise and PA regimen among Saudi women diagnosed with CAD (Zwack et al., 2023).

8.3.2 Socio-cultural customs

The findings from the current study show that the choice of being physically active is greatly affected by the socio-cultural customs and habits of the Saudi population. Women in Saudi Arabia, whether staying at home or employed, often follow the traditional roles of house management. They are responsible for managing the house and caring for the family. For our participants, doing housework and attending to the family's needs takes priority over engaging in PA. Moreover, Saudi people live within extended families and thus, social obligations related to different affairs of the aunts, uncles and cousins can take up a lot of the women’s time. This supports the findings of previous studies, as the participants agreed that taking care of the family and performing household duties is prioritised over engaging in PA and consuming a healthy diet (Donnelly

et al., 2012; Tunsi et al., 2023; Farahani et al., 2008). While Farahani et al. (2008) stated that the participants were ignorant of their health needs, in Tunsi et al. (2023), the participants expressed being socially pressured to fall into the traditional roles and put the family needs first and before their own (Farahani et al., 2008; Tunsi et al., 2023). Other sociocultural influences on undertaking PA were reported in the literature, including prohibiting Arab women from exercising in public or requiring a male companion to go to exercise facilities (Rio and Saligan, 2023; Donnelly et al., 2012). This, however, was not mentioned by our participants as the majority felt that they could be physically active in public, wearing what they considered appropriate Muslim women's attire. This may be because the preferred PA of most of the participants in this study was walking. Walking is considered socially acceptable as it does not require women to bend or wear tight clothes in public. Also, traditional norms and social dynamics are continuously changing in any part of the world. Certain aspects of the social and cultural beliefs in Arab and Muslim countries have changed over the recent years (Donnelly et al., 2012). However, some families welcomed the change while others, especially older generations, opposed the change and preserved traditional values (Donnelly et al., 2012). As a result, Donnelly et al. (2012) reported that some participants resisted the negative influence of the traditional cultural norms on their lifestyle, expressing more independence and taking responsibility for their health.

The influence of the religion of Islam on exercise and PA was perceived to be positive overall. Study participants viewed Islam as encouraging individuals to be physically active. This also corroborates the findings of some previous studies, as the participants in Donnelly et al. (2012) and Aljayyousi et al. (2019) stated that the teachings of Islam and the holy Prophet Mohammed encourage them to exercise and adopt a healthy lifestyle (Aljayyousi et al., 2019; Donnelly et al., 2012). On the other hand, other studies concluded that religion does not play a role in motivating people to engage in PA, or that the Islamic values of modesty and wearing loose garments have negatively affected Muslim women's ability to be physically active outdoors (Noh et al., 2023; Tunsi et al., 2023; Ansari et al., 2017). As mentioned earlier, the participants of this PhD study were mostly middle-aged to older women and were interested in walking, which is not usually hindered by the type of clothes worn. Younger participants did not

mind going to female-only gyms, where they could wear modern sportswear. This possibly explains why the views of our participants differ from those of Tunsi and colleagues (Tunsi et al., 2023), as they expressed that wearing loose garments in public limits their ability to jog (Tunsi et al., 2023). Also, it is important to note that while some of the previous studies that concluded Islam has either a neutral or negative effect on PA were quantitative studies (Noh et al., 2023; Ansari et al., 2017), this PhD study is qualitative and therefore does not measure the effect of religion on PA or test the cause-and effect relationship between religion and PA. This PhD study suggests that Saudi women viewed Islam as supportive of exercise and PA, but it did not test if this outlook significantly affected their efforts to be physically active. Such a test would require a quantitative approach. The qualitative approach serves to highlight how religion shapes people's lives and how this knowledge can be incorporated to promote healthy and active lifestyles. Noh and colleagues (2023) found a strong association between religion and PA; however, religious faith did not have a mediating effect on individuals' motivation to engage in PA (Noh et al., 2023). The authors explained that the association with PA might be attributed to certain religious practices, e.g., attending worship services that encourage practising PA (Noh et al., 2023). This was also reported by Hardison-Moody and Yao (2019), who conducted a programme within faith communities to promote active living, and incorporated breaks to encourage people to walk and re-designed the parking spaces to be walking-friendly (Hardison-Moody and Yao, 2019). These walking breaks, along with the restructuring of the environment, resulted in 49% of individuals increasing their daily PA (Hardison-Moody and Yao, 2019).

The lack of a 'culture of exercise' in the past meant that Saudi women did not develop a habit of being physically active from a young age. Until recently, physical education was not part of school education for girls (Al-Hazzaa, 2018). Participants explained that the lack of a previous history of exercising has made it harder for them to adopt a physically active lifestyle later in life. The root of this was explained by Bourdieu (1992), who used the term *habitus* to describe an internal system that has an unconscious bias toward certain behaviour that was considered familiar and has been learned through socialisation (Bourdieu, 1992). Bourdieu stressed the importance of early life experiences as the base of

our *habitus*, as we associate these experiences with kindred people and comfortable surroundings (Bourdieu, 1992). This indicates that a lack of PA history in the early years of life can result in a reluctance to engage in PA, especially if it has been socially unfamiliar for all people with whom the individual associates, i.e. women, to practice.

Habit is defined as a set of actions that is performed automatically, with little attention or effort, in response to certain triggers or cues present in the individual's surroundings (e.g. a specific time of the day, an entertaining radio show) (Hagger, 2019; Rebar et al., 2020). Automaticity is key in understanding habits, as performing the habitual behaviour requires little thinking and deliberation (Hagger, 2019; Rebar et al., 2020). This indicates that when physical activity, for example, becomes a habit, maintaining a physically active status is no longer a tedious task to accomplish. Rather, exercising becomes a regular part of the individual's day, performed easily and effortlessly. While exercise and PA can become habits at any stage of life by frequently performing the behaviour of PA for a variable period of time (Hagger, 2019; Rebar et al., 2020), having already developed the habit in the past facilitates performing the behaviour (i.e. exercise and PA) when the intention to engage in such behaviour and the goal pursuit linked to that particular behaviour is weak (Hagger, 2019). This suggests that a lack of PA as a habit in Saudi women's past can make it difficult for them to take up a regular PA regimen, especially if they are not highly motivated to become physically active (Hagger, 2019).

Previous studies have shown a significant association between participation in PA and sport at a young age and PA in adulthood (Smith et al., 2015; Malina, 2001). Al-Hazzaa (2002) studied PA and fitness among Saudi children and revealed a significant relationship between the active time boys spend during physical education class and their active time outside the school (Al-Hazzaa, 2002). This points to the importance of participation in physical education classes in persuading children to be active in their own time. Such classes were not accessible to Saudi girls in school for many years. Consequently, it might be difficult to build the habit of being physically active at an older age. Nonetheless, hard does not mean impossible. A study by Almaqhawi (2022) explored the barriers and facilitators to PA among Saudi women living in the UK (Almaqhawi, 2022). What the women perceived as barriers to PA in Saudi, were viewed as

facilitators to engaging in PA in the UK (Almaqhawi, 2022). The participants stated that the weather in the UK is nice, parks are available, gyms are affordable and accessible without transportation needs, and the culture of the UK encourages them to be physically active without worrying about what they choose to wear for a specific exercise, all of which the participants missed when they were in Saudi Arabia (Almaqhawi, 2022). Moreover, these women were all students and stated that the organised student life gave them more opportunities for their PA (Almaqhawi, 2022). Clearly, the sample of Almaqhawi (2022) is different from the population of the current study in relation to the average age and the underlying health condition. However, the interest in the study findings was to see whether Saudi women can overcome the lack of exercise habit when living away from the other perceived socio-cultural influences. In addition to the qualitative data, Almaqhawi (2022) also asked the participants to complete the short version of the International Physical Activity Questionnaire (IPAQ) (Almaqhawi, 2022). Despite the perception of numerous facilitators for engaging in exercise and PA in the UK, half of the sample were not physically active as measured by the short version of the IPAQ. Notably, despite being described as a qualitative study based on interpretive phenomenology, Almaqhawi (2022) collected quantitative data to assess the participants' PA levels (Almaqhawi, 2022). Nevertheless, the study had a small sample of twelve participants (Almaqhawi, 2022). Consequently, limited inferences can be taken from the study, however, more research, with a larger sample size, needs to be undertaken to investigate the PA levels of Saudi women living abroad (Almaqhawi, 2022).

8.3.3 Social and professional support

The participants expressed social and family encouragement as an enabler for being physically active. The influence of the people around us is well recognised by psychologists as an external motivator for our behaviour and, therefore, was considered one of the fourteen TDF domains explaining behavioural barriers and enablers (Cane et al., 2012). Moral familial support is recognised as a facilitator that empowers women to face PA challenges (Tunsi et al., 2023; Donnelly et al., 2012; Jones et al., 2021). Family encouragement of Saudi women to be physically active is likely affected by their awareness of the

importance of PA. Family values and overall social norms play a major role in encouraging or discouraging certain activities or exercises (Tunsi et al., 2023; Donnelly et al., 2012; Jones et al., 2021). Thus, it is important to involve the families in patients' education to increase their awareness of the importance of PA for individuals diagnosed with CAD, as well as healthy family members. This can encourage all family members to support women diagnosed with CAD to exercise not only by mere emotional support, but by actively exercising with them.

The participants of the current study also discussed the role of HCPs in supporting and encouraging women diagnosed with CAD to uptake and adhere to exercise and PA. Similar to familial social support, the professional support role as an enabler of being physically active was also recognised in the literature (Donnelly et al., 2012). Interestingly, in Donnelly et al. (2012), the participants stressed the role of the physicians in supporting their adoption of a healthier lifestyle, without mentioning other HCPs (Donnelly et al., 2012). While in this PhD study, the participants highly appreciated the support of physiotherapists and CR staff. This is likely because women who enrolled on the CR programme have frequently visited the CR clinic and seen the staff two or three times a week. The CR clinic also offered follow-up phone calls after the end of the programme through the virtual clinic, all of which is likely to create a stronger connection between CR staff and women diagnosed with CAD compared to physicians, who are seen less frequently. Study participants who did not have access to a CR programme reported receiving inadequate support from physicians and insufficient information regarding the type, intensity, frequency, and duration of PA they should undertake. This echoes findings from the Tunsi and colleagues' (2023) study, where the participants stated their interactions with the physicians were brief, hastened and lacked compassionate attention, negatively affecting their attempts at lifestyle modifications (Tunsi et al., 2023).

8.3.4 Facilitators for being physically active

Study participants expressed different factors as facilitators to the uptake of and adherence to a regular exercise and PA regimen (see sections 5.3.4 and 6.4.2). Saudi women diagnosed with CAD focused on willpower and determination, and the benefits they associated with exercise and PA as the main motivators

for physical activity. Healthcare professionals viewed the level of women's education and their awareness of the importance of PA, the availability of environmental resources, and family support as the determinants that encourage Saudi women diagnosed with CAD to become physically active. The importance of family and other types of social and professional support was highly stressed by Saudi women diagnosed with CAD and, therefore, formed a main theme, which was discussed in the previous section 8.3.3).

Beliefs about the consequences of undertaking exercise and PA are one of the TDF 14 domains that explain behavioural barriers and facilitators (Cane et al., 2012). Women who believed being physically active would help them be healthy and reduce weight, or have associated pleasure with PA, felt motivated to engage in exercise and PA, which corroborates the findings of previous studies among women diagnosed with cardiovascular disease as well as healthy subjects (Donnelly et al., 2012; Garcia et al., 2022). Garcia and colleagues (2022) conducted an umbrella review of the barriers and facilitators for different domains of PA (Garcia et al., 2022). The evidence synthesis revealed that positive beliefs about consequences, pleasure and fun with PA were positively associated with leisure-time PA (Garcia et al., 2022). The participants in Donnelly et al. (2012) aspired to look good, lose weight and improve their health, which they associated with being physically active, thus they were motivated to exercise (Donnelly et al., 2012). Determination, willpower, and taking responsibility for one’s health are also documented to be associated with engaging in a healthy and active lifestyle (Donnelly et al., 2012; Garcia et al., 2022). Though women in the current study did not mention education as a factor affecting their PA habits, the participating HCPs perceived that the more educated women were, the more physically active they were likely to be. Literature also supports this relationship between the level of education and the performance of PA, as education level was found to be positively associated with PA levels, the number of daily steps undertaken, and the weekly exercise hours and days (Kari et al., 2020; Chang, 2021).

The role of the physical environment was perceived to be important by both Saudi women diagnosed with CAD and their healthcare professionals. However, they differ in their opinion around the availability and the number of these resources, with HCPs stating there were enough resources to facilitate

women to become physically active, and women expressing a lack of appropriate and affordable resources as a challenge to their ability to engage in PA. The effect of the physical environment: the availability of facilities and walking-friendly roads on practicing exercise and PA is well documented in the literature (Tunsi et al., 2023; Donnelly et al., 2012; Jones et al., 2021; Garcia et al., 2022). For example, in Donnelly et al. (2012), the participants appreciated that the Qatari government has provided recreational facilities and clubs for women at affordable prices and considered accessibility to such environmental resources as an enabler to exercising (Donnelly et al., 2012). Similarly, in Jones et al. (2021) 57.8% of the moderately active participants and 41.2% of the whole sample regarded lack of access to exercise facilities and unavailability of safe places to walk as barriers to getting physically active, and these findings were highly significant ($p=0.001$, <0.001 respectively) (Jones et al., 2021). The availability of facilities varies from one area to another, and depending on their accessibility, study participants were likely to perceive the physical environment as either a facilitator or a barrier to being physically active. The kind of physical resources needed also differs between people depending on the type of activity they prefer to perform. Thus, the Saudi participants in Tunsi and colleagues' study also held contradicting views of the role the physical environment plays in encouraging or discouraging PA based on the area they live in and the kind of facilities they look for, with some complaining about the lack of safety for walking in the neighbourhood and others satisfied with the available facilities (Tunsi et al., 2023).

8.3.5 Barriers to being physically active

The participants of the current study acknowledged several barriers affecting the ability of Saudi women, diagnosed with CAD, to become physically active (sections 5.3.5 and 6.4.3), all of which were reported in the literature as possible barriers to being physically active among individuals diagnosed with CAD or healthy participants. The barriers reported in the current study slightly varied between Saudi women diagnosed with CAD and their HCPs. The physical ability and the existence of comorbidities, including osteoarthritis, rheumatoid arthritis and knee pain, were the most discussed among both groups of participants. In the literature, unfavourable health conditions, fatigue, discomfort, difficulty in breathing and conditions associated with joint pain are

reported to be barriers to engaging in and adhering to exercise and PA (Donnelly et al., 2012; Garcia et al., 2022; Jones et al., 2021). Saudi women diagnosed with CAD also stressed the challenges of the elements of the physical environment, including the weather and transportation. As discussed previously (section 8.3.4), HCPs perceived that the overall physical environment was encouraging to women's efforts to become physically active. They emphasised the availability of indoor facilities (e.g. malls) where everyone can practice brisk walking regardless of the weather conditions. However, this was not the view of the women interviewed, as some preferred outdoor activities over indoor exercises. Existing literature supports the effect of the climate on individuals' willingness to engage in PA (Donnelly et al., 2012; Jones et al., 2021; Almaqhawi, 2022). In Jones et al. (2021), 70% of the sample, which included inactive, moderately active and active participants, reported the weather as a deterrent to being physically active (Jones et al., 2021).

Transportation issues were acknowledged by both women diagnosed with CAD and their HCPs in the current study as a barrier preventing some women from getting to PA-friendly spaces. Other studies also discussed the ease of access to exercise facilities and the availability of public or private means of transportation as factors affecting individuals' ability to be physically active (Garcia et al., 2022; Jones et al., 2021; Almaqhawi, 2022). For example, in Garcia and colleagues' (2022) umbrella review, the authors reported better public transportation and short distances to facilities among the environmental factors that affect individuals' ability to engage in PA (Garcia et al., 2022).

Another perceived barrier to undertaking exercise and PA found in this PhD study is psychological readiness, and these included feeling bored, unmotivated and leaning towards a restful and comfortable lifestyle. Similar findings were also reported in other studies investigating barriers and facilitators to PA (Garcia et al., 2022; Jones et al., 2021). Negative emotions, lack of energy, interest, motivation, and inclinations towards sedentary behaviour were all reported in the literature as barriers to being physically active (Garcia et al., 2022; Jones et al., 2021). The final barrier to exercise and PA is the reported lack of time and social commitments, which has been previously discussed (section 8.3.2). Apart from family responsibilities and social obligations, which are related to the perceived gender roles in the Saudi culture, a general lack of time was also

reported in the literature as a barrier to being physically active faced by men and women alike (Garcia et al., 2022; Jones et al., 2021).

Adherence and maintenance of exercise and PA:

Apart from initiating PA, this study aimed to explore factors affecting the ability of Saudi women, diagnosed with CAD, to adhere to exercise and PA. In general, the participants in the current study perceived the barriers and facilitators to the uptake of and adherence to exercise and PA similarly. However, some participants highlighted reasons that hindered their adherence to exercise and PA after starting, namely: exacerbation or worsening of an underlying medical condition, a lack of transportation to the exercise facility, and boredom (more details in chapter 5, Section 5.4). An umbrella review of the main factors affecting the adherence to PA among older adults and those with chronic diseases reported issues with the prescribed exercise and lack of exploration of the trainee's perceived barriers and facilitators to exercise as factors that affected the ability of individuals diagnosed with different cardiovascular conditions to adhere to the prescribed CR exercises (Collado-Mateo et al., 2021). This partially resonates with this PhD study's findings, as exacerbation of the underlying medical conditions the woman complained of suggests that their medical condition, preference and/or disfavour for exercises were not properly assessed before starting the CR sessions, and the exercises were not individually prescribed to fit with her medical comorbidities. The review also documented the inability to integrate the exercise regimen into daily living, which included a lack of transportation, as a reason for not adhering to exercise and PA (Collado-Mateo et al., 2021). Lastly, the absence of enjoyment was also reported as a reason for not maintaining a physically active status (Collado-Mateo et al., 2021). This underlines the importance of the initial exploration of the barriers and facilitators of exercise and PA perceived by Saudi women diagnosed with CAD. Many women who participated in the current study reported enjoyment and weight loss as perceived benefits of exercise, which motivated them to exercise. Unlike the health benefits of exercising, enjoyment is not guaranteed, and an enjoyable exercise experience may change over time, for various reasons, to become unpleasant or boring. Also, weight loss can be considered as an intermediate-term goal that, once achieved, the women may lose their motivation to continue exercising. Therefore, it is

imperative to understand what individually motivates each woman who has been diagnosed with CAD to exercise and regularly follow up with them to ensure they are staying motivated and adhering to exercise and PA. Other factors that were reported in the literature to affect the ability of individuals, with different medical diagnoses, to adhere to exercise and PA include: self-efficacy and willpower, social influence and support, competency and skills, exercise education, medical supervision, communication and feedback, goal setting with participants having an active role in the process, lack of time, lack of resources, fear of injury, and lack of energy, several of which were discussed by the participants of this PhD study as factors that generally affected the uptake of and adherence to a regular exercise and PA regimen (Collado-Mateo et al., 2021; Zalewski et al., 2014).

8.3.6 The need for cardiac rehabilitation

The HCPs who participated in this study emphasised the need for having several CR programmes in the area. A study investigating the density of CR in the Eastern Mediterranean region reported the availability of one CR place for 335 patients in Saudi Arabia (Turk-Adawi et al., 2019b). Although it has been around six years since Turk-Adawi et al. (2019b) was published, no updated information on the CR density in Saudi Arabia was found (Turk-Adawi et al., 2019b). Therefore, the capacity of the available CR centres is likely to be still incapable of admitting all individuals diagnosed with CAD in the kingdom, thus leaving many women diagnosed with CAD without access to CR services. Half of the women who participated in the current study did not have access to CR services because the hospital they attended does not offer them. Moreover, most of these women were not given the option to be referred to other hospitals that provide CR services and were not aware of the availability of such programmes. This corroborates the findings of Tunsi et al. (2023) where the Saudi participants of the study demanded more access to CR services (Tunsi et al., 2023). This problem, however, is not confined to Saudi Arabia. There is a regional and global deficiency of CR programmes (Turk-Adawi et al., 2019b; Turk-Adawi et al., 2019a). Moreover, the utilisation of these programmes worldwide is less than satisfactory, especially by women and ethnic minorities (Ragupathi et al., 2016; Sawan et al., 2022; Mathews and Brewer, 2021b; Carew et al., 2023). No published information about women's referral and

enrolment rates in Saudi Arabia was found. A recent review of global CR registries did not identify any CR registry in the Middle East, which can be used to learn about the characteristics (e.g. exercise doses, total number of sessions), and utilisation of CR programmes (Grace et al., 2024).

8.4 Contribution to the body of knowledge

There is a dearth of knowledge about the physical activity of individuals diagnosed with CAD in Saudi Arabia. Therefore, the current study explored the PA experiences of Saudi women who have been diagnosed with CAD, investigating barriers and facilitators to the uptake of and adherence to exercise and PA from the perspectives of Saudi women diagnosed with CAD and their healthcare professionals. Some of the findings of this study resonate with previous literature investigating barriers and facilitators to PA among healthy individuals and those diagnosed with CAD. (Tunsi et al., 2023; Donnelly et al., 2012; Garcia et al., 2022; Jones et al., 2021; Almaqhawi, 2022). However, other findings were specific to this study. This section highlights these new findings, which add to the body of knowledge to allow us to better understand the experience of Saudi women, post CAD diagnosis, and have a better insight into their needs when trying to adopt a physically active lifestyle. Consequently, insight is likely to facilitate the development of a behavioural change intervention to promote the uptake of and adherence to a regular exercise and PA regimen among Saudi women diagnosed with CAD.

8.4.1 Saudi women diagnosed with CAD possess insufficient knowledge regarding PA recommendations

As this is a qualitative study focused on exercise and PA alone, rather than lifestyle modifications, the findings revealed details regarding the description of exercise and PA. This PhD study highlighted that Saudi women, who had been diagnosed with CAD, generally had insufficient knowledge regarding the characteristics of the recommended PA levels per week. This includes the suitable type of activity, the required intensity, and the minimum duration and frequency to engage in PA per week. This lack of knowledge is likely to hinder their ability to become physically active, regardless of other facilitators or inhibitors. Some previous studies that investigated the barriers and facilitators to becoming physically active in healthy individuals and people with CAD reported

knowledge or the lack of it, as a factor that affects the uptake of PA (Garcia et al., 2022; Gilbert et al., 2019), but no study was found to investigate knowledge of the characteristics of PA to be performed for individuals to achieve a physically active status. Women diagnosed with CAD may know the importance of PA and the health benefits associated with it. However, unless they have enough knowledge of the details of the PA to be performed in order to become physically active, their endeavours will likely be unsuccessful, as they may fail to accumulate the required minimum of 150 minutes of moderate-intensity physically activity per week and/or engage in a low-intensity PA (e.g. slow walking instead of brisk walking). HCPs must be aware of the importance of giving detailed education to Saudi women diagnosed with CAD regarding the characteristics of the recommended PA per week to reap the benefits for their cardiac health.

8.4.2 Lack of preparation for exercise in early childhood among Saudi women

The effect of social habits and cultural values on the lifestyle of the population is well-recognised in the literature (Rio and Saligan, 2023; Tunsi et al., 2023; Donnelly et al., 2012; Jones et al., 2021). Because socio-cultural customs vary tremendously between different populations, one reason this study was conducted is to explore the effect of the Arabian and Islamic culture of Saudi Arabia on the PA habits of Saudi women diagnosed with CAD. The participants elaborated on the Islamic perspective on PA, women's designated roles, responsibilities and priorities in Saudi society, and the perceived challenge caused by a lack of preparation for being physically active from a younger age. The positive role of Islam in encouraging people to lead healthy lives and become physically active, as well as the recognised gender roles, were documented by Tunsi and colleagues (2023) as they explored barriers and facilitators to lifestyle modifications in individuals who have suffered a cardiac event in Saudi Arabia. However, Saudi women’s perceived difficulty in building a habit of being physically active after being raised without physical education or practice was only highlighted in the current study. Most of the participants in Tunsi et al. (2023) were men (61.9%) (Tunsi et al., 2023). Thus, this PhD study is unique in focusing on Saudi women as they are likely to have different social

roles, expectations and experiences compared to Saudi men. Exploring the barriers and facilitators to PA through a socio-cultural lens helps in designing interventions that are likely to be successful in promoting uptake of and adherence to a regular exercise and PA regimen among the chosen population.

8.4.3 Identifying potential intervention components to promote PA among Saudi women diagnosed with CAD

Unlike many previous studies that used the socio-ecological model as the underpinned framework in investigating PA (Tunsi et al., 2023; Donnelly et al., 2012; Jones et al., 2021), this is the first study conducted in Saudi Arabia and the Middle East to adopt the TDF to investigate the barriers and facilitators to the uptake of and adherence to exercise and PA among women diagnosed with CAD, and as such, has yielded some distinctive findings that were not identified in previous studies. However, the chief advantage of using the TDF was that it allowed for a smooth linking of the study findings to the COM-B model, BCW, and BCTs to develop potential behavioural change intervention components that respect the socio-cultural context, to promote the uptake of and adherence to exercise and PA among Saudi women. The proposed components were visually presented in the form of a logic model (**Figure 7.3**) to facilitate presentation to relevant stakeholders. After presenting the proposed intervention components, a nominal group technique will be used to discuss, prioritise and rank the components, in order to develop a PA-promoting intervention befitting of the real-world setting. However, this step will be accomplished in future research, as it is beyond the objective of this PhD study.

8.5 Implication of the research for policy and practice

The study findings revealed that although most of the women acknowledged the importance of being physically active for individuals with CAD, several factors were perceived to hinder their endeavour of adopting a physically active lifestyle. These barriers and facilitators must be taken into consideration in developing interventions to promote the uptake of and adherence to exercise and PA among the population of interest. In chapter 7, the TDF-informed findings were linked to the COM-B model, and BCW and the following intervention functions were identified to promote PA: Education, persuasion,

enablement and training. Suitable BCTs were then selected for each intervention type (**Figure 7.3**).

The proposed PA-promoting intervention components focused on measures directed towards Saudi women diagnosed with CAD. This is because such components can be implemented by the hospital administration without governmental involvement. However, there are policy recommendations that are likely to promote PA among individuals who have been diagnosed with CAD in Saudi Arabia. The BCW suggests certain policy categories for each type of intervention function (Michie et al., 2014a). The most relevant to promoting PA among Saudi women who have been diagnosed with CAD are: Communication/ marketing, Guidelines, Environmental/social planning, and Service provision (Michie et al., 2014a).

8.5.1 Communication/marketing policy to promote PA in the community

The study's findings revealed the importance of raising community awareness of the significance of PA for individuals diagnosed with CAD. The interviewed HCPs as well as some of the women who have been diagnosed with CAD, stressed the need for launching widespread campaigns to promote PA, involving conducting lectures and seminars in the hospitals and community hubs: universities and shopping malls, similar to national campaigns conducted for other diseases (e.g. breast cancer). Printed health information, e.g. posters, pamphlets and brochures, should also be utilised and distributed among individuals with CAD and their families. Additionally, governmental media channels: TV, internet websites and social media can be used to deliver credible information about exercise and PA to the whole community. Despite the numerous initiatives to promote PA and healthy living in Saudi Arabia, many people were unaware of these initiatives (Al-Hazzaa and AlMarzooqi, 2018; Tunsi et al., 2023). The initiatives, mostly directed toward public health and primary prevention of cardiovascular disease, were not sustainable enough to produce an effect (Al-Hazzaa and AlMarzooqi, 2018). PA-promoting initiatives and campaigns need to be widespread across the country, well-advertised and most importantly, target individuals with CAD, for them to bring about a change in the PA levels and the cardiac health of the Saudi population.

8.5.2 Guidelines for HCPs training on PA counselling

In this PhD study, HCPs reported varying levels of competence and confidence to deliver effective PA education, and the Saudi women, who were diagnosed with CAD, reported that they were not satisfied with the PA education they received. Studies revealed a lack of formal training in PA counselling for HCPs in Saudi Arabia (Alahmed and Lobelo, 2019; AlMarzooqi and Saller, 2022). Therefore, it is important to train HCPs for the role of providing PA education and counselling (AlMarzooqi and Saller, 2022; Svavarsdóttir et al., 2016; Coombes et al., 2021). To ensure all HCPs are competent in promoting PA among individuals with CAD, the Ministry of Health and the Ministry of Education guidelines should make sure that training around PA counselling is included in HCPs' undergraduate education and provide them with periodic short postgraduate training courses as recommended by existing literature, (Coombes et al., 2021; AlMarzooqi and Saller, 2022; Svavarsdóttir et al., 2016) to refresh their knowledge and skills regarding the culturally appropriate approaches to advocate a physically active lifestyle.

8.5.3 Environmental/social planning for PA-friendly facilities

One of the perceived barriers to PA among the participants was the lack of appropriate exercise facilities, the importance of which is well documented in the literature (Jones et al., 2021; Garcia et al., 2022). Establishing more indoor exercise-friendly facilities, affordable gyms, and accessible shopping malls is likely to motivate more women to be physically active during the summertime. When the weather is nice, having more parks, corniches and walkways will encourage people to walk, and ensuring the safety of pedestrians by designing walking-friendly roads is likely to change society's attitude toward walking as a means of transportation (Barnett et al., 2017; Jensen et al., 2017). Thus, slowly building a culture of a physically active lifestyle.

8.5.4 Service provision policy to provide more CR services

As discussed earlier (in this chapter, section 8.3.6 and in chapter 6, section 6.4.4), the participants of this study stressed the need for more cardiac rehabilitation centres in Saudi Arabia, which echoes the findings of Tunsi et al. (Tunsi et al., 2023). Cardiac rehabilitation is a class I recommendation of a secondary prevention programme that reduces the risk of further cardiac events

and the likelihood of future hospitalisation, while improving the quality of life for individuals diagnosed with CAD (Simon et al., 2018; Dibben et al., 2021; Vasankari et al., 2021; Vrints et al., 2024). There is a lack of documentation of the available on CR programmes in Saudi Arabia. As mentioned earlier, the most recent study that was found to investigate the number and characteristics of CR programmes in the Middle East was published more than five years ago and documented the availability of one CR programme in Saudi Arabia with a CR density of 335 (one CR place for 335 patients) (Turk-Adawi et al., 2019b). Since the publication of Turk-Adawi et al. (2019b), other programmes are assumed to have been established, however, there is no official data to prove this. The available CR centres could very likely still be incapable of admitting all individuals diagnosed with CAD, which deprives many individuals diagnosed with CAD, women included, of the opportunity to access CR services.

Therefore, it is important to establish more CR programmes in Saudi Arabia to rehabilitate individuals with CAD, help them regain control of their lives and adopt healthy habits to modify their risk for further cardiac complications, including the habit of engaging in physical activity (Rashed et al., 2020; BACPR, 2023). Moreover, the utilisation of traditional CR centres is still limited (Ragupathi et al., 2016; Sawan et al., 2022; Mathews and Brewer, 2021a). Thus, it is essential to establish other modes of CR delivery and incorporate technology in operating these programmes, e.g. home-based CR programmes, hybrid CR programmes and community-based CR to help improve accessibility to CR services for people experiencing transportation difficulties, all while maintaining the same effectiveness of traditional hospital-based programmes (McDonagh et al., 2023; Nathanail et al., 2022; Katzenberg et al., 2018; Suskin et al., 2022).

8.6 Strengths and limitations

To my knowledge, this is the first qualitative study to focus on the experiences of Saudi women who have been diagnosed with CAD, in taking up and adhering to a regular exercise and PA regimen. The use of a descriptive qualitative approach allowed for a deeper comprehension of Saudi women’s attitudes towards PA and their views on the necessity of adopting a physically active lifestyle after their cardiac event, along with their perception of the barriers and facilitators they faced when deciding to become physically active. A recent

qualitative study, which was published during the data analysis of the current study, investigated barriers and facilitators to adopting a healthy lifestyle among Saudis following a cardiac event (Tunsi et al., 2023). However, the current study differs from Tunsi and colleagues' study as it focused solely on physical activity, rather than exploring multiple risk factors modification. Consequently, this study yielded richer data concerning exercise and PA. Additionally, unlike the participants of Tunsi et al.'s (2023) study who were mainly men (62%), this study focused on women's views only, as they are often overlooked in Arab and Middle Eastern research. In addition, to enrich these findings, the study also integrated HCP's views of the barriers and the facilitators to the uptake of and adherence to exercise and PA that face women diagnosed with CAD and the things that can be changed, on community and institutional levels, to help women diagnosed with CAD be more physically active. Finally, to the best of my knowledge, this is the first study to use the TDF as the underpinning framework to investigate barriers and facilitators to exercise and PA among the population of Arab and Middle Eastern women who have been diagnosed with CAD. Using the TDF facilitated the utilisation of the study findings in the development of behavioural change interventions using the BCW. The development of interventions, using behavioural change theories increases the likelihood of achieving the target behaviour, i.e. promoting PA among individuals diagnosed with CAD (Michie et al., 2008).

However, this study is not without limitations. First, as a qualitative study, the sample was a small purposive sample comprised of Saudi women diagnosed with CAD and their HCPs. The participants were recruited from two hospitals in the Eastern province of Saudi Arabia, purposefully based on their ability to answer the research question (Patton, 1990). Despite choosing the largest administrative region in Saudi Arabia for recruitment, Saudi Arabia is vast and culturally diverse. Thus, the views and experiences of those who participated in the study may differ from those residing in other administrative areas. Consequently, the study's findings are limited to those belonging to the recruitment centres and cannot be generalised to the entire population (Andrade, 2021; Mwita, 2022). However, qualitative researchers do not aim to generalise their findings, but that does not make the findings less useful. The findings can be transferred to a similar context, under the discretion of the

research reader (Lincoln and Guba, 1985; Drisko, 2025). Moreover, maximum variation in the sample was sought for both women diagnosed with CAD and HCPs, to ensure diversity and present different perspectives (Patton, 1990) . Women of a wide age range, who were working, retired, or housewives, were interviewed, and HCPs of different relevant occupations and nationalities were recruited and participated in the study.

Additionally, this study adopted a descriptive qualitative design, which allowed for exploring the barriers and facilitators to exercise and PA by employing a simple analysis technique that does not take the findings away from the original data through high-level complex interpretations. This resulted in a clear understanding of the factors affecting Saudi women's endeavours to be physically active. However, a mixed-method design incorporating a quantitative survey investigating the barriers and facilitators to exercise and PA before (explanatory) or after (exploratory) conducting the semi-structured interviews would have enriched the study. Nonetheless, the limited time designated for data collection, as per the policy of the Saudi Cultural Bureau, who sponsored this scholarship, deemed sequential studies unfeasible.

8.7 The challenges of using the TDF

The TDF is a comprehensive framework that utilised thirty-three psychological and behavioural change theories and developed 14 Domains that enable us to understand barriers and facilitators to behavioural change (Michie et al., 2005; Atkins et al., 2017). The TDF has been successfully adopted in research investigating various aspects of the field of pharmacy in Saudi Arabia, including Mohammed et al. (2021) and Alharthi (2024). However, it is the first time that it has been used to investigate exercise and PA among the Saudi population and particularly Saudi women diagnosed with CAD. Using the TDF enabled having a comprehensive view of the barriers and facilitators of exercise and PA among Saudi women diagnosed with CAD. However, there were also some challenges with using the TDF. Lacking a psychological background made the TDF domains and the associated constructs confusing and difficult to understand. To overcome this, the researcher attended an introductory course on the COM-B model, TDF, BCW, and BCTs. Yet, the first approach to data analysis was overwhelming as a considerable amount of data seemed to fit in more than one domain. This was discussed by Phillips et al. (2015), as the study's participants

perceived TDF domains to overlap due to a lack of a specific and clear operational definition of the domains and constructs (Phillips et al., 2015). However, after a discussion with the supervisors, it was advised to start the analysis inductively and then themes were mapped to related TDF domains. For example, women were asked if exercise and PA fit their character and lifestyle, which was meant to be associated with the Social and Behavioural Role and Identity domain. However, when women answered, they narrated stories about the religion of Islam, what they should wear, how they are perceived and judged by others, and their daily routine in the house, all of which were associated with a complex melange of religious and socio-cultural influences and not merely their self-identity. Therefore, the inductive analysis identified the theme (Religious and socio-cultural influences), which was then linked to the social and professional role and identity, and social influence domains, among others. Consequently, this helped in using the TDF to guide the data collection and analysis without restricting the researcher's vision or forcing the dismissal of any identified data that does not fit into one of the TDF domains.

8.8 Future research recommendations

Research investigating secondary prevention of CAD and risk factor modification in Saudi Arabia is sparse. Physical inactivity is prevalent among the healthy population, and the current study has identified some of the barriers and facilitators to the uptake of and adherence to exercise and PA among Saudi women diagnosed with CAD. The following research investigations are recommended to further the current knowledge.

8.8.1 Developing a behavioural change intervention to promote the uptake of and adherence to exercise and PA among Saudi women diagnosed with CAD

Having identified possible barriers and facilitators to exercise and PA among Saudi women who have been diagnosed with CAD, it is essential to use this knowledge to design an intervention that aims to eliminate or lessen the effect of the barriers while fostering the impact of the facilitators, thus encouraging more women diagnosed with CAD to be physically active. The current study has proposed intervention components based on theoretical underpinnings that are likely to promote exercise and PA among Saudi women diagnosed with CAD.

However, this provisional plan needs to be further developed through a discussion with the stakeholders using a nominal group technique. The discussion findings will then be analysed to prioritise the intervention components to be implemented and design a practical and applicable PA-promoting intervention. Additionally, following the implementation of the intervention, further research is warranted to evaluate the impact of the intervention on promoting physical activity among the target population and to recommend, if necessary, any amendments to the applied intervention.

8.8.2 Cardiac rehabilitation research

Cardiac rehabilitation is a class I recommendation for the secondary prevention of CAD (Simon et al., 2018; Vrints et al., 2024). However, reliable information concerning the existing CR programmes in Saudi Arabia is difficult to find. Research is needed to document the number of existing CR programmes in Saudi Arabia and the density of CR in the kingdom. Also, there is a lack of published guidelines for operating CR programmes in Saudi Arabia. Thus, the quality of the existing programme cannot be determined. Research is needed to evaluate the quality and the effectiveness of these programmes by examining the characteristics of the programmes (the number of employees, their qualifications, the total number of sessions offered, the number of sessions per week, the length of the session, the types and intensity of the exercises offered, etc.), the availability of other risk factors modification services (smoking cessation, psychological support, nutrition, etc..), the utilisation rates (referral, enrolment, and completion rates), and end-user satisfaction. Such information will give HCPs, administrators and policymakers a clear picture of the status of these programmes and identify areas for improvement.

8.9 Quality and rigour in qualitative research

The quality and rigour of qualitative studies cannot be judged using the same measures as for quantitative studies (internal and external validity, reliability, and objectivity). Qualitative studies align with different paradigms than quantitative studies and have other research purposes. To construct a rigorous qualitative study, four analogue concepts for trustworthiness must be observed: credibility, transferability, dependability, and confirmability (Lincoln and Guba,

1985; Guba, 1981) (See **Table 8.2**). The researchers in qualitative research must employ reflexivity to examine how their background, personal experiences and views may play a role in shaping their interpretations of the findings (Creswell and Creswell, 2018).

Table 8.2 Criteria for establishing rigour and trustworthiness in qualitative research (Lincoln and Guba, 1985; Guba, 1981)

Credibility (internal validity)	The accuracy of the data collected and its ability to answer the research question.
Transferability (External validity)	The ability to apply the research findings in other contexts.
Dependability (Reliability)	The transparency of the research process.
Confirmability (Objectivity)	The neutrality of the data.

8.9.1 Credibility

Collecting data through in-depth individualised interviews allows the researcher to come as close as possible to the participants to understand their experience. Using interview schedules guided by a theoretical framework ensures the relevance and richness of the information gathered. The interviews were audio recorded, transcribed verbatim, and direct quotes were used in the analysis. Moreover, frequent debriefings with the research supervisors were conducted to discuss the codes, theme choices and the interpretation of the data.

8.9.2 Transferability

The results of this study might be especially relevant to the social and cultural aspects of Saudi women. However, it could be applied to a different setting with a similar nature. A thick description of the study context, data collection, and analysis process is provided so that readers can judge for themselves if the results can be applied to their chosen context (Geertz, 1973).

8.9.3 Dependability

The presence of an audit trail: a transparent and detailed description of the choices made in the research process, which are congruent with the philosophical paradigm under which this study was designed, as well as a clear justification for the choices made ensures the study's dependability.

8.9.4 Confirmability

Reflexivity was practised by the researcher to be aware of her own bias. See section 8.9.5. In addition, regular meetings with the supervisors were conducted to ensure accurate interpretation of the findings.

8.9.5 Reflexivity

A qualitative researcher believes in multiple realities shaped by our personal views. Critical realism confirms the presence of objective reality unrelated to the human experience, while recognising the role of our interpretation in defining such reality (Houston, 2001; Taylor, 2018; Gorski, 2013). Different interpretations result in different realities for each individual, including the researcher. Thus, the researcher’s role is to understand the participants’ realities and describe them using their language. To do that, the researcher must be aware of and acknowledge his or her reality first. Reflexivity is the researchers’ critical awareness of their own beliefs, inclinations and past experiences and how they affect the research process (during the data collection) and outcome (through the analysis of the data) (Creswell and Creswell, 2018; Haynes, 2012). Understandably, qualitative researchers cannot separate themselves from the research. In qualitative research, researchers are considered among the tools of the research process (Creswell and Creswell, 2018). Therefore, qualitative researchers are bound to have an impact on the setting, participants, and the outcome of the research. For the aforementioned reason, researchers must make known their views, feelings, past experiences and what they are learning throughout the research process. For this study, a reflective journal was kept so that the researcher (ZS) could continuously examine her own biases when preparing, conducting and analysing the participants' interviews and try to lessen her inevitable effect on the research process.

As a researcher, I was aware that my background as a nursing lecturer specialised in critical care had an impact on the research process. Supervising

nursing students in coronary care units sparked my interest in secondary prevention measures of the disease, while being a Saudi woman, facilitated focusing on Saudi women who have been diagnosed with CAD in a way that would not have been possible for a male or non-Saudi researcher, due to the conservative nature of Saudi women. Therefore, I leveraged my professional and sociocultural background to conduct this research. In addition, I recognised that as a qualitative researcher, I had an inevitable effect on the data collection and analysis. My presence during the interviews as a PhD student studying in the UK had an impact on some of the participants. Many women who participated in the study stated that they regarded me as their daughter. They felt eager to help and wanted to give the right answer, despite my telling them there were no right or wrong answers. One participant asked me after answering if the answer was good, and another said, apologetically, that she is an old and uneducated woman and therefore answered my questions according to her limited capability. Also, discussing PA is likely to be affected by social desirability bias. Participants are likely to want to come across as energetic and active, afraid of being judged by me. Thus, I sought to minimise the impact of my background on the process of data collection and to mitigate potential bias through reflections and discussions with my supervisors. These reflections helped me resolve this issue and put my participants at ease by explaining, at the beginning of the interview, that I was interested only in what they felt and experienced, and that the interview was a friendly discussion and a judgment-free space.

Additionally, I was concerned about the power relationship while recruiting and interviewing the participants. There is a perceived power imbalance favouring the researcher in qualitative research (Råheim et al., 2016). I was aware of this and have made sure to approach the women in a friendly manner and explain to the women who participated in the study that they have all the control over what they want to share and when they choose to share it. However, the situation was a little different with the physicians. Physicians usually have the power and the upper hand in the healthcare system. Being a nurse and recruiting doctors for interviews to ask them about their awareness of the PA guidelines and their role in encouraging women diagnosed with CAD to increase their PA level made me feel tense. Fortunately, the participants understood the purpose of my

research and did not take any of the questions personally. Also, with time and regular discussions with my supervisors, I developed the courage and the confidence to ask questions in a clear and neutral manner and be an attentive listener.

As a critical care nurse and Saudi woman, I was aware that physical inactivity is prevalent in Saudi Arabia (Alqahtani et al., 2021). I was not regularly engaging in physical activity, and most women I met in the coronary care unit were not either. Also, the people I knew, who religiously attended the gym, were trying to lose or maintain weight. It is common to hear people questioning why you would need to go to the gym if you have never been overweight. Therefore, I had a preconceived idea that the women I was going to interview were most likely inactive and imagined many of the barriers they may mention as reasons for not uptalking or maintaining PA. I was aware of the picture I had painted before starting my first interview. I documented my feelings and was determined not to let them influence the way I posed my questions. I asked open-ended questions like: How easy or difficult is it for you to undertake 150 minutes of moderate-intensity physical activity? What challenges prevent you from achieving the recommended level of physical activity? I made sure to listen to their experience and not to feed them the answers I had in mind. It helped that my first participant defied all my expectations. Despite her advanced age, she was walking daily, attending her CR appointments and did not mind the hot weather. This made it easy for me to realise that every woman has her own experience and may not necessarily fit the picture I had of Saudi women, despite being one of them. Nonetheless, it is imperative to acknowledge the ways I have influenced data collection. Although the interviews followed a semi-structured format, the probing questions I chose to ask have possibly influenced the participants' discussion. These choices were likely shaped by my personal perspectives and resulted in shedding light on certain issues more than others.

Moreover, my impact on the research process was not limited to the data collection phase. Rather, it extends to the data analysis. As mentioned earlier, I did not engage in PA on a regular basis despite being aware of the importance of being physically active. Working left me little time for myself, and the hot weather often prevented enjoying an outdoors walk during breaks. I have already known and experienced some of the barriers to being physically active.

However, I have had period of commitment to exercise and PA in the past. Therefore, I strived through reflexivity to have my personal experience with exercise and PA as a positive factor that helps me understands the women's views rather than being imposed on the findings. This was achieved by taken sufficient time to familiarised myself with the data so that I comprehend the participants perception of the research subject. Right after conducting the first interview, I started immersing myself in the data. I listened to the audio recordings, transcribed the interviews, read the transcripts, translated the ones conducted in Arabic, and finally started coding; inductively analysed the data, and deductively connected the identified themes and subthemes to the TDF domains. In addition, reading the reflective notes written during the data collection and processing helped me become aware of my views and feelings and the way I made the participants feel during the interviews, which facilitated the development of the themes and subthemes while being consciously aware of where my personal experience ends and the participants' begin. Nonetheless, it is imperative to understand that the findings of qualitative studies do not only reflect the participants' views, but rather a melange of the participants' views, the researcher's understanding of these views, and the influence of the participants-researcher dynamics on participants' answers during the interviews (Finlay, 2002).

8.10 Dissemination of the findings

The preliminary findings of the study have been discussed through participation in a postgraduate researcher conference at the University of Leeds. Future dissemination in peer-reviewed journals is planned, including the findings of the scoping review, the findings of the qualitative study and the proposed behavioural change intervention components. The target journals are cardiology, cardiovascular, nursing, preventive medicine, and public health journals. Additionally, a summary of the findings of the qualitative study and the potential behavioural change intervention will be shared with policymakers in the Saudi Ministry of Health and different hospital administrations to discuss, prioritise and implement the study recommendations to promote PA among Saudi women who have been diagnosed with CAD.

8.11 Conclusion

Physical activity is an essential element of the secondary prevention of coronary artery disease. However, physical activity levels are generally low in the Middle East and Saudi Arabia, especially among women. A scoping review of the nature, scope and type of physical activity undertaken by Middle Eastern women after being diagnosed with coronary artery disease showed a low prevalence of PA among Middle Eastern women who have been diagnosed with CAD and low participation in cardiac rehabilitation programmes. Thus, this study aimed to explore the attitudes, beliefs, barriers, and facilitators to the uptake of and adherence to a regular exercise and physical activity regimen among Saudi women diagnosed with CAD. The aim of the study was achieved through a descriptive qualitative approach, which employed semi-structured interviews to explore the views of Saudi women diagnosed with CAD, as well as the healthcare professionals responsible for their care, regarding exercise and PA post-diagnosis of CAD. The study was underpinned by the theoretical domain framework, which informed the data collection and analysis.

The findings of the qualitative study draw attention to the importance of educating women diagnosed with CAD on the significance of being physically active. Moreover, they highlight the necessity of implementing PA-promoting interventions that are culturally tailored to the needs of Saudi women diagnosed with CAD, and engaging relevant stakeholders in designing, implementing and evaluating such interventions in future research studies. Therefore, as a first step, the current study findings were linked to the COM-B model and the behavioural change wheel to identify suitable intervention components to promote the uptake of and adherence to exercise and PA among Saudi women who have been diagnosed with CAD. The provisional intervention plan was illustrated in the form of a logic model (**Figure 7.3**) and is to be presented to the relevant stakeholders in Saudi Arabia in the next step. Using a nominal group technique, the proposed intervention components will be discussed for consensus and ranking, to further develop the plan for implementation in a real-world setting, in order to promote uptake of and adherence to a regular exercise and PA regimen among Saudi women diagnosed with CAD.

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Appendix A: Operational definitions

A.1 Physical activity

Physical activity is defined as “any bodily movement produced by skeletal muscles that results in energy expenditure” (Caspersen et al., 1985, p.126). Physical activity is sometimes used interchangeably with the term exercise, although they do not have the same meaning. Exercise is defined as

“a subset of physical activity that is planned, structured, and repetitive and has as a final or an intermediate objective the improvement or maintenance of physical fitness” (Caspersen et al., 1985, p.126). For the purpose of this scoping review, both definitions are acceptable for reference to physical activity in Middle Eastern women who have been diagnosed with CAD.

A.2 The Middle East

The often referred to as the Middle East and North Africa (MENA), is a geographical region located between the southwest of Asia and the north of Africa. The exact definition of the region varies between sources, with the most common classification including 19 countries, 14 from the Middle East and 5 North African countries (Algeria, Bahrain, Egypt, Iran, Iraq,
Israel, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Palestine, Qatar, Saudi Arabia, Syria, Tunisia, United Arab Emirates, and Yemen); with a total population of around 360 million people residing in the region (Worldatlas, 2024; World Bank Group, 2024). Turkey is located between Europe and the Middle East. It is included in border definitions of MENA but intermittently excluded in other contexts (Worldatlas, 2024). Eastern Mediterranean Region (EMR) is another term that is used in health research and adopted by the World Health Organisation (WHO). The EMR definition differs from that of MENA by the addition of the four Arabic and/or Islamic countries (Afghanistan, Djibouti, Pakistan, and Somalia) that are not geographically located neither in southwest of Asia nor the north of Africa. (WHO, 2022). For the purposes of this scoping review, the definition of MENA with is chosen because the countries included in the definition are closer geographically and have more cultural and/or religious similarities.

A.3 Coronary artery disease (CAD)

CAD also known as coronary heart disease (CHD) or ischemic heart disease (IHD), is defined as inadequate circulation to the heart caused by stenosis or occlusion in the coronary arteries (The US Institute of Medicine, 2010). In addition to the previous definitions, a relevant Cochrane systematic review conducted on a wider population was used to identify synonyms for coronary artery disease and physical activity (Anderson et al., 2016b). Google search engine was used to identify search terms related to the Middle East.

Appendix B: The electronic search strategy used in the electronic databases and Google Scholar search engine

Database	Terms	Hits	Kept #	Date
Medline	africa, northern/ or algeria/ or egypt/ or libya/ or morocco/ or tunisia/ or south sudan/ or sudan/ or middle east/ or bahrain/ or iraq/ or jordan/ or kuwait/ or lebanon/ or oman/ or qatar/ or saudi arabia/ or syria/ or united arab emirates/ or yemen/ or somalia/ or mauritania/ or djibouti/ or arabs/ or comoros/ or (algeria* or bahrain* or comor* or egypt* or iraq* or jordan* or kuwait* or kuweit* or leban* or liban* or lubnan* or lobnan* or yemen* or aden or sanaa or UAE or Emirat* or (abu adj dhabi) or dubai or libya* or morocco or moroccan* or oman* or muscat or palestin* or ghazza or ghaza or gaza or (west* adj2 bank) or q?atar* or katar* or saudi* or KSA or Riyadh or Syria* or tunis* or ((east* or north*) adj2 africa*) or sudan* or djibouti* or somali* or mauritania* or ifni or (trucial adj state*) or MENA or EMRO or ((middle or near) adj2 east*) or (east* adj2 mediterranean) or orient or arabs or arab or arabia or levant).mp. exp Exercise Therapy/ or Sports/ or Physical Exertion/ or rehabilitat*.mp. or (physical* adj5 (fit* or train* or therap* or activit*)).mp. or exp Exercise/ or (train* adj5 (strength* or aerobic* or exercise*)).tw. or ((exercise* or fitness) adj3 (treatment or intervent* or Programmeme*)).tw. or exp Rehabilitation/ or kinesiotherap*.tw. or	3019 After limit to English and 2009-current 2088	4	2 December 2021

	"Physical Education and Training"/ or Patient Education as Topic/ or (patient* adj5 educat*).tw. or ((lifestyle or life-style) adj5 (interven* or Programmeme* or treatment*)).tw. or Self Care/ or (self adj5 (manag* or care or motivate*)).tw. or exp Psychotherapy/ or psychotherap*.tw. or (psycholog* adj5 intervent*).tw. or Counseling/ or (counselling or counseling).tw. or ((behavior* or behaviour*) adj5 (modify or modificat* or therap* or change)).tw. or (psycho-educat* or psychoeducat*).tw. or (motivat* adj5 (intervention or interv*)).tw. or Health Education/ or (health adj5 educat*).tw. or (psychosocial or psycho-social).tw. or (cognitive adj2 behav*).tw. or exp Sedentary Behavior/ or exercis*.mp. or physical activit*.mp. or strength.mp. or balance.mp. or weight bearing.mp. or sport*.mp. or swim*.mp. or cycl*.mp. or jog*.mp. or run*.mp. or bik*.mp. or danc*.mp. or walk*.mp. exp Myocardial Ischemia/ or (myocard* adj5 (ischaemia or ischemia)).tw. or (isch?emi* adj5 heart).tw. or exp Coronary Artery Bypass/or (myocard* adj5 infarct*).tw. or (heart adj5 infarct*).tw. or angina.tw. or (coronary adj5 (disease* or bypass or thrombo* or angioplast*)).tw. or exp Percutaneous Coronary Intervention/ or (percutaneous coronary adj2 (interven* or revascular*)).tw. or exp Angioplasty/ or angioplast*.tw. or ((coronary or arterial) adj4 dilat*).tw. or endoluminal repair*.tw. or exp Stents/ or stent*.tw. or (pci or ptca).tw. or exp Atherectomy/ or			

	atherectom*.tw. or acute coronary syndrom*.tw.			
CINHAL (EBSCO)	S55 S10 AND S23 AND S35 AND S53 AND S54 S54 ((MH "Middle East+") OR (MH "Africa, Northern+")) OR (TI ((middle W2 east*) OR (north* W2 Africa*) OR (west* W2 bank) OR (east* W2 mediterranean) OR lebanon OR lebanese OR algeria* OR bahrain* OR comoros* OR egypt* OR iraq* OR jordan* OR kuwait* OR libanaise OR yemen* OR dubai OR (abu W2 dhabi) OR aden OR sanaa OR UAE OR emirat* OR libya* OR morocco OR moroccan* OR ifni OR (trucial W2 state*) OR oman* OR muscat OR palestin* OR gaza OR qatar* OR katar* OR quatar* OR saudi* OR KSA OR Syria* OR tunis* OR sudan* OR djibouti* OR somali* OR mauritania* OR levant OR MENA OR EMRO OR orient OR arabs OR arab OR arabia) OR AB ((middle W2 east*) OR (north* W2 Africa*) OR (west* W2 bank) OR (east* W2 mediterranean) OR lebanon OR lebanese OR algeria* OR bahrain* OR comoros* OR egypt* OR iraq* OR jordan* OR kuwait* OR libanaise OR yemen* OR dubai OR (abu W2 dhabi) OR aden OR sanaa OR UAE OR emirat* OR libya* OR morocco OR moroccan* OR ifni OR (trucial W2 state*) OR oman* OR muscat OR palestin* OR gaza OR qatar* OR katar* OR quatar* OR saudi* OR KSA OR Syria* OR tunis* OR sudan* OR djibouti* OR somali* OR mauritania* OR levant OR MENA OR EMRO OR orient OR arabs OR arab OR arabia)) S53 S23 OR S36 OR S37 OR S38 OR S39 OR S40 OR S41 OR S42 OR S43	276 limit to English 254 2009-2021 219	1	23 December 2021

	OR S44 OR S45 OR S46 OR S47 OR S48 OR S49 OR S50 OR S51 OR S52 S52 (cognitive N2 behav*) S51 (psychosocial or psycho-social) S50 (health N5 educat*) S49 (MH "Health Education") S48 (motivat* N5 (intervention or interv*)) S47 (psycho-educat* or psychoeducat*) S46 ((behavior* or behaviour*) N5 (modify or modificat* or therap* or change)) S45 (counselling or counseling) S44 (MH "Counseling") S43 (psycholog* N5 intervent*) S42 psychotherap* S41 (MH "Psychotherapy+") S40 (self N5 (manag* or care or motivate*)) S39 (MH "Self Care") S38 ((lifestyle or life-style) N5 (interven* or Programmeme* or treatment*)) S37 (patient* N5 educat*) S36 (MH "Patient Education") S35 S10 OR S24 OR S25 OR S26 OR S27 OR S28 OR S29 OR S30 OR S31 OR S32 OR S33 OR S34 S34 "acute coronary syndrom*" S33 atherectom* S32 (MH "Atherectomy+") S31 pci or ptca S30s tent* S29 (MH "Stents+") S28 "endoluminal repair*" S27 ((coronary or arterial) N4 dilat*) S26 angioplast* S25 (MH "Angioplasty+") S24 (percutaneous coronary N2 (interven* or revascular*)) S23 S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18 OR S19			

	OR S20 OR S21 OR S22 S22 exercise* OR “physical activit*” OR “resistance training” OR rehabilitat* OR strength* OR balance OR ”weight bearing” OR sport* OR walk* OR jog* OR danc* OR swim* OR run* OR cycl* OR bik* S21 (MH "Physical Education and Training") S20 kinesiotherap* S19 ((exercise* or fitness) N3 (treatment or intervent* or Programmeme*)) S18 ((exercise* or fitness) N3 (treatment or intervent* or Programmeme*)) S17 (train* N5 (strength* or aerobic* or exercise*)) S16 (MH "Exercise+") S15 (physical* N5 (fit* or train* or therap* or activit*)) S14 rehabilitat* S13 (MH "Physical Activity") S12 (MH "Sports") S11 (MH "Therapeutic Exercise+") S10 S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 S9 (coronary N5 (disease* or bypass or thrombo* or angioplast*)) S8 angina S7 (heart N5 infarct*) S6 (heart N5 infarct*) S5 (myocard* N5 infarct*) S4 (MH "Coronary Artery Bypass+") S3 (isch?emi* N5 heart) S2 (myocard* N5 (ischaemia or ischemia)) S1 (MH "Myocardial Ischemia+")			
Embase	exp Heart Muscle Ischemia/ (myocard* adj5 (ischaemia or ischemia)).tw.	2376 Limit to (English/	1	27 December 2021

	(isch?emi* adj5 heart).tw. exp Coronary Artery Bypass Graft/ (myocard* adj5 infarct*).tw. (heart adj5 infarct*).tw. angina.tw. (coronary adj5 (disease* or bypass or thrombo* or angioplast*)).tw. exp percutaneous coronary intervention/ (percutaneous coronary adj2 (interven* or revascular*)).tw. exp angioplasty/ angioplast*.tw. ((coronary or arterial) adj4 dilat*).tw. endoluminal repair*.tw. exp stent/ stent*.tw. (pci or ptca).tw. exp atherectomy/ atherectom*.tw. acute coronary syndrom*.tw. or/1-8 or/1-20 exp Kinesiotherapy/ Sport/ rehabilitat*.mp. (physical* adj5 (fit* or train* or therap* or activit*)).mp. exp Exercise/ (train* adj5 (strength* or aerobic* or exercise*)).tw.	2009-current /human) 1825		

	((exercise* or fitness) adj3 (treatment or intervent* or Programmeme*)).tw. exp Rehabilitation/ kinesiotherap*.tw. Physical Education/ patient education/ (patient* adj5 educat*).tw. ((lifestyle or life-style) adj5 (interven* or Programmeme* or treatment*)).tw. self care/ (self adj5 (manag* or care or motivate*)).tw. exp psychotherapy/ psychotherap*.tw. ((behavior* or behaviour*) adj5 (modify or modificat* or therap* or change)).tw. (motivat* adj5 (intervention or interv*)).tw. health education/ (health adj5 educat*).tw. exp Sedentary Behavior/ exercis*.mp. physical activit*.mp resistance training.mp. strength.mp. balance.mp. weight bearing.mp. sport*.mp. swim*.mp cycl*.mp jog*.mp. run*.mp.			

	bik*.mp. danc*.mp. walk*.mp. africa, northern/ or algeria/ or egypt/ or libya/ or morocco/ or tunisia/ or south sudan/ or sudan/ or middle east/ or bahrain/ or iraq/ or jordan/ or kuwait/ or lebanon/ or oman/ or qatar/ or saudi arabia/ or syria/ or united arab emirates/ or yemen/ or somalia/ or mauritania/ or djibouti/ or arabs/ or comoros/ or (algeria* or bahrain* or comoros* or egypt* or iraq* or jordan* or kuwait* or kuweit* or leban* or liban* or lubnan* or lobnan* or yemen* or aden or sanaa or UAE or Emirat* or (abu adj dhabi) or dubai or libya* or morocco or moroccan* or oman* or muscat or palestin* or ghazza or ghaza or gaza or (west* adj2 bank) or q?atar* or katar* or saudi* or KSA or Syria* or tunis* or ((east* or north*) adj2 africa*) or sudan* or djibouti* or somali* or mauritania* or ifni or (trucial adj state*) or MENA or EMRO or ((middle or near) adj2 east*) or (east* adj2 mediterranean) or orient or arabs or arab or arabia or levant).mp. africa, north*.mp. Arab*.mp. Algeria*.mp. morocc*.mp. Egypt*.mp. libya*.mp. tunisia*.mp. comor*.mp.			

	djibouti*.mp. Mauritania*.mp. Somalia*.mp. Leban*.mp. Syria*.mp. Iraq*.mp. Saudi*.mp. Qatar*.mp. Oman*.mp. Bahrain*.mp. Kuwait*.mp. emirat*.mp. yemen*.mp. palestin*.mp. Jordan*.mp. Sudan*.mp. or/59-83 or/23-44 22 and 84 and 85			
SportDiscus	S16 AND S37 AND S38 S38 "Middle East" OR "Africa, Northern+" OR (middle W2 east*) OR (north* W2 Africa*) OR (west* W2 bank) OR (east* W2 mediterranean) OR lebanon OR lebanese OR algeria* OR bahrain* OR comoros* OR egypt* OR iraq* OR jordan* OR kuwait* OR libanaise OR yemen* OR dubai OR (abu W2 dhabi) OR aden OR sanaa OR UAE OR emirat* OR libya* OR morocco OR moroccan* OR ifni OR (trucial W2 state*) OR oman* OR muscat OR palestin* OR gaza OR qatar* OR	80 limit to English and (2009-crrent) 60	0	28 December 2021

	katar* OR quatar* OR saudi* OR KSA OR Syria* OR tunis* OR sudan* OR d ... S37 S17 OR S18 OR S19 OR S20 OR S21 OR S22 OR S23 OR S24 OR S25 OR S26 OR S27 OR S28 OR S29 OR S30 OR S31 OR S32 OR S33 OR S34 OR S35 OR S36 S36 exercise* OR “physical activit*” OR “resistance training” OR rehabilitat* OR strength* OR balance OR ”weight bearing” OR sport* OR walk* OR jog* OR danc* OR swim* OR run* OR cycl* OR bik* S35 (health N5 educat*) S34 Health Education S33 (motivat* N5 (intervention or interv*)) S32 ((behavior* or behaviour*) N5 (modify or modificat* or therap* or change)) S31 (self N5 (manag* or care or motivate*)) S30 Self Care S29 ((lifestyle or life-style) N5 (interven* or Programmeme* or treatment*)) S28 (patient* N5 educat*) S27 Patient Education S26 "Physical Education and Training" S25 kinesiotherap* S24 ((exercise* or fitness) N3 (treatment or intervent* or Programmeme*)) S23 (train* N5 (strength* or aerobic* or exercise*)) S22 Exercise			

	S21 (physical* N5 (fit* or train* or therap* or activit*)) S20 rehabilitat* S19 "Physical Activity" S18 Sports S17 "Therapeutic Exercise+" S16 S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15 S15 "acute coronary syndrom*" S14 atherectom* S13 pci or ptca S12 Stents S11 ((coronary or arterial) N4 dilat*) S10 angioplast* S9 (percutaneous coronary N2 (interven* or revascular*)) S8 (coronary N5 (disease* or bypass or thrombo* or angioplast*)) S7 angina S6 (heart N5 infarct*) S5 (myocard* N5 infarct*) S4 Coronary Artery Bypass S3 (isch?emi* N5 heart) S2 Myocardial Ischemia S1 (myocard* N5 (ischaemia or ischemia))			
Psychinfo	exp Myocardial Infarctions/ or exp Ischemia/ (myocard* adj5 (ischaemia or ischemia)).tw. isch?emi* adj5 heart).tw.	593 limit to human English and	0	30 December 2021

	exp Heart Surgery/ (myocard* adj5 infarct*).tw. (heart adj5 infarct*).tw. angina.tw. (coronary adj5 (disease* or bypass or thrombo* or angioplast*)).tw. (percutaneous coronary adj2 (interven* or revascular*)).tw. angioplast*.tw. Percutaneous Coronary Intervention.tw. ((coronary or arterial) adj4 dilat*).tw. stent*.tw. (pci or ptca).tw. (pci or ptca).tw. acute coronary syndrom*.tw. or/1-16 exp Exercise/ Sports/ exp Sports/ Physical Exertion/ exp Physical Activity/ rehabilitat*.mp. (physical* adj5 (fit* or train* or therap* or activit*)).mp. (train* adj5 (strength* or aerobic* or exercise*)).tw. ((exercise* or fitness) adj3 (treatment or intervent* or Programmeme*)).tw. exp Rehabilitation/ kinesiotherap*.tw. "Physical Education and Training"/	(2009-current) 437		

	exp Training/ Patient Education.mp. or exp Client Education/ (patient* adj5 educat*).tw. ((lifestyle or life-style) adj5 (interven* or Programmeme* or treatment*)).tw. exp self care/ (self adj5 (manag* or care or motivate*)).tw. ((behavior* or behaviour*) adj5 (modify or modificat* or therap* or change)).tw. (motivat* adj5 (intervention or interv*)).tw. exp Health Education/ (health adj5 educat*).tw. exp Sedentary Behavior/ exercis*.mp. physical activit*.mp. resistance training.mp. strength.mp. balance.mp. weight bearing.mp. sport*.mp. swim*.mp. cycl*.mp. jog*.mp. run*.mp. bik*.mp. danc*.mp. walk*.mp. or/18-54			

	africa, northern/ or algeria/ or egypt/ or libya/ or morocco/ or tunisia/ or south sudan/ or sudan/ or middle east/ or bahrain/ or iraq/ or jordan/ or kuwait/ or lebanon/ or oman/ or qatar/ or saudi arabia/ or syria/ or united arab emirates/ or yemen/ or somalia/ or mauritania/ or djibouti/ or arabs/ or comoros/ or (algeria* or bahrain* or comoros* or egypt* or iraq* or jordan* or kuwait* or kuweit* or leban* or liban* or lubnan* or lobnan* or yemen* or aden or sanaa or UAE or Emirat* or (abu adj dhabi) or dubai or libya* or morocco or moroccan* or oman* or muscat or palestin* or ghazza or ghaza or gaza or (west* adj2 bank) or q?atar* or katar* or saudi* or KSA or Syria* or tunis* or ((east* or north*) adj2 africa*) or sudan* or djibouti* or somali* or mauritania* or ifni or (trucial adj state*) or MENA or EMRO or ((middle or near) adj2 east*) or (east* adj2 mediterranean) or orient or arabs or arab or arabia or levant).mp. qatar*.mp. saudi*.mp. oman*.mp. iraq*.mp. kuwait*.mp. Arab*.mp. yemen*.mp. syria*.mp. tunisia*.mp. jordan*.mp. Emirat*.mp.			

	comor*.mp. algeria*.mp. Egypt*.mp. palestin*.mp. djibouti*.mp. leban*.mp. morocc*.mp. mauritania*.mp. Libya*.mp. Sudan*.mp. bahrain*.mp. Somalia*.mp. or/56-79 17 and 55 and 80			
Scopus	Cardiac OR "myocardial ischemia" OR "myocardial infarction" OR "Coronary disease" OR angina OR "percutaneous coronary intervention" OR "coronary artery bypass graft" OR pci OR ptca OR angioplas* OR “acute coronary syndrome” "Physical activit*" OR "physical inactivit*" OR "sedentary time" OR exercise* OR sport* OR "resistance training" OR strength* OR balance OR "weight bearing" OR walk* OR jog* OR dance* OR swim* OR run* OR cycle* OR bike* OR rehab* OR educat* "Middle East*" OR "Africa, Northern+" OR "middle W2 east*" OR "north* W2 Africa*" OR "west* W2 bank" OR "east* W2	913 after limiting for English and (2011-current) 667	0	16 January 2021

	mediterranean" OR lebanon OR leban ese OR algeria* OR bahrain* OR com oros* OR egypt* OR iraq* OR jordan* OR kuwait* OR libanaise OR yemen* OR dubai OR "abu W2 dhabi" OR aden OR sanaa OR uae O R emirat* OR libya* OR morocco OR moroccan* OR ifni OR oman* OR mu scat OR palestin* OR gaza OR qatar* OR katar* OR quatar* OR saudi* OR ksa OR syria* OR tunis* OR sudan* OR djibouti* OR somali* OR mauritani a* OR levant OR mena OR emro OR orient OR arabs OR arab* OR arabia			
Google scholar	(exercise |“physical activity” |rehabilitation |sport |walk |jog) + (“myocardial ischemia” |infarction |coronary disease |"percutaneous coronary intervention” | bypass |cardiac) + (Arabs | “middle east”)	The first 200 results were retrieved	2	16 January 2022

Appendix C: Characteristics of the selected studies

Table C.1 Characteristics of the selected studies

Author/Year	Study design, setting and location	Aim of the study	Sampling and ethnicity	Data collection technique/analysis	Summary of the main results
Acar et al 2017	Quantitative, Prospective cohort study Setting: Outpatient setting, Turkey	To investigate factors which may influence undertaking regular physical activity in patients with a history of coronary revascularisation.	Sampling: Non-probability sample (convenient). Consecutive out-patient visitors were recruited. N= 202 participants. 54 females (26.7%) Ethnicity/ nationality: Turks.	Data collection: A questionnaire designed by the investigators. Medical history was obtained from medical records. Data analysis: Descriptive statistics, Chi-square test or Fisher's exact test for categorical variables. For	22.8 % of the total sample performed regular physical activity. 15.2 % of the physically active were females, 13% of the total female sample. Walking is the most common type of physical activity. Median of the total sample exercised twice a week for 2 hrs. Being female, unemployed, having low education or low income, and lack of regular follow up are predictors for

Author/Year	Study design, setting and location	Aim of the study	Sampling and ethnicity	Data collection technique/analysis	Summary of the main results
				continuous variables, t-test for normally distributed variables, and the Mann-Whitney U test for skewed distribution. Univariate and multivariate logistic regression analysis.	not engaging in regular physical activity
Zhao et al 2017	Quantitative, Clinical Audit Setting: Outpatient cardiology clinics in 11 countries. 5	To investigate whether there are sex differences in the management of coronary heart	Sampling: Non-probability sample (convenient). Consecutive out-	Data collection: Data obtained by trained research staff following a	91% of middle eastern women performed adequate physical activity.

Author/Year	Study design, setting and location	Aim of the study	Sampling and ethnicity	Data collection technique/analysis	Summary of the main results
	centres from the Middle East (Saudi Arabia)	disease risk factors among patients with established coronary heart disease from three diverse regions.	patient visitors were recruited. N= 10,112 participants. 1580 Participants from the Middle East (Saudi Arabia) 413 of the Middle Eastern sample were women (26.1%) Ethnicity/nationality: Arabs (Saudi)	standardized procedure and recorded on a one-page data collection sheet. Data Analysis: Descriptive statistics. Logistic regression analyses were used to obtain odds ratios.	After adjustment for age, males were more physically active then females. No difference in cardiac rehabilitation participation by gender as both sexes are not adequately attending. All lifestyle targets were better achieved by men.
Nalini 2014	Quantitative,	To analyse the use of cardiac rehabilitation after	Sampling: Cluster sample. All CABG patients	Data collection: Examination of	Less than half of the women were referred to cardiac

Author/Year	Study design, setting and location	Aim of the study	Sampling and ethnicity	Data collection technique/analysis	Summary of the main results
	Cross-sectional study Setting: The cardiac rehabilitation centre of Imam-Ali University Hospital in Kermanshah, Iran	coronary bypass surgery by gender and geography To examine the effects of systematic referral, Programme model, and insurance types on cardiac rehabilitation participation in the west of Iran.	referred to the center between September 2002 and June 2012 were registered to be invited for the study. N= 4735 participants, 1340 women (28.3%) Ethnicity/ nationality: Iranians	medical records and cardiac rehabilitation attendance records. Data analysis: Descriptive statistics, Chi-square test for categorical variables, independent t test for continuous variables Z test used to compare the	rehabilitation (575 women (42.9%)) 209 women participated in cardiac rehabilitation (15.6% out of all women, 36.3% out of the referred ones) 186 completed the Programme (13.9% out of all women, 32.3% out of the referred). There was no significant difference in referral based on gender, but participation and completion rates are significantly lower in women than men. When stratified by location, women referral rate was

Author/Year	Study design, setting and location	Aim of the study	Sampling and ethnicity	Data collection technique/analysis	Summary of the main results
				changes, before and after systematic referral, and between different groups.	significantly lower than men living far away from the centre. Systemic referral has significantly increased women referral from 33.4% to 95.1%. 23.4% of women living far away chose the hybrid Programme.
Sadeh et al. 2021	Quantitative, Cohort study Setting: Seven cardiothoracic wards located throughout Israel.	To investigate the association between residential greenness and exercise-related physical activity in a cohort	Sampling: Cluster sample. All CABG patients in the study centers who were found eligible were included.	Data collection: Interview and medical records examination. Residential greenness was estimated using the satellite-	33 women participated in CR (17.7%). At baseline, 34 of women who did not participate in CR (22.2%) and 15 of those who did (45.5%) reported being physically active.

Author/Year	Study design, setting and location	Aim of the study	Sampling and ethnicity	Data collection technique/analysis	Summary of the main results
		of Israeli coronary patients and examine potential interactions between participation in cardiac rehabilitation according to sex and the level of greenness on exercise-related physical activity one year after surgery.	N= 846 participants. 186 females (22%). Only 32 (3.8%) Arabs of the total sample, among which there is 5 women (0.6%) Ethnicity/ nationality: Israelis. Israeli-born Jews, Russian-born Jews and Arabs.	derived Normalized Difference Vegetative Index (NDVI), which measures the amount of vegetation over a unit area. Data analysis: Descriptive statistics, Chi square, ANOVA, Student's t-test and the Mann–Whitney U-test, Logistic regression.	The number of hours per week was also collected. 119 of non-CR participants (77.8%) and 18 of CR participants (54.5) reported 0 hour of PA per week. 18 of the non-participants (11.8) and 6 of the participants (18.2) reported 1-2.49 hour per week. 15 of the non-participants (9.8) and 9 of the participants (27.3) reported 2.5 to 4.99 hrs per week. 1 of the non-CR participants (0.7) and none of the CR participants reported more 5 or more hrs per week.

Author/Year	Study design, setting and location	Aim of the study	Sampling and ethnicity	Data collection technique/analysis	Summary of the main results
					This shows that being physically active at baseline increases the chance of CR participation. Overall, participation in cardiac rehabilitation was especially low (<18%) among women. Exposure to greenness did not differ according to cardiac rehabilitation status The results of women were not stratified by ethnicity.
Gerber et al 2011 (b)	Quantitative. Longitudinal prospective cohort study	(1) to compare survival experience between baseline (pre-MI) inactive,	Sampling: Convenient sample	Data collection: Structured interview at 5 different times and medical	Only 14% of women who survived remained continuously active throughout the follow-up period.

Author/Year	Study design, setting and location	Aim of the study	Sampling and ethnicity	Data collection technique/analysis	Summary of the main results
	Setting: Central Israel	irregularly active and regularly active patients; and (2) to examine long-term trajectories of leisure time physical activity (LTPA) post-MI and their association with mortality risk.	N= 1390 participants. 19% women (262) Ethnicity/ nationality: Israelis. Ethnicity not mentioned.	records examination. Data analysis: Descriptive statistics, Chi square test for comparison of categorical variables and analysis of variance for continuous variables, Cox proportional hazards models were constructed to evaluate the unadjusted and	

Author/Year	Study design, setting and location	Aim of the study	Sampling and ethnicity	Data collection technique/analysis	Summary of the main results
				covariate-adjusted hazard ratios.	
Gerber et al. 2011 (a)	Quantitative. Longitudinal prospective cohort study Setting: Central Israel	To examined whether neighbourhood socio-economic status predicts long-term trajectory of leisure-time physical activity (LTPA), an established prognostic factor.	Sampling: Convenient sample N= 1410 participants. 19% women (265) Ethnicity/ nationality: Israelis. Ethnicity not mentioned.	Data collection: Structured interview at 5 different times and medical records examination. Data analysis: Descriptive statistics, Chi square test for comparison of categorical variables and analysis of	Female gender is independent predictor of decreasing leisure time physical activity (LTPA) after MI.

Author/Year	Study design, setting and location	Aim of the study	Sampling and ethnicity	Data collection technique/analysis	Summary of the main results
				variance for continuous variables, Generalized estimating equations (GEEs).	
Dankner et al. 2015	Quantitative. A multicentre interventional controlled cohort study. Setting: The cardiothoracic department of five medical centres in Israel.	To investigate the effect of the implemented intervention aimed at increasing the awareness of patients and medical staff to the benefits of cardiac rehabilitation	Sample: Convenient sample. N= 1024 participants. 504 in the intervention arm and 520 in the control arm. Among the intervention group, 110 women were	Data collection: Interview and medical records examination. Data analysis: Descriptive statistics, differences between the two groups were compared using	Belonging to the intervention arm was strongly associated with increased participation in cardiac rehabilitation. Participants in cardiac rehabilitation were more often men and more likely to have reported performing regular physical activity.

Author/Year	Study design, setting and location	Aim of the study	Sampling and ethnicity	Data collection technique/analysis	Summary of the main results
		programme on the rates of participation in cardiac rehabilitation in a diverse population and on subpopulations according to sex, age, socioeconomic status and cultural background, and examined reasons for non-participation.	(22%). 134 women (26%) participated in the control group. Ethnicity/ nationality: Israelis. Ethnicity is not mentioned.	the T-test, Chi-square test and Fisher's exact test. Model prediction was developed using multiple logistic regression.	Reasons for not participating in cardiac rehabilitation cited by participants were lack of knowledge and poor accessibility. Lack of knowledge as a reason for not participating in cardiac rehabilitation decreased between control and intervention and the reduction was more pronounced for women than for men.

Author/Year	Study design, setting and location	Aim of the study	Sampling and ethnicity	Data collection technique/analysis	Summary of the main results
Donnely et al 2012	Qualitative Setting: Doha, Qatar	To find ways to effectively promote cardiovascular health and cardiovascular disease prevention activities among Qatari women (national and non-national Arabic women living in Qatar) by investigating how social, cultural, and economic factors influence	Sampling: Maximum variation purposive sample. N= 50 participants. 100% females Ethnicity/ nationality: Arabs, two (Iranians) Persians/ Qatari Citizens (70%) and Qatari residents (30%).	Data collection: In-depth interviews with open ended questions Data analysis: NVivo software was used for systematic, rigorous development of code categories and subcategories	Opportunities for Arabic women with cardiac disease to engage in healthy lifestyle including physical activities depends on the following: Having an informal social support system (family and friends) Having a formal social support system (health care providers and the government) Valuing individual responsibility. Valuing looking good and feeling healthy.

Author/Year	Study design, setting and location	Aim of the study	Sampling and ethnicity	Data collection technique/analysis	Summary of the main results
		Qatari women's dietary practices, smoking behaviour, and participation in physical activities.			Having some knowledge of the causes of heart disease. The positive influence of religion. Positive influence of changing sociodemographic and economic conditions. Led to more independence of women. Challenges to Engage in Healthy Lifestyles: Traditional cultural values and practices: traditional values and practices that restrict women's mobility remain in existence,

Author/Year	Study design, setting and location	Aim of the study	Sampling and ethnicity	Data collection technique/analysis	Summary of the main results
					especially among the older generations Lack of supportive spouse Women's roles and responsibilities. Negative influences of changing sociodemographic and economic conditions. Living in a harsh climate. Women's current health conditions
Farahani et al 2008	Qualitative Grounded theory. Setting: Two educational hospitals, Tehran	To identify key issues relating to cultural factors influencing education of cardiovascular	Sampling: Purposive Sample. N= Nine patients hospitalized owing to	Data collection: Face-to-face open-ended interview. Data analysis:	Physical activity was not a priority for the patients, and they ignored it for the sake of taking care of the family. "I am a housewife and mother of six children. As I

Author/Year	Study design, setting and location	Aim of the study	Sampling and ethnicity	Data collection technique/analysis	Summary of the main results
		disease patients in Iran.	myocardial infarction or unstable angina. Ethnicity/ nationality: Persians/ Iranians.	Coding was carried out line by line, and comparative analysis of the excerpts was performed in two phases. In the first phase, categories and themes in the data were identified and grouped into domains. In the second phase, the categories and domains were regrouped	wake up early in the morning, I work at the house till late at night, and I dare find even a few minutes to serve myself and due to my heavy duties, I don't find enough time to perform sports or any kinds of physical exercises"

Author/Year	Study design, setting and location	Aim of the study	Sampling and ethnicity	Data collection technique/analysis	Summary of the main results
				into major themes.	
AlSaleh and Baniyasin 2022	Design: Quantitative Cross-sectional study Setting: Two university hospitals in Jordan	(1) To describe the prevalence of PA levels in patients with CHD and the benefits of and barriers to PA as perceived by Jordanian patients with CHD. (2) To describe the relationship between perceived benefits of and barriers to PA and the participation of	Sapling: Convenient Sample. N= 400 diagnosed with CHD. 141 (35.3%) are women. Ethnicity/ nationality: Arabs/ Jordanians.	Data collection: Structured interview using IPAQ and researcher developed tool for assessing the perceived benefits and barriers to PA Data analysis: Descriptive statistical analysis, The Pearson correlation, t-	44% of the women were physically active. Men were significantly more active than women. Labourer of both genders are more likely to be physically active than office worker. 60% of the whole sample (males and females) received weak PA advice or no advice at all. People who perceived their health as very good were statistically more physically active. No statistical

Author/Year	Study design, setting and location	Aim of the study	Sampling and ethnicity	Data collection technique/analysis	Summary of the main results
		these patients in PA. (3) To describe the influence of selected sociodemographic and health characteristics on perceived benefits of and barriers to PA and the participation of PA.		test, chi square test, Fisher's exact test, and one-way analysis of variance.	significance was found for participants with Excellent health perception. Presence of chronic disease is significantly associated with being physically active. Many perceived health benefits were significantly associated with being physically active. Barriers perception was significantly different between physically active and non active participants. Physically active patients exhibited fewer physical, psychological, social, and environmental barriers to the

Author/Year	Study design, setting and location	Aim of the study	Sampling and ethnicity	Data collection technique/analysis	Summary of the main results
					perception of PA than non-physically active participants. Most perceived benefits of PA were physiological, while the most barriers were psychological and social. More females perceived “feeling uncomfortable” and “not enough time” as barriers to PA more than their male counterparts. PA advice had a significant negative relationship with barriers such as “not enough time,” “feeling of being uncomfortable,” “lack of advice,” and “feeling too boring.”

Author/Year	Study design, setting and location	Aim of the study	Sampling and ethnicity	Data collection technique/analysis	Summary of the main results
Tunisi et. Al 2023	Design: Exploratory qualitative study. Setting: Two hospitals in Jeddah, Saudi Arabia	To explore the barriers and facilitators to healthy lifestyle changes among Saudis after cardiac events.	Sampling: Purposive Sample. N: 21 patient who had a cardiac event. 8 women (38.1%) Ethnicity/nationality: Arabs/Saudis	Data collection: Semi-structured interviews. Data analysis: Framework analysis using the Social Ecological Model	Women results: Socio-cultural norms: Established gender roles: (husband's support + women's attire) "I wish I could go to the gym, but my husband won't let me. He thinks that I better look after my children. (P8)" "Our culture is influencing every aspect of our lives. I prefer walking outdoors than going to gym, but this means that I must walk or jog wearing Abaya, which is really difficult. this limits our options. (P11)"

Author/Year	Study design, setting and location	Aim of the study	Sampling and ethnicity	Data collection technique/analysis	Summary of the main results
					Insufficient Healthcare services: “It is really important for us to spend enough time and not be rushed. People wait weeks for their appointments. Imagine the disappointment when the doctor looks busy and doesn’t give you the full attention. This really matters. (P11)” Policy regulations: “I think we now see more awareness campaigns and events compared to before. The focus is more on epidemic topics though. Importance of healthy

Author/Year	Study design, setting and location	Aim of the study	Sampling and ethnicity	Data collection technique/analysis	Summary of the main results
					lifestyle and heart health awareness programs are rarely seen. (P18)”
Vahedi et al 2023	Design: Quantitative Cross-sectional study Setting: A general hospital in Tahran, Iran	To identify factors associated with knowledge, attitude and practice (KAP) related to CVD and to compare this KAP between premature CAD and CAD patients.	Sampling: Convenient Sample. N= 100 CAD (27% women) and 100 PCAD patients (42% women. Women comprise 34.5% of the total sample. Ethnicity/ nationality: Persians/ Iranian.	Data collection: Questionnaire Data analysis: Descriptive statistical analysis, Mann-Whitney test, univariate logistic regression, and Multivariate logistic regression.	58 (29%) reported highly insufficient physical activity behaviour, 61 (30.5%) reported insufficient physical activity behaviour, 47 (23.5%) reported sufficient physical activity behaviour, 20 (10%) reported satisfactory PA behaviour and only 14 (7%) reported highly satisfactory PA. This result was not reported by gender. 74.5% of the sample were aware of physically inactivity as risk for CVD. The

Author/Year	Study design, setting and location	Aim of the study	Sampling and ethnicity	Data collection technique/analysis	Summary of the main results
					awareness was more in younger participants (PCAD, 85%) than older participants (CAD, 64%) but was not reported by gender. In univariate analysis, Sex was the only factor significantly associated with physical activity, with men exhibiting higher levels than women (P=0.026) In a multivariate logistic regression model, the odd ratio for physical activity behaviour is less for women, but not statistically significant (P: 0.055).

Appendix D: Critical Appraisal of the Included Studies

Table D.2 Critical appraisal of the included studies:

	Score (0-3)					
Criteria	Paper: Acar et al (2017)	Paper: Zhao et al (2017)	Paper: Gerber et al (2011a)	Paper: Nalini (2014)	Paper: Sadeh at al. (2021)	Paper: Gerber et al (2011b)
Explicit theoretical framework	0	0	0	0	3	0
Statement of aims/objectives in main body of report	3	3	3	3	3	3
Clear description of research setting	3	3	3	3	3	3
Evidence of sample size considered in terms of analysis	0	0	0	0	0	0
Representative sample of target group of a reasonable size	2	3	3	3	3	3
Description of procedure for data collection	3	3	3	3	3	3

Rationale for choice of data collection tool(s)	0	0	3	0	1	0
Detailed recruitment data	1	1	3	3	3	3
Statistical assessment of reliability and validity of measurement tool(s) (Quantitative only)	0	0	3	0	1	0
Fit between stated research question and method of data collection (Quantitative only)	3	3	3	3	3	3
Fit between stated research question and format and content of data collection tool e.g. interview schedule (Qualitative only)	-	-	-	-	-	-
Fit between research question and method of analysis (Quantitative only)	3	3	3	3	3	3
Good justification for analytic method selected	3	3	3	3	3	3

Assessment of reliability of analytic process (Qualitative only)	-	-	-	-	-	-
Evidence of user involvement in design	0	0	0	0	0	0
Strengths and limitations critically discussed	2	3	3	2	3	3
Total and percentage	23/42 (54.8%)	25/42 (59.5%)	33/42 (78.5%)	26/42 (61.9%)	32/42 (76.2%)	27/42 (64.3%)

	Score (0-3)					
Criteria	Paper: Dankner (2015)	Paper: Donnely et al. (2012)	Paper: Farhani et al. (2008)	Paper: Alsaleh and Baniyasin (2022)	Paper: Tunisi et al. (2023)	Paper: Vahedi
Explicit theoretical framework	0	3	0	0	3	0

Statement of aims/objectives in main body of report	3	3	1	3	3	3
Clear description of research setting	3	3	3	3	3	3
Evidence of sample size considered in terms of analysis	0	3	0	3	3	3
Representative sample of target group of a reasonable size	3	3	3	3	3	3
Description of procedure for data collection	3	3	3	3	3	3
Rationale for choice of data collection tool(s)	0	0	0	3	3	3
Detailed recruitment data	3	0	3	3	3	0
Statistical assessment of reliability and validity of measurement tool(s) (Quantitative only)	0	-	-	3	-	3
Fit between stated research question and method of data collection (Quantitative only)	3	-	-	3	-	3

Fit between stated research question and format and content of data collection tool e.g. interview schedule (Qualitative only)	-	3	3	-	3	-
Fit between research question and method of analysis	3	3	3	3	3	3
Good justification for analytic method selected	3	3	3	3	2	3
Assessment of reliability of analytic process (Qualitative only)	-	3	3	-	3	-
Evidence of user involvement in design	0	0	0	3	3	3
Strengths and limitations critically discussed	3	3	3	0	3	2
Total and percentage	27/42 (64.3%)	33/42 (78.6%)	28/42 (66.7%)	36/42 (85.7%)	41/42 (97.6%)	35/42 (83.3%)

Appendix E: Participant Information Sheet

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Title: Exploring attitudes, barriers and facilitators to the uptake of and adherence to exercise and physical activity among Saudi women diagnosed with coronary artery disease: a qualitative study.

Participant Information Sheet: Saudi women

Invitation

You are invited to take part in the above research study. Before deciding if you would like to participate, it is important for you to understand the purpose of the research and what taking part involves. Please read this information carefully before deciding whether to take part. Please contact the researcher if anything is not clear, or if you would like more information. Many thanks for taking the time to read this information

What is the purpose of the project?

Lack of physical activity and leading a more sedentary lifestyle are identified among the reasons for the high prevalence of coronary artery disease in the Eastern Mediterranean region. Therefore, this study aims to identify the reasons that make undertaking exercise and physical activity easy or hard for you after your diagnosis of coronary artery disease

Why have I been chosen?

You have been invited to participate in this study because you are a Saudi woman who has been diagnosed with coronary artery disease. We aim to interview around 15-20 women with coronary artery disease

What does the study involve?

If you decided to participate, you will be invited to an interview and asked to talk about your opinion about the need for exercise and physical activity after being diagnosed with coronary artery disease and what makes it easy or difficult to be physically active. The interview will be undertaken with your consent, either face-to-face or online using either Microsoft Teams or Zoom (depending on your preference). If face-to-face, the interview will be conducted in a hospital setting. The interview is expected to take about an hour and will be audio-recorded with your consent. The interview will follow an interview guide. However, if you feel that there is important information to add, you are free to tell the researcher about your thoughts. You are also free to take a break or stop the interview if you feel uncomfortable.

What will happen to the results of the research project?

Your anonymised responses and that of other participants will be analysed and reported. Some direct quotes may be used from all participants to illustrate the views and opinions expressed; however, these will not be associated with your name. The

results of this study will form a part of Zainab Al-Sabei's PhD thesis and will be published in a peer reviewed scientific journal and presented at conferences

Do I have to take part?

No, taking part is completely voluntary. If you decide to take part, you will be asked to sign a consent form before starting the face-to-face interview or record your agreement by reading and agreeing to every item in the consent form before starting the online interview. You may withdraw from the study at any stage during or after the interview without giving a reason. If you decide to withdraw your information from the study, you will be able to do so until two weeks after participation in the interview without giving any reason and without any negative consequences. After two weeks, your anonymous contribution during the interview will be analysed and therefore cannot be withdrawn

What are the possible benefits of taking part?

There are no direct benefits to you from taking part in the study. However, the information you provide will help us better understand your experience with exercise and physical activity after being diagnosed with coronary artery disease, and the education and support you receive from healthcare professionals, which may result in improving the provided healthcare services

What are the possible disadvantages and risks of taking part?

There are no direct risks to you from taking part in the study. However, if at any point you feel upset or uncomfortable with any of the questions being asked during the interview, you are free to refuse to answer any question, and leave the interview at any time without having to explain this

Use, dissemination, and storage of research data

Once all the data has been collected, the interview recordings will be transcribed, and analysed. I can share the results with you. If you wish me to do this, please provide your email address following the interview and I will send you a summary of the findings. The findings will be written into a PhD Thesis and will be published in relevant healthcare journals. No participant will be identified in any publication. Data will be kept within a password-protected file on a secure cloud-based storage for 3 years, and then archived in the University of Leeds repository for 10 years. Data generated during the research will be retained in accordance with the University's Data Protection Policy. Also, kindly check this link for information about research privacy notice: Research-Participant-Privacy-Notice.docx (live.com). You can translate the document by clicking on the three dots in the upper right corner, click translate and then choose the Arabic language.

What will happen to my personal information?

All your information that is given to the researcher will remain strictly confidential. All information recorded during the interviews will be handled in the strictest confidence. The consent form and the written information containing your personal details will be stored securely in a locked cabinet in the researcher's home office where no one other than the researcher will have access and will be scanned within 48 hours. Once an electronic copy is kept securely, the paper forms will be destroyed. The electronic forms, interviews transcripts and other files will be stored encrypted, and password protected on the researcher's OneDrive account provided by the University of Leeds. A pseudonym will be used in the interview transcripts. No names or identifying

statements will be used in any report or presentation. All your personal details will be destroyed once the data collection is completed. No personal information will be traced back to you for any reason. The digital audio recording of the interview will be used for reference only and will be deleted after transcription. The recording will be stored as a password-protected file on a secure cloud-based storage at the University of Leeds. **Please note that if unsafe/unprofessional practice was disclosed during the interview, the researcher will need to report it to the hospital administration. Also, if you are exposed to** a threat of violence or illness during the interview, the researcher will contact the relevant authorities (police, ambulance)

How will the recorded media be used?

The digital audio recordings will be transcribed, anonymised, and analysed. The recordings will not be used for any other purposes nor accessed by anyone other than the researcher

Who is organising/ funding the research?

This research is part of Zainab's PhD project in the University of Leeds, UK, and sponsored by the Ministry of Education in Saudi Arabia

Who has reviewed this study?

Ethical approval has been granted by the School of Healthcare Research Ethics Committee (SHREC) at the University of Leeds as well as Imam Abdulrahman bin Faisal University, and Qatif Central Hospital in Saudi Arabia

What if I have concerns about the study?

If you have any questions or would like further details about the study, please contact Zainab Al-Sabei (see contact details below) who will do her best to answer your questions. You can also contact her principal supervisor: Dr. Maria Horne, or second supervisor: Professor Gretl McHugh (see contact details below)

What do I do now?

If you decided to participate in this research, you can contact me (the researcher) by phone or via email. I will arrange a convenient appointment and place to do the interview with you. Prior to the start of the face-to-face interview, I will need to ask you to sign the attached informed consent form (or record your consent during the online interview) and I will provide a copy for you to keep.

Thank you for taking time to read this information sheet and for considering participating in the study.

Contact for further information:

Zainab Al-Sabei
PhD student, School of Healthcare, University of Leeds
E-mail: hczaa@leeds.ac.uk
Phone: +447470383370

Principal supervisor:	**Second supervisor:**
Dr. Maria Horne	Professor Gretl McHugh

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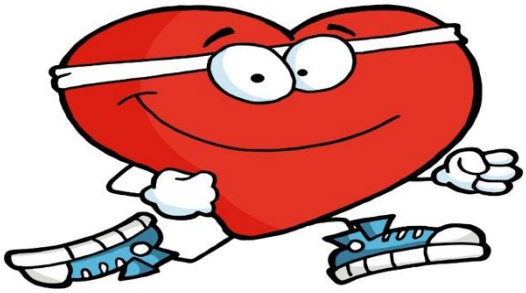
Email: m.horne@leeds.ac.uk Email: g.a.mchugh@leeds.ac.uk

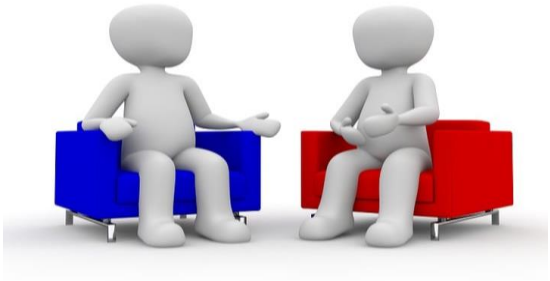
Appendix F: Pictorial Participant Information Sheet

Title: Exploring attitudes, barriers and facilitators to the uptake of and adherence to exercise and physical activity among Saudi women diagnosed with coronary artery disease: a qualitative study.

What is the study about?

	Lack of physical activity is one of the reasons of coronary artery disease.
 This Photo by Unknown Author is licensed under CC BY-NC	This study aims to learn about exercise and physical activity in people with coronary artery disease.
This Photo by Unknown Author is licensed under CC BY-SA-NC	We want to interview you and ask you about your physical activity. It is up to decide to take part.

What will happen if I take part?

	You will be interviewed and asked about your exercise and physical activity habits. The interview will be audio recorded with your agreement.
This Photo by Unknown Author is licensed under CC BY-NC	You can choose to be interviewed in person or online using Microsoft teams or Zoom.
	Before the interview you will be asked to sign a consent form. If the interview is online, your consent will be recorded.
This Photo by Unknown Author is licensed under CC BY-NC	If you decided not to take part, nothing in your usual care will change

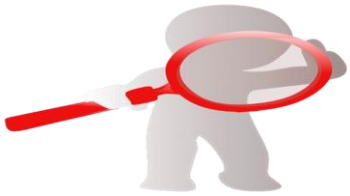
What will happen to my information?

 This Photo by Unknown Author is licensed under CC BY-NC	All information collected from you will be kept safe. Your name will not be used in any report, presentation or publication. All information will be protected in line with the United Kingdom data protection act and the General Data Protection Regulation (GDPR).

What if I want to withdraw from the study?

 This Photo by Unknown Author is licensed under CC BY-NC	You can take break during the interview or stop it anytime without giving any reason.
	You can withdraw up to two weeks after the interview without giving any reason.

What is the risk of taking part?

	There are no expected risks, and if you feel uncomfortable during the interview you can stop it.

What is the benefit of taking part?

 This Photo by Unknown Author is licensed under CC BY-NC	You will help us understand your experience with physical activity. This information can improve the provided care

What if I have a question?

	If you have any questions or want more information, you can contact the researcher or her supervisors. Zainab Al-Sabei E-mail: hczaa@leeds.ac.uk Phone: +447470383370 Principal supervisor: Dr. Maria Horne Email: m.horne@leeds.ac.uk Second supervisor: Professor Gretl McHugh Email:g.a.mchugh@leeds.ac.uk Also, kindly check this link for information about research privacy notice: Research-Participant-Privacy-Notice.docx (live.com) You can translate the document by clicking on the three dots in the upper right corner, click translate and then choose the Arabic language.

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Appendix G: Consent form for Saudi women who have been diagnosed with CAD

Exploring attitude, barriers, and facilitators to the uptake of and adherence to exercise and physical activity among Saudi women diagnosed with coronary artery disease: a qualitative study. **Consent form: Saudi women** **Participant identification number** ☐	**Add your initials next to the statement if you agree**
I confirm that I have read and understand the information sheet v.06 dated 14/06/2023 explaining the above research project and I have had the opportunity to ask questions about the project.	
I understand that my participation is voluntary and that I am free to withdraw without giving any reason or there being any negative consequences, during the interview or any time up to two weeks after conducting the interview. In case of withdrawal, all data collected will be deleted. In addition, should I not wish to answer any particular question or questions, I am free to decline.	
I understand that members of the research team may have access to my anonymised responses. I understand that my name will not be linked with the research materials, and I will not be identified or identifiable in the report or reports that result from the research. I understand that my responses will be kept strictly confidential.	
I understand that the data collected from me may be stored and used in relevant future research and direct quotes from my interview may be included in published documents in an anonymised form.	
I understand that relevant sections of the data collected during the study, may be looked at by individuals from the University of Leeds or from regulatory authorities where it is relevant to my taking part in this research.	
I understand that my interview will be digitally audio-recorded	
I agree to take part in the above research project.	

Name of participant	
Participant's signature	
Date	
Name of lead researcher	
Signature	
Date*	

*To be signed and dated in the presence of the participant.
Once this has been signed by all parties the participant should receive a copy of the signed and dated participant consent form, the letter/ pre-written script/ information sheet and any other written information provided to the participants. A copy of the signed and dated consent form should be kept with the project's main documents which must be kept in a secure location.

Appendix H: Interview schedule for Saudi women diagnosed with coronary artery disease

Introduction

Thank you for agreeing to take part in this interview. The purpose of the interview is to allow me to understand your perception of the need to be physically active, as well as the barriers and facilitators that you face when deciding to undertake exercise and physical activity. The interview is expected to take approximately one hour, and you are free to stop participating at any time. All information obtained from you will remain strictly confidential.

The researcher will ask the participant to sign the consent form.

Are you happy for me to record the interview?

Do you have any further questions regarding the interview before we start?

Opener – How long have you been diagnosed with coronary artery disease?

TDF Domains	**Questions for Saudi women**
1. Knowledge (awareness of the existence of something)	1. What does physical activity mean for you? 2. What does exercise mean for you? 3. What is your understanding of what moderate intensity physical activity is? *Probe: Can you give me an example?* *Researcher will then tell the participant that moderate intensity physical activity is any activity where you will have heavy breathing but still able to talk. e.g., brisk walking, bicycling, gardening, sweeping.* 4. Do you know what the recommended levels for physical activity are per week? *Probe: If so, do you think that you are meeting these recommendations?*

	5. Do you think it is importance that you exercise and or undertaken physical activity if you have heart disease?
2. Skills (any ability or proficiency acquired through practice)	6. How easy or difficult is it for you to undertake 150 minutes of moderate intensity physical activity for a woman with coronary artery disease? 7. What skills do you think you need to be able to do PA?
3. Social/professional role and identity (a coherent set of behaviours and displayed personal qualities of an individual or a social or work setting)	8. Do you think exercising and being physically active fits your character and lifestyle? 1. What do you think the opinion of Islam toward exercise and physical activity? Probes: Do it encourage or discourage it? Can a Muslim woman be physically active?
4. Beliefs about capabilities (acceptance of the truth reality or validity about ability, talent, or facility that a person can put into constructive use)	10. How confident are you about your ability to perform 150 minutes of moderate intensity physical activity? *Prompt: would it be easy or hard?* 11. What challenges prevent you from achieving the recommended level of physical activity? *Probe: What can you do to overcome these challenges?*
5. Optimism (the confidence that things will happen for the best, or that desired goals will be attained)	12. Do you feel that that you can be more physically active in the future? How do you think becoming more physically active is going to affect the course of your disease?
6. Beliefs about consequences (acceptance of the truth reality or validity about outcomes of a behaviour in a given situation)	13. What do you think will happen to you if do not undertake regular exercise or physical activity? *Prompt: good and not so good effects on body and health*
7. Reinforcement (increasing the probability of a response by arranging a dependent relationship or contingency between the response and the given stimulus)	14. Are there any incentives that could encourage you to be more physically active? 15. If you decided to be physically active, how would you do it?

	For example, how would you start? *Probes: for example: Planning, step counter*
8. Intentions (a conscious decision to perform a behaviour or a resolve to act in a certain way)	16. Do you plan to change anything about your exercise and PA levels? *Probe: How/what changes are you thinking about making to increase your exercise and PA levels?*
9. Goals (mental representation of outcome or end states that an individual wants to achieve)	17. Do you want to increase your exercise and PA levels? 18. Do you want to move more than you are at the moment?
10. Memory attention and decision processes: ability to retain information, focus selectively on aspects of the environment and choose two or more alternatives	19. Is exercising or doing PA something you do without thinking? 20. Is increasing your exercise and PA levels something you have thought about before today? 21. Do you exercise and undertake PA because you have been advised to?
11. Environmental context and resources- any circumstance or a person's situation, environment that discourages or encourages the development of skills and abilities, independence, social competence, and adaptive behaviour	22. How easy do you find it to exercise or undertake PA in your city/community area? *Probes: Are there gyms and designated walking areas around you? If no, would it influence you to exercise if they were available?* *Probe: What could be different about these places to help you to exercise or do more PA?* 23. How does the weather affect your decision to undertake 150 minutes of moderate intensity physical activity?
12. Social influences (those interpersonal processes that can cause an individual to change their thoughts, feelings or behaviours)	24. Think about the people you see every day, like family and friends, are they people who are more active or do regular exercise and PA? 25. Do these people make you want to do more or less? *Probes: Do you have someone who exercise with you?*

13. Emotion (a complex reaction pattern, involving experiential, behavioural and psychological elements, by which the individual attempts to deal with personally significant matters or events)	26. How does/would the idea of performing 150 minutes of moderate intensity physical activity per week make you feel? *Probes: fear, anxiety, happiness*
14. Behavioural regulation (anything aimed at managing or changing objectively observed, measured actions)	27. How could your family or healthcare professionals help you to undertake exercise and PA to become more physically active?

Thank you for taking the time to take part in this interview.

Appendix I: Interview schedule for healthcare professionals

Introduction

Thank you for agreeing to take part in this interview. The purpose of the interview is to allow me to understand your perception of the barriers and facilitators that Saudi women face when deciding to exercise and become physically active, as well as the education and support you offer them as a healthcare professional. The interview is expected to take approximately one hour, and you are free to stop participating at any time. All information obtained from you will remain strictly confidential.

The researcher will ask the participant to sign the consent form

Are you happy for me to record the interview?

Do you have any further questions regarding the interview before we start?

TDF Domains	**Questions for Healthcare professionals**
1. Knowledge (awareness of the existence of something)	Are you aware of any recommendations related to exercise and PA for Saudi women with CAD? *Probe: How do you explain moderate intensity activity to Saudi women?* What is your view on the importance of increasing and maintaining exercise and PA among Saudi women with CAD? Or What is your view on the importance of the cardiac rehabilitation programme for Saudi women with CAD? What do you think makes some Saudi women with CAD more active than others?
2. Skills (any ability or proficiency acquired through practice)	How can you monitor the exercise and PA levels of Saudi women?

	How do you manage Saudi women's exercise and PA levels?
3. Social/professional role and identity (a coherent set of behaviours and displayed personal qualities of an individual or a social or work setting)	What guidelines do you follow in providing exercise and PA advice to Saudi women with CAD? What do you consider to be your role in relation to increasing Saudi women's exercise and PA levels?
4. Beliefs about capabilities (acceptance of the truth reality or validity about ability, talent, or facility that a person can put into constructive use)	How confident do you feel about being able to modify, increase Saudi women's with CAD physical activity levels?
5. Optimism (the confidence that things will happen for the best, or that desired goals will be attained)	How do you feel about advising/encouraging increasing exercise and PA among Saudi women with CAD? For example, will it stay the same, lessen or increase? *Probe: Does this concern you at all?*
6. Beliefs about consequences (acceptance of the truth reality or validity about outcomes of a behaviour in a given situation)	Can you tell me what do you know about the benefits of regular exercise and PA among Saudi women with CAD? *Probe: Consider the impact on physical health, mental health etc.* Can you tell me what do you know about the risks or the negative impact of not undertaking regular exercise and PA on Saudi women with CAD? *Probe: Consider physical health, mental health, etc*
7. Reinforcement (increasing the probability of a response by arranging a dependent relationship or contingency between the response and the given stimulus)	What is the general response you give to Saudi women with CAD in relation to increasing exercise and PA during the follow-up/ cardiac rehabilitation/exercise programme?

8. Intentions (a conscious decision to perform a behaviour or a resolve to act in a certain way)	Is there a need to increase the exercise and PA levels of Saudi women with CAD? and if so what do you intend to do to modify Saudi women's exercise and PA levels?
9. Goals (mental representation of outcome or end states that an individual wants to achieve)	Do you have any goals/objectives related increasing the exercise and PA levels of Saudi women with CAD? And if so, what are they?
10. Memory attention and decision processes: ability to retain information, focus selectively on aspects of the environment and choose two or more alternatives	Are there any prompts you use to encourage exercise and PA among Saudi women with CAD when they attend the cardiac rehabilitation programme?
11. Environmental context and resources- any circumstance or a person's situation, environment that discourages or encourages the development of skills and abilities, independence, social competence, and adaptive behaviour	Are there any areas you have identified as not helping Saudi women with CAD to exercise and /or become more physically active? And if so, what are they? Do you think there is adequate resources available for Saudi women with CAD to be physically active? Prob: from the hospital and in the community. What changes in services, programmes or resources can be made to encourage Saudi women with CAD to be more physically active?
12. Social influences (those interpersonal processes that can cause an individual to change their thoughts, feelings or behaviours)	Do you think your own PA behaviour and that of other healthcare professionals might influence Saudi women with CAD undertaking regular exercise and PA? Do you think Saudi women influence each other in becoming more physically active?
13. Emotion (a complex reaction pattern, involving experiential, behavioural and psychological elements, by which the individual attempts to deal with personally significant matters or event)	Are you concerned about the amount of exercise and PA Saudi women with CAD undertake?

14. Behavioural regulation (anything aimed at managing or changing objectively observed, measured actions)	Can you tell me how you could help Saudi women with CAD increase and undertake regular exercise and PA?

Thank you for taking the time to take part in this interview.