The influence of perceived levels of physical activity on engagement with cardiac rehabilitation after acute coronary syndrome

Sheona McHale

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Abstract

Background: Cardiac rehabilitation (CR) is an effective therapy to reduce the risk of hospital readmission after an acute coronary syndrome (ACS) diagnosis. Despite this, half of eligible individuals do not engage. The reasons for this are complex and include patient-level barriers such as beliefs about being already active. Indeed, up to 40% of eligible individuals report meeting physical activity (PA) guidelines prior to attendance, yet little is known about how this influences CR engagement decisions. Therefore, the aim of this thesis was to provide evidence about how previous experience of PA influenced PA and CR engagement after an ACS diagnosis.

Methods: Firstly, a systematic review of 12 studies, representing 388 participants from six countries, explored how previous PA experience influenced engagement with PA during CR was undertaken. Subsequently, a mixed methods explanatory sequential study included a cross-sectional element examining self-reported PA levels, illness perceptions and physical self-descriptions for 67 participants (mean age 64.2 (±10.53SD)), and a qualitative element involving telephone interviews with 26 previously active ACS survivors (aged 44-77 years).

Results: Systematic review synthesis indicated that perceptions of physical ability, exercise self-reliance, severity of cardiac condition and fitness identity influenced perceived CR need. In the mixed-methods study, perceptions of previous PA levels influenced PA engagement decisions after an ACS diagnosis and during CR. Most participants (n=50, 74.6%) self-reported being at least moderately active and self-concept for being active predicted self-reported PA prior to CR. Participants understood ‘being active’ through the lens of previous PA and self-evaluation of health. CR communication and peer comparisons influenced engagement decisions and motivation for fitness goals. Individuals who self-reported being at least moderately active required CR support to increase PA intensity levels after an ACS diagnosis.

Conclusions: ACS survivors conceptualise “being active” based on previous PA experience and these preconceptions influence future fitness goals.

Declaration of Authorship

I hereby declare that:

a) This work has not been submitted for any other degree or professional qualification

b) That this thesis is the result of my own independent work and is not part of a collaboration

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List of Abbreviations

ACS	Acute coronary syndrome
AMI	Acute myocardial infarction
BIPQ	Brief Illness Perceptions Questionnaire
CABG	Coronary artery bypass grafting
CAD	Coronary artery disease
CHD	Coronary heart disease
CMO	Chief Medical Officer
COVID-19	Coronavirus disease 2019
CR	Cardiac rehabilitation
ECG	Electrocardiogram
FITT	Frequency, Intensity, Time, Type
HAPA	Health action process approach
HR	Heart rate
IPAQ-SF	International Physical Activity Questionnaire – Short Form
MET	Metabolic equivalent
MI	Myocardial infarction
NACR	National audit of cardiac rehabilitation
NSTEMI	Non ST elevation myocardial infarction
PA	Physical activity
PCI	Percutaneous coronary intervention
PEO	Population Exposure Outcomes
PSDQ-S	Physical Self-Description Questionnaire – Short Form
RCT	Randomised control trial
RPE	Rating of perceived exertion
SCT	Social cognitive theory

SIMD	Scottish Index of Multiple Deprivation
Std.	Standard
STEMI	ST elevation myocardial infarction
UK	United Kingdom
WHO	World Health Organisation

Chapter 1. Introduction

1.1 Background

Coronary heart disease (CHD) is a major cause of death worldwide (World Health Organisation, 2016). Acute Coronary Syndrome (ACS), a manifestation of CHD, is responsible for over 632,000 deaths each year in Europe (Wilkins et al., 2017). Over the past 30 years mortality rates from ACS have declined and preventing reoccurrence is a priory for people after a diagnosis (Collet et al., 2021). International clinical guidelines recommend people diagnosed with ACS receive secondary prevention interventions to support risk factor management (Piepoli et al., 2016). Cardiac rehabilitation (CR) is recognised internationally as an effective programme reducing mortality and encompassing risk factor management (Anderson et al., 2016), however, 50% of eligible individuals choose not to attend (Bjarnason-Wehrens et al., 2010). In the UK, 40% of eligible individuals report meeting moderate levels of physical activity prior to the start of CR (British Heart Foundation, 2016), yet little is known about how prior physical activity influences engagement with physical activity after diagnosis. Therefore, the research in this thesis aimed to explore how previous experience of physical activity influenced engagement with physical activity after a diagnosis of ACS and in the context of CR.

1.2 Coronary heart disease

CHD is a term used to refer to the disease process of atherosclerosis, which is a build-up of fatty deposits within the coronary arteries (American Association of Cardiovascular and Pulmonary Rehabilitation, 2021).

CHD may cause a reduction of blood flow within the coronary arteries leading to myocardial ischemia (insufficient supply of oxygen to the myocardium). ACS is a collective term that includes three conditions (unstable angina, non ST elevation myocardial infarction (NSTEMI) and ST elevation myocardial infarction (STEMI) (Roffi et al., 2016). The symptoms of ACS result from the dislodgment, or rupturing, of a thrombus from the inflamed atheromatous plaque within the coronary arteries (Collet et al., 2021). This leads to either a partial or complete blockage of a coronary artery, which may, or may not, result in acute cardiomyocyte injury/necrosis (Roffi et al., 2016). ACS is associated with the presence, or absence, of increased cardiac troponin levels within the blood, indicating the extent of cell damage to the heart muscle (Collet et al., 2021).

A clinical presentation of ACS is characterised by symptoms of myocardial ischaemia such as chest pain, pressure, tightness or burning (Collet et al., 2021). Patients presenting with ongoing chest pain (>20 mins) are typically assessed from electrocardiogram (ECG) and diagnosed with a STEMI if ST elevation is recorded, whereas patients presenting with acute chest pain and no ST elevation, are typically diagnosed with a NSTEMI (Collet et al., 2021). Ischaemic symptoms of chest pain may also be associated with the condition unstable angina, distinguishable from a STEMI or NSTEMI by a lack of increased cardiac troponin levels (Roffi et al., 2016).

CHD is a leading cause of death and disability globally, representing an estimated 7.4 million deaths per annum (World Health Organisation, 2016). In Europe, over 335,000 men and 297,000 women will die prematurely each year as a result of CHD and the primary cause of death will be attributed to myocardial infarction (MI) (Wilkins et al., 2017). Information from the National

Health Service Scotland reports that ACS contributes to more than half of all deaths from CHD and is a major factor in the premature death of both men and women within 6 months of a CHD diagnosis (Information Services Division, 2020).

In the UK, the age-standardised death rates from CHD for both male and females have declined between the years of 1980 to 2015 (from 645 to 177 deaths per 1000,000 males; from 313 to 87 deaths per 100,000 in females) (Wilkins et al., 2017). The reduction in mortality rates is partly due to improvements in the initial diagnosis and treatment of CHD, and means that there are an increasing number of people living longer with a diagnosis (Puymirat et al., 2017). The result is that the economic burden in terms of health resources has continued to increase during this time period (Murphy et al., 2020). For example, in Scotland, the number of cardiac prescriptions, including CHD medication, increased by 6.6% between the years 2004 and 2014 (Information Services Division, 2020).

1.3 Treatment

The objective for this non-curative disease is to treat the symptoms and reduce the risk of further events. The core management of ACS is firstly to treat the acute event by revascularisation treatment to re-establish blood flow to the diseased or narrowed coronary arteries, limiting the damage to the myocardium and managing the symptoms of CHD (Collet et al., 2021). Revascularisation techniques are percutaneous coronary intervention (PCI) and Coronary artery bypass grafting (CABG) (Fanning et al., 2016).

PCI may be used as a primary treatment for ACS or as an elective, or planned treatment, for stable angina (Roffi et al., 2016). The treatment is used as a minimally invasive intervention and involves inserting a catheter, either into the femoral or radial artery, and feeding this towards the site of the blockage (Collet et al., 2021). Thereafter, a specialised balloon is inflated to expand the artery and re-establish blood flow (Fanning et al., 2016). This procedure may include the insertion of a stent, a small fine wire mesh tube, often coated with drugs, which when inserted into the coronary artery will increase the diameter and re-establish blood flow (Scottish Intercollegiate Guidelines Network 148, 2016). This treatment is considered a routine procedure, and provides immediate relief from the symptoms of ACS (Fanning et al., 2016). The results from a nationwide cohort study of 427,467 PCI procedures report that the overall 30 day mortality rate following primary PCI is 4.8% (O'Neill et al., 2017).

One of the key advances of PCI treatment has been the reduction in time spent in hospital (Gilchrist, 2014). In the UK, the duration of stay within a hospital setting depends upon the individual case, and whether the PCI procedure is a primary treatment for ACS or an elective treatment for stable angina (Scottish Intercollegiate Guidelines Network, 2017). In clinical guidelines, primary PCI is the preferred revascularisation treatment to restore blood flow and limit myocardium damage immediately after a diagnosis of ACS (Collet et al., 2021). An alternative treatment is a surgical revascularisation technique called coronary artery bypass grafting (CABG) (Roffi et al., 2016). When compared to PCI, CABG is an invasive surgical procedure requiring an incision into chest wall and blood vessels to be taken from elsewhere in the body and used to bypass the obstructed or narrowed sections of the coronary arteries. The length of hospital stay post procedure is between five and eight days (NHS UK, 2015), with a further period post-hospital discharge to encourage sternal bone healing and stability (American Association of Cardiovascular and Pulmonary Rehabilitation, 2021).

During the past ten years there has been a 33.5% reduction in CABG procedures (Information Services Division, 2020), and PCI has become the most common procedure used to treat CHD in the UK (Banning et al., 2015). Despite this, CABG remains a contemporary treatment for approximately 5-10% of NSTEMI patients, with individuals who have more complex conditions benefiting the most (Collet et al., 2021). For individuals who are stable or, at high risk of recurrent ischaemia, revascularisation treatments such as PCI and CABG may not be suitable immediately after a diagnosis of ACS, instead these treatments may be delayed (Collet et al., 2021). For this thesis, the focus will be on ACS patients treated with or without the revascularisation treatment of PCI or CABG.

Evidence from large scale quantitative studies confirm, unplanned re-hospitalisation is common within 30 days of discharge for a diagnosis of ACS and is associated with an increased risk of mortality and/or a reduction in quality of life (Hess et al., 2016; Southern et al., 2014). For elderly patients, the advancement of PCI treatment has not improved patient quality of life measures in the longer term (Shan et al., 2014). Survivors of ACS are at an increased risk of a further event when compared to individuals of the same age who have not experienced an acute cardiac event (Kotseva et al., 2012). Subsequently, patients are offered medication, including antiplatelet agents (e.g. aspirin), beta blockers, angiotensin receptor blockers/angiotensin converting enzyme inhibitors and lipid lowering agents (e.g. statins).

1.4 Recovery from ACS

In order to improve the effectiveness of the revascularisation treatments, promote medication adherence, and reduce the risk of MI and re-hospitalisation, clinical guidelines recommend all patients diagnosed with ACS receive a programme of comprehensive risk factor management (Collet et al., 2021). Cardiac rehabilitation (CR) is a comprehensive and cost-effective programme (Anderson & Taylor, 2014) reducing cardiovascular mortality (Ji et al., 2019), and encompassing risk factor management and exercise to support changes to lifestyle, and wellbeing (American Association of Cardiovascular and Pulmonary Rehabilitation, 2021). CR information includes reference to the secondary prevention lifestyle changes a patient may need to address in relation to their physical activity behaviours in order to improve their risk of future cardiovascular events (Piepoli et al., 2016).

1.5 Cardiac rehabilitation

CR is recognised internationally as an effective programme to improve secondary prevention of CHD and reduce hospital readmission when compared to usual care (Anderson & Taylor, 2014; Dalal et al., 2015). In the UK, typically, this programme begins during the in-patient stay, or within twenty-four hours of discharge, and the comprehensive programme continues for a minimum period of eight weeks as an outpatient (British Association of Cardiovascular Prevention and Rehabilitation, 2017).

CR is designed to reduce the physiological and psychological effects of cardiac illness and provide medical evaluation, prescribed exercise, cardiac risk factor modification, education and counselling (Dalal et al., 2015). CR offers a multidisciplinary approach to support patients with ACS to manage risk factors related to the secondary prevention of CHD, for example, lifestyle factors such as smoking cessation, obesity, physical activity and exercise (American Association of Cardiovascular and Pulmonary Rehabilitation, 2021). Additionally, CR provides risk factor education, and physical and psychological support to help patients improve their self-efficacy, beliefs and readiness to change behaviour. Furthermore, after a diagnosis of ACS all patients are eligible to receive an initial CR assessment to agree personal behaviour change goals and the early provision of a structured CR exercise programme (British Association of Cardiovascular Prevention and Rehabilitation, 2017; Scottish Intercollegiate Guidelines Network, 2017).

1.5.1 Exercise-based cardiac rehabilitation interventions

Physical activity is broadly defined as bodily movement that results in energy expenditure (Pelliccia et al., 2021). One of the core components of the CR programmes is undertaking a level of activity this is purposeful to improve or maintain fitness, a subset of physical activity, commonly defined as ‘exercise’ (American Association of Cardiovascular and Pulmonary Rehabilitation, 2021). The initial CR assessment provides an opportunity to discuss exercise habits and support the individual to self-monitor exercise intensity and duration by self-assessment measures (British Association of Cardiovascular Prevention and Rehabilitation, 2017).

An important initial consideration of exercise planning is to consider an individual’s previous physical activity behaviour. For the primary prevention of CHD, the UK Chief Medical Officer’s (CMO’s) 2019 physical activity recommendations stipulate adults (19 to 64 years) to accumulate at least 150 minutes of moderate, or 75 minutes of vigorous physical activity each week, and activities to maintain strength on at least two days of the week (Department of Health & Social Care, 2019). Additionally, the guidance recommends reducing time spent being sedentary and breaking up long periods of inactivity. Associations between leisure time physical activity habits and risks for cardiovascular mortality has shown that people who report no moderate or vigorous physical activity per week are at increased risk when compared to those who report moderate and vigorous physical activity in as little as one or two sessions per week (O'Donovan et al., 2017). The CMO's recommendations advocate any activity is better than none. After a diagnosis of ACS, these recommendations form the basic CR minimum standard requirement for physical activity (Pelliccia et al., 2021).

CR secondary prevention clinical guidelines for physical activity include disease specific exercise guidance, including advice regarding the frequency, intensity, duration and the type of exercise recommended (American Association of Cardiovascular and Pulmonary Rehabilitation, 2021; Association of Chartered Physiotherapists in Cardiac Rehabilitation, 2015; Piepoli et al., 2016). Exercise is physical activity that involves muscular and metabolic activity (aerobic /anaerobic) which involves movement of the limbs and can be tailored towards the individual's current activity level and exercise behaviour (Fletcher et al., 2013). Exercise should be completed at least two to three times per week for between 20 and 60 minutes (not including warm up and cool-down), and other days to include walking or alternative leisure activities (American Association of Cardiovascular and Pulmonary Rehabilitation, 2021). Exercise at moderate intensity has historically been recommended in clinical guidelines as the ideal cardio-protective level of exertion and is cited in one of the largest case-control studies of 29,972 MI participants from across 52 countries, INTERHEART, to offer protection against a further MI (Yusuf et al., 2004). Exercising at a moderate level is defined as an activity where the rate of energy expenditure, reported in metabolic equivalents (METS), is between 3-6 METS or where talking during the activity would mean a conversation was possible (Piepoli et al., 2016).

The inclusion of vigorous exercise within the disease specific exercise prescription is safe, and improves cardio-respiratory fitness and exercise capacity (Gomes-Neto et al., 2017; Gonçalves et al., 2021; Liou et al., 2016; Rognmo et al., 2012). Exercise of a vigorous level is defined as an activity between 6-9 METS or where talking during the activity would mean a conversation was harder but possible (Piepoli et al., 2016). Despite the cardio-respiratory benefits of vigorous exercise, there is limited evidence related to women and older adults (Gonçalves et al., 2021). Additionally, vigorous activity may be a barrier to participation for some individuals. For example, for some women and individuals who are overweight, the effort of extra exertion can feel unpleasant (Ekkekakis et al., 2010). Others have been reported to experience increased anxiety in relation to thoughts of a reoccurring cardiac event at higher exercise intensity levels (Farris et al., 2018).

The aim of exercise-based CR interventions is to support individuals in establishing and/or maintaining a regular routine of physical activity behaviour, and the dose-response relationship of the exercise prescription is central to such interventions (Piepoli et al., 2016). Participants who adhere to exercise guideline advice will reduce the risk of developing further disease complications and re-admittance to hospital (Bajekal et al., 2012; Critchley et al., 2003; Dalal et al., 2015; Hotchkiss et al., 2014; Stolker et al., 2012). The risk stratification of individuals prior to embarking in exercise-based CR ensures that the intensity of exercise undertaken results in a low risk of a further event occurring during a session (Anderson et al., 2016). The risk of a cardiovascular event within exercise-based CR is approximately one per 116, 906 patient hours of participation (Thompson et al., 2007).

A Cochrane review of 63 randomised control trials (RCT's), which included 14,486 people with CHD, confirmed that exercise-based CR reduces the risk of cardiovascular mortality (RR 0.74, 95% CI 0.64 to 0.86) and hospital admission (RR 0.82, 95% CI 0.70 to 0.96) irrespective of whether the intervention was hospital based or home based (Anderson et al., 2016). Such programmes aid both the physical and psychological recovery of this patient population and reduce all-cause mortality by 13% and non-fatal MI by 38% (Anderson & Taylor, 2014; Clark et al., 2005). However, the significant benefits, such as improved ventricular function, aerobic capacity, cardiac remodelling and cardiorespiratory fitness, are achieved when ACS patients are supported to exercise at moderate-to-vigorous and vigorous intensity levels recommended in clinical guidelines (Aamot et al., 2014; Barrabes, 2015; Gonçalves et al., 2021).

1.6 Cardiac rehabilitation uptake and adherence

Despite the substantial benefits, non-attendance and adherence to exercise-based CR are significant problems and undermine the efficacy of CR (Stolker et al., 2012). In fact, 50% of eligible individuals across Europe do not attend (Bjarnason-Wehrens et al., 2010). The reasons for this are many and include inadequate legislation, funding, service deficits and low support from health authorities and patients' groups (Lima de Melo Ghisi et al., 2018; Piepoli et al., 2015). In the United Kingdom (UK), the National Audit of Cardiac Rehabilitation (NACR) provides a snapshot of UK CR delivery, which is reported via the British Heart Foundation. The latest available report indicates that half of eligible patients choose not to attend CR and the most common reason is a lack of interest (British Heart Foundation, 2019). This is likely to be oversimplification, as barriers are complex, and include low referral from acute services, embarrassment about attending groups, distance to the service, parking at the service, perceptions about the benefits of CR, and cultural and gender barriers (Neubeck et al., 2012). In addition to poor uptake, 30% of those who do attend in England, Wales and Northern Ireland, will dropout and the main reason recorded for this is ‘unknown’. What is known from the last time physical activity was reported in the NACR audit, is that 40% of eligible patients reported meeting moderate levels of physical activity prior to the start of CR (British Heart Foundation, 2016), yet little is known about how physical activity levels prior to ACS diagnosis influence engagement with physical activity after diagnosis. Furthermore, it is unclear how previous experience of physical activity influences engagement with CR.

One factor that potentially influences CR engagement is the time between diagnosis and the start of exercise-based CR. Over 50% of programmes in England, Northern Ireland and Wales, do not meet the national target of starting patients within 33 days of the index MI or PCI (British Heart Foundation, 2019). During this time delay, patients might return to their regular daily activities and the opportunity to engage with CR exercise guidance may be lost. Of particular concern are those individuals for whom a physical activity or exercise behaviour has been established prior to their diagnosis and treatment, because this patient group may require modification of their existing behaviour to take account of CR exercise intensity and time guidelines. Exercise that is outside the recommended guidelines is associated with an increased cardiovascular risk (Pandey et al., 2016; Williams & Thompson, 2014). For example, when exercise intensity is high to maximal, and conversation is difficult to impossible, or excessive exercise is undertaken for extended periods (running more than 30 miles per week), the risk of cardiovascular events in individuals post MI is increased when compared with the cardiovascular adaptations of moderate exercise (Williams & Thompson, 2014).

Controversially, findings reported from one RCT led to the value of CR, as practised in the UK, being questioned (West et al., 2012). The Rehabilitation after MI trial (RAMIT), recruited 1813 patients during the period 1997-2000 and followed these patients for up to 9 years, and apart from reporting CR to make no important effect on mortality, the study concluded that fewer patients after rehabilitation were exercising when compared to control groups (West et al., 2012). In addition, despite 73% of the control patients having knowledge of the CR programme, these patients did not feel the need for further advice, including exercise-training advice. However, the findings of this study by West et al. (2012) have been refuted because the evidence presented in the RAMIT trial was out of date and conducted before the use of contemporary medicines and treatments such as early thrombolysis (BACPR Elected Council Members, 2012; Taylor, 2012). This suggests the need to understand the underlying behaviours of participants to best tailor CR to the needs of contemporary participants.

1.7 Exercise behaviour

An exercise behaviour is the regular repetition of a purposeful activity, such as swimming or jogging. Starting and maintaining an exercise behaviour is influenced by a number of factors, such as psychological and social determinants (Biddle et al., 2015). Psychological factors include processes related to a person’s cognition, motivation and beliefs, for example, review evidence among older adults reports a person may be more likely to initiate an exercise behaviour if exercise is perceived to be beneficial to individual needs. Additionally, social factors include a person’s social network, for example, exercise initiation may be more likely where an individual receives social support from a significant other, such as family or friends (Darlow & Xu, 2011; van Stralen et al., 2009).

A further possible factor to starting and maintaining an exercise behaviour is associated with a previous experience of exercise or a prior exercise habit (van Stralen et al., 2009). Although a previous experience of exercise may not result in an exercise habit, because habit formation is linked to a number of contextual influences (Hagger, 2019), the role of habit in exercise behaviour suggests decision making, or cognitive processes, are minimal (Gardner & Rebar, 2019). According to Gardner & Rebar (2019), the habitual process may be evoked automatically and linked to a specific stimulus, meaning the future habit is influenced by the previous exercise behaviour. Contextual influences, such as the experience of an ACS diagnosis, may interrupt the habitual processes and result in a change in the exercise behaviour (Hagger, 2019).

Research addressing exercise behaviour in cardiac patients has predominantly focused on techniques to establish a lifetime exercise behaviour, for example, motivational techniques such as goal setting, and the role of decision making in adherence or non-adherence (Duff et al., 2017; Ghisi et al., 2015; Goodwin et al., 2016; Heron et al., 2016). CR is a behavioural intervention and theories and models of health behaviour change are a core component of the evidenced-based standards for the delivery of CR programmes in the UK (British Association of Cardiovascular Prevention and Rehabilitation, 2017).

A recent systematic review investigating the effects of CR to alter daily physical activity habits in individuals after a diagnosis of ACS, confirmed that a standard centre-based CR, including a structured exercise programme combined with psychosocial and educational interventions, does not affect improvement, nor maintenance, of an active lifestyle in this patient group (ter Hoeve et al., 2015). Furthermore, the synthesised findings of the 26 RCTs suggested standard CR programmes were variable in their protocols, resulting in the inability to understand what elements of CR impact physical activity indicating future research is needed to pilot different behavioural interventions aimed at increasing physical activity levels for those taking part.

CR is a complex intervention and the challenges of knowing what works for whom are only partially understood. Several studies have provided insight into the factors influencing participation in behavioural interventions aimed at increasing physical activity and exercise performance levels. One factor that influences an individual’s physical activity behaviour is a person’s belief about one’s physical self, for example, physical self-descriptions. A qualitative study of 116 people with chronic conditions found a person’s description of themselves in relation to exercise influenced their uptake and adherence to exercise-on-referral services and pulmonary rehabilitation (Pentecost & Taket, 2011). For example, an exercise-identity, such as describing oneself as active, positively influenced participant’s willingness to attend exercise services (Pentecost & Taket, 2011). Physical self-concept, a description of one’s physical self in relation to dimensions such as being physically active, has been associated with increased levels of self-reported physical activity in older adults with a fear of falling (Sales et al., 2017). Similarly, an intervention study including older adults showed that physical self-concept for being ‘sporty’ was associated with increased objectively measured fitness levels in skiing (Amesberger et al., 2011). In a cardiac population, physical self-concept studied with 413 adolescents diagnosed with mild congenital heart disease showed that self-concept dimensions, including describing oneself as active, was found to determine higher levels of cardiopulmonary fitness (Chen et al., 2015). However, because of physical self-concept being insufficiently studied within adults with CHD, it is unknown whether physical self-descriptions are associated with exercise performance levels in adults diagnosed with ACS.

In view of the limited evidence regarding individuals who consider themselves an exerciser, or consider themselves to be active prior to entering exercise-based CR, there is a need to explore previous physical activity behaviour. To inform the future effectiveness of interventions there is a need to understand the impact of CR to support physical activity habits, specifically in individuals who report that they are already active when diagnosed with ACS. In addition, there is a need to understand how previously active individuals engage with exercise-based CR and whether their perceptions influence physical activity engagement within the context of CR.

1.8 Social cognitive frameworks for physical activity

Psychological theories offer socio-cognitive frameworks to help understand the factors influencing physical activity motivation and behaviour (Abraham et al., 1998). Social Cognitive Theory (SCT), an interpersonal theory of behaviour determinants, is one theory that can explain the reciprocal interaction between behaviour, the environment, and cognitive and personal factors (Bandura, 1986). SCT offers a framework to understand how physical activity behaviour is initiated and maintained within the context of health promoting interventions such as exercise-based CR (Bandura, 2004). Bandura suggests that self-influences are required for people to overcome obstacles to health in order to initiate or maintain health behaviours such as physical activity. To make or maintain behaviours, the benefits, risks, barriers and facilitators of a behaviour need to be understood (Bandura, 2004). In addition, individuals need to perceive they can control their own behaviour, have knowledge to set and achieve goals, and understand the costs and benefits of adopting alternative behaviours (Bandura, 2004).

Self-efficacy is a central construct of SCT theory, representing an individual’s judgement of his/her own capability to achieve a certain level of performance within a given behaviour whilst considering perceived behavioural barriers and difficulties (Abraham et al., 1998; Bandura, 1997). Bandura (1997) confirms there to be four determinants informing an individual’s self-efficacy judgments of capability: mastery experience, vicarious experience, social persuasion and emotional and physiological states. Mastery experiences, also referred to as past experiences or performances, are suggested to be one of the strongest information sources to influence self-efficacy beliefs (Bandura 1997). This means that individuals who have been previously active for some time prior to their ACS diagnosis may have higher self-efficacy beliefs for being active post ACS diagnosis. The success of the previous experience can build a strong belief in personal efficacy, whereas as a previous negative experience will undermine personal efficacy beliefs for being active (Bandura, 1997). Strengthening efficacy beliefs in capability can be achieved from vicarious experiences, such as seeing someone similar to oneself (social comparison) within exercise-based CR successfully perform physical activity after an ACS diagnosis. Additionally, positive verbal feedback received from a health professional during CR physical activity performance can help to strengthen self-efficacy (Bandura, 1997). In contrast, where an individual is exposed to negative social comparisons or negative feedback about performance, this information can result in a reduction of personal efficacy beliefs. Finally, emotional and psychological states, such as anxiety, are factors influential in self-efficacy beliefs of capability (Bandura, 1997). A study of 134 participants (mean age 63.6 years) who engaged in a lifestyle change programme, including CR, found self-efficacy for exercise was negatively influenced by depressive symptoms at baseline and 4 months, and reported a lack of motivation at 12 months in people with CHD who were overweight or obese (Alharbi, Gallagher, et al., 2017). Within this study, the emotional state negatively influenced judgements of performance and diminished self-beliefs of efficacy.

The relationship between self-efficacy beliefs and an individual’s confidence to continue or change a physical activity behaviour is influenced by three types of self-efficacy; task, barrier and scheduling (Du et al., 2012). Self-efficacy is task specific, representing the confidence a person has in their ability to perform elements of a task (Bandura 1997). For example, the statement ‘I am confident that I can engage in 150 minutes of physical activity each week,' demonstrates that the strength of the belief is linked to the confidence in capability to perform the behaviour (Beauchamp et al., 2019). The confidence to successfully perform physical activity in the face of perceived challenging conditions is related to barrier self-efficacy, also referred to as self-regulatory efficacy (I am confident to engage in 150 minutes of physical activity each week even if the weather is bad). The ability to organise time and commitments around physical activity refers to scheduling self-efficacy (I am confident to engage in 150 minutes of physical activity each week for the next three months even if my workload increases) (Woodgate & Brawley, 2008).

Outcome expectations is a further construct of self-efficacy associated with motivation and maintenance of behaviour, and shown to increase physical activity behaviour levels after a CHD diagnosis (Blanchard et al., 2015; Woodgate & Brawley, 2008). This is the belief that participating in a behaviour will lead to an anticipated outcome (if I participate in 150 minutes of moderate physical activity every week it will improve my health) (Bandura, 1997). Individuals believing their physical activity behaviour will result in a positive outcome are more likely to be active when compared to those expecting a negative behavioural outcome (Blanchard et al., 2015). Literature suggests that for those expecting negative outcomes, improving personal efficacy for physical activity and performance capability may encourage individuals to envisage positive outcomes for themselves (Beauchamp et al., 2019).

A number of studies have examined SCT in CR populations and found that the self-efficacy construct can predict future physical activity behaviour (Bennett et al., 1999; Blanchard et al., 2015; Blanchard et al., 2002). However, self-efficacy can be influenced by several factors in people diagnosed with CHD. For example, the role of social and environmental factors can affect the relationship between self-efficacy and behaviour performance (Bandura, 1999; Bandura, 2004; Beauchamp et al., 2019). Health systems, such as CR interventions, may interrupt the theorised association, resulting in self-efficacy failing to drive performance because the physical activity performance demands are ambiguous or patients are not motivated within the CR exercise domain (Bandura, 1997). Alternatively, the intervention may positively influence self-efficacy and physical activity behaviour (French, 2014). French and colleagues report increased self-efficacy and physical activity behaviour is associated with interventions incorporating behaviour change techniques (BCTs) such as "provide instruction on how to perform the behaviour" and "prompt practice". However, being older in age has been found to negatively affect behaviour change techniques (BCT's) associated with greater self-efficacy and physical activity levels, for example, self-regulatory techniques such as prompting self-monitoring of behaviour and providing feedback on performance. Suggesting that older adults find BCTs less acceptable and the motivation to increase physical activity may be less important (French et al., 2014). Given this evidence and the fact that self-efficacy can be influenced by several factors, this thesis will explore physical activity levels of individuals after a diagnosis of ACS to understand how this can effect decisions about physical activity and engagement with CR post event through the lens of SCT.

1.9 Chapter conclusions

Despite the wealth of evidence proving CR improves survival and quality of life, 50% of ACS patients choose not to attend the CR exercise programme. Forty percent of eligible individuals report already achieving the recommended moderate levels of physical activity, yet little is known about how active individuals engage with physical activity after a diagnosis of ACS. To inform future research and the promotion of exercise, there is a need to first explore the individual views and experience of adults perceiving themselves active after a diagnosis of ACS. Given that the cardio protective benefits of physical activity are subject to a specific exercise prescription, there remains a need to understand whether active adults engage with this prescription. Due to the lack of evidence related to how habitually active individuals engage with exercise-based CR after a diagnosis of ACS, there was a need to explore how and if active adults diagnosed with ACS engage with CR recommended physical activity levels.

Problem statement: Little is known about how previous experience of physical activity influences engagement with physical activity after a diagnosis of ACS and in the context of CR.

Overall aim of PhD:

To explore how previous experience of physical activity influenced engagement with physical activity after a diagnosis of ACS and in the context of CR.

Chapter 2. A systematic review and thematic synthesis exploring how previous experience of physical activity influences engagement with cardiac rehabilitation

This chapter contains work that has been peer reviewed and published (**Appendix 1**). The chapter is presented as an extended version of the published manuscript, which was limited to 3500 words.

2.1 Introduction

Coronary heart disease (CHD), which frequently presents as ACS, contributes to over 17 million global deaths per annum (World Heart Federation, 2017). Survivors of ACS are twice as likely to have a cardiac event compared to people with no history of CHD (Brieger et al., 2015). Therefore, preventing recurrence is a priority focus of international population approaches (World Heart Federation, 2017). Globally, CR is recognised as a cost-effective programme, which helps participants reduce cardiovascular risk factors, improve quality of life, and reduces hospital readmission (Anderson et al., 2016).

Exercise is a central component of CR and when performed regularly as prescribed by exercise-based CR is positively associated with improvements in secondary prevention outcomes and quality of life (Anderson et al., 2016; Yusuf et al., 2004). The goal of exercise-based CR is to support participants establishing a regular exercise routine and the dose response relationship between the exercise amount and the risk of a secondary event is central (American Association of Cardiovascular and Pulmonary Rehabilitation, 2021). Furthermore, current standards for CR recommend exercise is tailored towards the participant’s current exercise behaviour (British Association of Cardiovascular Prevention and Rehabilitation, 2017). The process of stratifying the risk of a further event during exercise prior to embarking on a structured exercise regime ensures the prescribed intensity of a CR programme is low risk for participants post cardiac event (American Association of Cardiovascular and Pulmonary Rehabilitation, 2021).

Despite the substantial benefits of exercise-based CR, contemporary research highlights programme factors that undermine the efficacy of CR (Lima de Melo Ghisi et al., 2018). Across Europe, over 42% of CR programmes perceived they had insufficient capacity to meet demand, reporting insufficient staffing to be a major issue (Lima de Melo Ghisi et al., 2018). In the United Kingdom (UK), 50% of eligible individuals choose not access CR services (British Heart Foundation, 2019), and the most common reason reported is a lack of interest. Of those who attend, 30% will drop-out. Furthermore, 45% of programmes do not meet the national target of starting patients within 33 days of their cardiac event (British Heart Foundation, 2016). During this time delay, patients may return to their regular daily activities. A review including 26 randomised control trials (n=9239), investigating the effects of CR to alter daily physical activity habits after a diagnosis of ACS, confirms centre-based CR does not affect improvement, or maintenance, of an active lifestyle (ter Hoeve et al., 2015). The findings of Ter Hoeve et al. (2015) suggest CR programmes have varied protocols, resulting in an inability to understand what CR elements impact PA. Understanding these components is essential to improve interventions aimed at addressing physical activity habits.

Several factors influence an individual’s engagement with exercise and physical activity. These are socioeconomic characteristics (Clark et al., 2013), opportunities/constraints and individual attitudes (Neubeck et al., 2012), preferences, motivation, and skills (Alharbi, Gallagher, et al., 2017; French et al., 2014; Michie et al., 2011). Further influences relate to psychological correlates of the ‘self’, for example, the meanings a person attributes to themselves within a situation (Pentecost & Taket, 2011). These personal constructs influence individual exercise and physical activity decisions, for example, contributing to an exercise identity (Pentecost & Taket, 2011). An individual’s level of physical activity prior to a cardiac event is likely to be an important factor, but to date, has received little attention in the research literature. Up to 40% of eligible patients report already achieving the recommended level of physical activity prior to staring exercise-based CR (British Heart Foundation, 2019); however, it is unclear how this influences engagement with CR services. Qualitative findings from a systematic review (n=1213), confirm individual barriers affecting attendance include beliefs related to physical activity, for example, believing themselves to be already active (Neubeck et al., 2012). Therefore, the aim of this review is to systematically examine qualitative evidence describing patient’s perceptions and experiences, and synthesise what is known about how previous experience of physical activity in adults diagnosed with ACS influences engagement with physical activity during CR.

2.2 Methodological justification for a systematic review

A systematic review provides an opportunity to bring together previous research on a subject to assess the effectiveness of an intervention or understand how an intervention works and for whom it works (Munn et al., 2018). Literature highlights the strengths and weaknesses of the systematic review process. Strengths include the rigour of the systematic search and analysis strategies, which can reduce bias and form the basis for new theory. Weaknesses include literature being limited to primary studies, as opposed to including policy and practice literature (Grant & Booth, 2009). Adopting a rigorous process can ensure only relevant and high-quality primary research is included within the review (Munn et al., 2018). A systematic review can provide a comprehensive search of empirical evidence and offer a critical synthesise of primary studies related to a specific review question (Noyes et al., 2018). Finally, a systematic review can inform practice and future research (MacLure et al., 2016).

Contemporary qualitative research has explored the perceptions and experiences of adults diagnosed with ACS and their engagement with physical activity during exercise-based CR. However, the focus of these studies varied, making it difficult to understand how previous experience of physical activity in adults diagnosed with ACS influences engagement with physical activity during CR. Therefore, to inform practice and future research, this study provided the first qualitative systematic review critically synthesising what was known about previous experience of physical activity in adults diagnosed with ACS. It sought to understand how this prior experience influenced engagement with physical activity during cardiac rehabilitation.

2.3 Aim

This qualitative systematic review aimed to examine evidence describing patients' perceptions and experiences, and synthesise what was known about how previous experience of physical activity in adults diagnosed with ACS influenced engagement with physical activity during cardiac rehabilitation.

2.4 Methods

This study is a qualitative systematic review using a thematic synthesis to produce conclusions from previous research (Thomas & Harden, 2008). This systematic review followed the Enhancing transparency in reporting the synthesis of qualitative research (ENTREQ) framework, which supported the rigorous synthesising of qualitative studies (Tong et al., 2012).

2.4.1 Registration of the qualitative systematic review protocol

To increase transparency and trustworthiness of the findings, best practice encouraged pre registering the systematic review (Stewart et al., 2012). This registration reduces the risk of others duplicating similar work (Tong et al., 2012). The review protocol was registered with PROSPERO - registration number is CRD42018096573.
https://www.crd.york.ac.uk/PROSPERO/display_record.php?RecordID=96573

2.4.2 Search methods

This review comprehensively searched peer-reviewed literature accessed from database searches of MEDLINE, CINHAL, PsycINFO and Embase between October 2017 and January 2018 using a pre-piloted search strategy to identify relevant qualitative evidence. The strategy was based on previous work undertaken in a recent clinical guideline review, SIGN 150 (Scottish Intercollegiate Guidelines Network, 2017). The national guidelines offered an up-to-date systematic review protocol, with the search stems being listed under the sub heading within the search narrative (Scottish Intercollegiate Guidelines

Network, 2017). An expert librarian was consulted since this review was part of a PhD project and the researcher was inexperienced at systematic reviewing. All medical subject headings in the SIGN list were exploded, for example, heart disease and rehabilitation. The use of truncation, symbolised by an asterisk*, for example, exercis*, expanded the stem of the key word and search for all endings of the word, including different spellings (Bettany-Saltikov, 2016). The key words, such as Acute Coronary Syndrome or ACS, were entered individually and searched within the title and abstract. All individual searches were combined using the ‘OR’ Boolean operator to form one single group. To produce the final number of citations, the overall groups were combined with the use of ‘AND’. Examples of the full electronic search strategy for Embase and MEDLINE, are included within Appendix 1.

The search strategy for MEDLINE was duplicated for CINHAL and PsycINFO. The total number of citations was saved in EndNote X8 (Clarivate^{TM} , 35T3 Boston, MA 002210) and screened for duplicates. To support the robust approach to the search strategy, cross-checking with supplementary methods, such as reference lists, citation tracking and hand searching was also completed (MacLure et al., 2016).

2.4.3 Study selection

Studies were eligible for selection if they:

1. Were primary qualitative studies that collected participant views, experiences, perceptions and perspectives of physical activity.
2. Included individuals diagnosed with ACS and treated with CABG or PCI.
3. Included adults 18 year of age or above.

4. Included individuals eligible to attend cardiac rehabilitation or secondary prevention
5. Were published in English as the systematic review was part of a PhD project with time and resource constraints.
6. Were published between 1990 and end of 2017. This time period represents the changes in the treatment of ACS, in particular the revascularisation treatments of PCI and CABG, and the introduction of exercise-based CR to recent clinical guidelines.

Studies were excluded from selection if they:

1. Focused on other types of heart disease such as heart failure.
2. Included only quantitative data.
3. Were not published in English.
4. Were letters, commentaries, reviews or discussion papers.

To improve the rigour and ensure the search is effective, a standardised tool is recommended (Aromataris & Riitano, 2014). The current study adopted the Population, Exposure, Outcomes (PEO) framework (**Appendix 3**) (Bettany-Saltikov, 2016) because this is considered suitable for qualitative questions. In this case, the outcome was seeking patient views or experiences of the exposure (MacLure et al., 2016) (**Table 2-1**).

Table 2-1: *Population, exposure and outcomes framework for this study*

Population	Exposure	Outcomes
Adults age 18 years or over diagnosed with ACS, MI, NSTEMI, STEMI, heart attack, heart disease, unstable angina,	Cardiac rehabilitation/therapy/ programme or secondary prevention rehabilitation/ programme/therapy	Experiences, views perceptions or perspectives of physical activity, fitness, exercise, exertion, sport

including patients treated with PCI or CABG	

Systematically screening of the titles and abstracts is the first step in selecting studies for inclusion in the systematic review (Aromataris & Riitano, 2014). To reduce bias and offer rigour, it is recommended that two or more researchers independently undertake an assessment of the articles using a screening tool (Boland et al., 2014). In this review, the primary reviewer (SMcH) and the second reviewer (CH), a research fellow, independently screened all titles and abstracts and the PEO screening selection tool was applied to all articles to determine whether each study was relevant to the review question. Further duplicate citations were identified and removed during this stage. In addition, the primary reviewer scanned all references and completed a search of the internet using the key words. Both reviewers agreed which articles should be retained for full reading. Any differences of opinion regarding the articles were resolved with discussion and documented (**Appendix 4**).

The next step was reading and systematically examining the full text for each of the identified articles. The PEO screening selection tool that was used to sift the titles and abstracts was modified to form a study selection template to support inter and intra-rater reliability. The selection template converted the inclusion and exclusion statements into questions specified the outcome related to previous physical activity. It offered predetermined criteria from which to assess the articles selected for full review, ensuring only the studies which answered ‘Yes’ to all criteria were included in the next stage of the review process.

2.4.4 Data extraction and analysis

Data were extracted using a Microsoft Excel spreadsheet (Microsoft Corporation, St. Redmond, WA, USA) to allow for assessment of study quality and evidence synthesis. The primary reviewer (SMcH) extracted author, publication year, location, title, research aim, setting, participant characteristics methodology, and main results.

2.4.5 Quality appraisal

Prior to the synthesis of the final papers, the quality of each study was assessed to avoid the risk of bias (Noyes et al., 2008). The quality appraisal process systematically examined each study, not to discount any study from the review, instead to critically appraise the strengths and weaknesses of the research (Bettany-Saltikov, 2016). The Consolidated criteria for reporting qualitative research (COREQ), a 32-item checklist was used to promote the explicit and comprehensive reporting the of primary studies (Tong et al., 2007). The COREQ tool encourages the reviewer to make judgments regarding the reporting of study methodology, philosophical background, data collection methods, interpreted findings, all domains specifically aligned with trustworthiness in qualitative research (Tong et al., 2012). The primary reviewer (SMcH) evaluated each study against the COREQ items. To support the robustness of this process a sample of three studies were evaluated by a second reviewer (CH) and evaluations were found to be similar.

2.4.6 Data synthesis

To generate new insights from the primary studies there was a need to identify a suitable method to synthesise the qualitative data. This review was exclusively qualitative, meaning that the primary studies were limited in number and included varying reporting styles, including ‘thin’ description and multiple quotations. Therefore the thematic synthesis methodology recommended by Thomas & Harden (2008) was best suited to accommodating the aim. This methodology offered an explicit and transparent method of reducing the data whilst embracing the requirements of a systematic review (Thomas & Harden, 2008).

The findings of the studies did not directly address the study review question, a similar situation to Thomas & Harden’s example referred to in the methods for thematic synthesis (Thomas & Harden, 2008). In order to avoid restricting the data analysis process and risk reducing the possibilities in the findings, the qualitative systematic research question was temporarily “put to one side” and the detailed methods for thematic synthesis, stage one were applied. The analysis process began with free line-by-line coding of all text labelled ‘results’ or ‘findings’ within the twelve studies. The verbatim text, extracted from the results section of the studies by one reviewer (SMcH), was placed within a Microsoft Excel spreadsheet (Microsoft Corporation, St. Redmond, WA, USA). The text included participant quotations, themes, sub-themes and the findings of the original authors. One reviewer (SMcH) coded each line of text and the second reviewer (CH) independently crosschecked paper versions. The “free” codes were presented in a column, headed “inductive analysis”, created inductively and representing the meaning of the text. All inductive codes were placed within a bank of codes (**Appendix 5**) (Thomas & Harden, 2008). This produced 65 initial inductive codes. One reviewer, (SMcH), looked for similarities and differences between the codes within the primary studies grouping the codes into new codes, which captured the meaning of each group of codes to develop nine themes. The nine themes were recorded along with example participant quotations. The analysis continued, and the nine descriptive codes were re-examined for consistency of interpretation and thereafter written up by one reviewer (SMcH), and checked by the second reviewer (CH). The descriptive themes remained close to the original studies. The themes were then re-examined by two reviewers (SMcH and CH). The development of analytical themes was achieved through discussion and a repeating cyclical process of examining themes, (Thomas & Harden, 2008). To support the robustness of the analytical process, two reviewers (SMcH and CH) cross-checked the analytical themes in relation to the review question. The analytical themes offered a new interpretation and went beyond the primary studies.

2.5 Results of the systematic review

From 486 studies, 12 qualitative papers met the criteria for inclusion within the qualitative systematic review (

Figure 2-1)

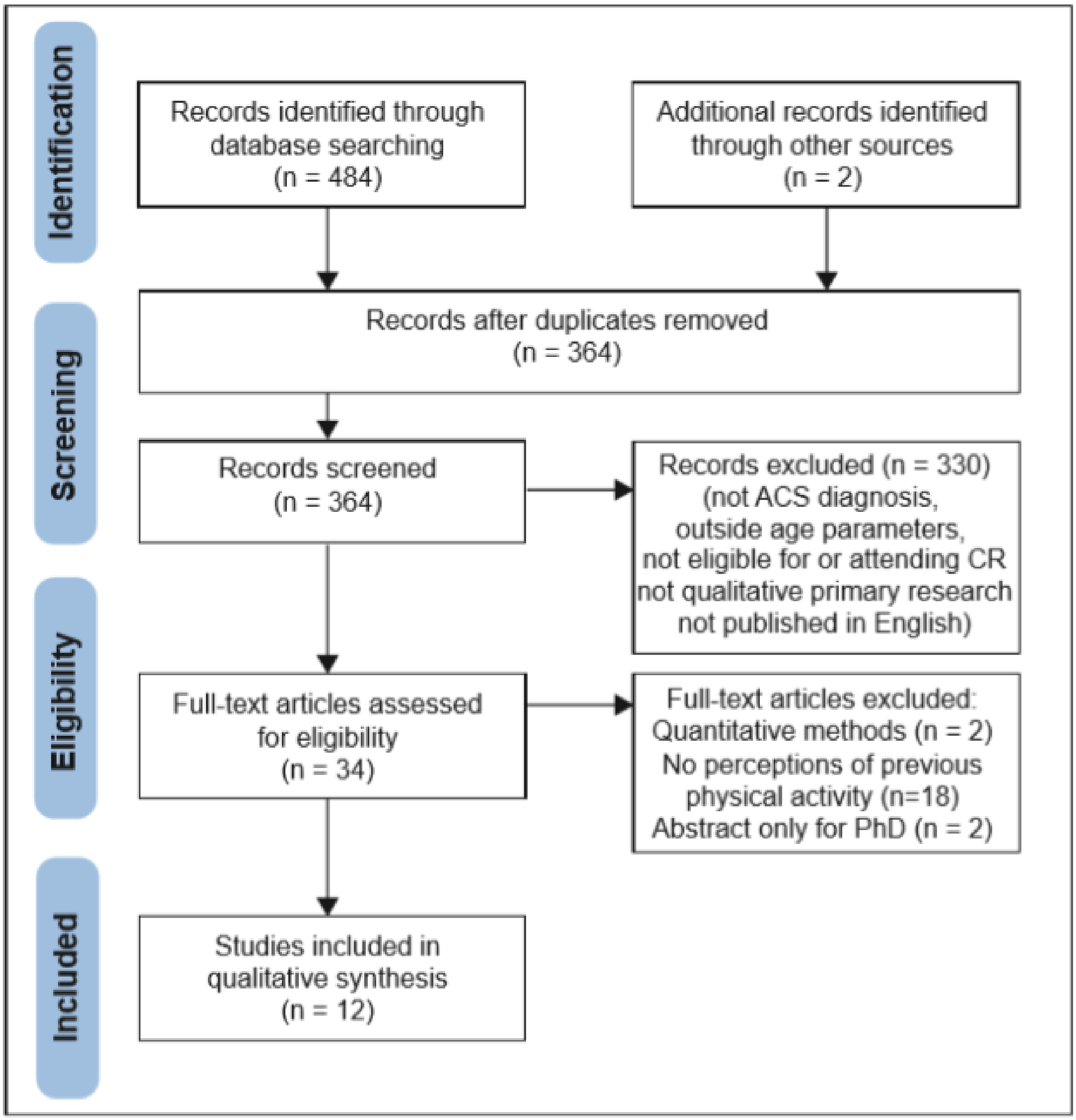


Figure 2-1: *PRISMA diagram: flow of studies in the systematic review*

2.5.1. Characteristics of studies

Twelve international studies from Canada (n=2), USA (n=1), Sweden (n=1) and the UK (n=8) represented 388 participants (women n=118, men = 270). The mean age reported ranged from 56 to 73 years who were diagnosed with ACS (n=3), MI (n=7) and participants post MI and CABG (n=1) and type 2 diabetes (n=1) (**Table 2-2**).

The years of publication spanned, and included 2004 to 2017. Studies reported populations to include white/Caucasian, British, Irish, Black Caribbean, Indian and Pakistani, with one study restricting the inclusion criteria to individuals living in British Columbia, self-identifying as Punjabi Sikh (Galdas et al., 2012). Few studies reported marital status (42%) and a limited number of studies reported occupational status (42%). All studies recruited participants from the inpatient or outpatient pathway of CR services. The majority of studies collected data via semi-structured interviews (n=11); nine studies collected data using face to face methods and two were conducted by telephone. One study collected data from focus groups.

Table 2-2: *Study Characteristics*

Author /Year/ Country	**Title**	**Research question /Aim**	**Source of participants**	**Participants (Including number)**	**Sex (n)**	**Method**	**Results**
Back et. al. (2017) Sweden	Important aspects in relation to patients' attendance at exercise-based cardiac rehabilitation - facilitators, barriers and physiotherapist's role: a qualitative study	To explore aspects that influence patients' attendance at exercise-based CR after acute CAD and the role of the physiotherapist in patients' attendance	Both at inpatient CCU phase 1 and at CR programme phase II	STEMI, NSTEMI, unstable angina, PCI (n=16) mean age 64.5 yrs.	M(11) F (5)	Content analysis	The results of the analysis identify four main categories influencing the patients' ability or will to attend exercise-based CR. (i) The patients' previous experience of exercise influenced attitudes to exercise during exercise-based CR. (ii) How well the CR staff during the acute phase met the patients' needs in relation to exercise-based CR. (iii) Important prerequisites for attending exercise- based CR include the physiotherapists role, patients' self-image, self-efficacy and practical factors. (iv) The patients' future ambitions with regard to exercise. Increased awareness of mortality and fear related to exercise influence attendance at exercise-based CR.
Clark et. al. (2004) Scotland	Promoting participation in cardiac rehabilitation: patient choices and experience	To compare decision making in relation to cardiac rehabilitation attendance in users, non-users and patients with high attrition rates	CR programme	MI, CABG (n = 44) 66 yrs.	M(33) F(11)	Framework method of analysis	Participants reported beliefs that influenced attendance decisions related to self, CHD, CR, other attending patients and health professionals' knowledge. Embarrassment about group or public exercise negatively influenced attendance. Those who attended reported increased faith in their bodies, a heightened sense of fitness and a willingness to support new patients who attended.

Cleary et. al.. (2015) USA	Perceptions of exercise and quality of life in older patients in the United States during the first year following coronary artery bypass surgery	To describe factors that influenced adherence to exercise, and perceptions of activity limitations and health-related quality of life	Phase 1 CR inpatient	MI, CABG (n=28) mean age 73 yrs.	M(23) F(5)	Descriptive content analysis	Influences varied across time points. Motivators included that it felt good to exercise and the belief that exercise improves physical health. Barriers to exercise included time, weather and pain/injury/illness.
Cooper et. al. (2005) England	A qualitative study investigating patients' beliefs about cardiac rehabilitation	To elicit patients' beliefs about the role of the cardiac rehabilitation course following myocardial infarction	Phase 1 CR	AMI (n=13) mean age 56 yrs.	M(9) F(4)	Phenomenology IPA	Beliefs about course content, perceptions of exercise, the benefits of CR and CR knowledge influenced attendance decisions. Some viewed CR as important to recovery, others misunderstood the role of exercise. Cardiac misconceptions were present and negatively influenced attendance.
Dale et. al. (2015) Canada	"I'm No Superman": Understanding Diabetic Men, Masculinity, and Cardiac Rehabilitation	The research question is unclear. This papers reports findings from study of gender and co-morbidity in male CR participants	CR	CHD and Type 2 Diabetic (n=16) mean age 66 yrs.	M(16)	Ethnography	Men assumed two positions to regain a sense of competency lost in illness: (a) working with the experts and (b) rejection of biomedical knowledge. The findings emphasize the priority given by the participants to the rehabilitation of a positive masculine identity.
Galdas et. al. (2012) Canada	Punjabi Sikh patients' perceived barriers to engaging in physical exercise following myocardial infarction	To explore the perceived barriers to engaging in physical activity among Canadian Punjabi Sikh individuals who have suffered an MI	CR programme	MI within past 6 months (n=15) mean age 65.6 yrs.	M(10) F (5)	Phenomenology	Perceived barriers to engagement in physical activity included difficulty in determining safe exertion levels independently; fatigue and weakness; preference for informal exercise; and migration related challenges.

Herber et. al. (2017) Scotland	Just not for me' - contributing factors to nonattendance/ non-completion at phase III cardiac rehabilitation in acute coronary syndrome patients: a qualitative enquiry	To explore what reasons non-attenders and non-completers give for their patterns of participation or non-participation in cardiac rehab and how future uptake could be enhanced	post phase III CR	ACS (n=25) mean age 62 yrs.	M(18) F(7)	mixed methods - thematic analysis	Major influences on participation were reported to be personal factors, programme factors and practical factors. Significant barriers to CR attendance were that participants perceived themselves unsuitable and lack of knowledge and/or misconceptions about CR.
Hird et. al. (2004) Scotland	Getting back to normal': Patients' expectations of cardiac rehabilitation	To determine patients' expectations of cardiac rehabilitation and how these might influence participation in cardiac rehabilitation programmes	Cardiac care unit - inpatient	CABG & valve surgery (n= 50) (M) 63 yrs. (F) 62 yrs.	M(34) F (16)	Descriptive study, Framework analysis	Many patients associated CR with recovery and exercise. The majority of patients reported receiving information about CR and half of patients were positive about attending CR with the most important factor being the exercise component. Barriers to CR include difficulty with transport and family commitments.
Jones et. al. (2007) England	DNA' may not mean 'did not participate': a qualitative study of reasons for non-adherence at home and centre-based cardiac rehabilitation	To explore patients' reasons for non-participation in or non-adherence at home and centre-based cardiac rehabilitation	BRUM trial – CR programme	MI, PTCA or CABG (n=49) mean age 62 & 63 yrs.	M(33) F(16)	The framework method	Reasons given for non-attendance and non-completion of CR were that patients participated in alternative exercise activities and other health problems prevented participants from exercising as much as they had expected. Non-adherers found some aspects of CR helpful and had made lifestyle changes. Lack of motivation to attend CR was the main reason for non-adherence in home programme, particularly for females.

McCorry et. al. (2009) Northern Ireland	Perceptions of exercise among people who have not attended cardiac rehabilitation following myocardial infarction	To explore in detail patients' beliefs about exercise for promoting recovery from MI within the context of cardiac rehabilitation among men and women who did not attend formal CR programme	GP practice	MI (n=14) mean age 64 yrs.	M(8) F (6)	Constant comparative analysis	Participants did not recognise the cardiovascular benefits of exercise, and perceived keeping fit through daily activities as sufficient for health. Health professionals were perceived to downplay importance of exercise and CR, with medication viewed as more important for health than exercise.
Robertson et. al. (2010) England	Embodied masculinities in the context of cardiac rehabilitation	To explore men's experiences of their embodied selves in the context of a cardiac rehabilitation programme?	CR	MI mentioned in data (n=34) 48-84 yrs.	M(34)	Secondary analysis - retrospective interpretation	The analysis generated four overarching themes as follows: Embodied emotionality includes men’s expression of emotions related to their body. Renegotiated embodiment includes reference to the men’s thoughts and feelings of their body prior to their cardiac event when compared to after their cardiac event. Embodiment and fitness refers to the renegotiation of the male identity and knowing the hidden body refers to an improved awareness of signals from within the body.
Shaw et. al. (2012) Scotland	Pre-exercise screening and health coaching in CHD secondary prevention: a qualitative study of the patient experience	Patients' attitudes towards and experience of a lifestyle intervention (specifically around exercise behaviour)	Primary care CVD secondary prevention clinic at 1 year follow up	MI, Angina, CHD, PCI (n=84) mean age 69.9 yrs.	M(41) F (43)	No theoretical framework reported – constant comparative analysis	The majority of patients were positive about CR referral. Patient barriers to attending and completing included belief that they were sufficiently active already, the existence of other health problems, feeling unsupported in the CR exercise class and competing demands.
Legend =	*CCU = Coronary Care Unit* *STEMI = ST elevation myocardial infarction*	*NSTEMI = non-ST elevation myocardial infarction* *MI = myocardial infarction* *AMI = Acute myocardial infarction* *CAD = Coronary artery disease*			*PCI = Percutaneous coronary intervention* *PTCA = Percutaneous transluminal coronary angioplasty* *CABG = Coronary artery bypass graft* *CVD = Coronary vascular disease*		

2.5.2 Methodological quality of studies

All studies had relevant ethical approvals. The comprehensiveness of reporting varied across the studies, with the number of criteria fulfilled ranging from 13-24. Items most frequently reported related to trustworthiness in study design and reporting of findings. Items less likely to be reported concerned transparency about the research team and relationship with participants (**Table 2-3**). Papers were not excluded based on the quality but the data synthesis process started with studies reporting the highest number of items.

Research team and reflexivity

The research team characteristics and relationship with participants was poorly reported across six studies (Cleary et al., 2015; Dale et al., 2015; Hird et al., 2004; Jones et al., 2007; Robertson et al., 2010; Shaw et al., 2012). The personal characteristics of the research team, including identity, gender, occupation, credentials, experience and training, are minimally reported. One study did not critically examine the gender of the researcher in relation to the influence this may have on data collection in a purposive all male sample (Dale et al., 2015). Nine studies failed to report items related to the researcher relationship with the participants, resulting in the inability to understand what measures were taken to safeguard the data from researcher bias (Clark et al., 2004; Cleary et al., 2015; Dale et al., 2015; Herber et al., 2017; Hird et al., 2004; Jones et al., 2007; McCorry et al., 2009; Robertson et al., 2010; Shaw et al., 2012).

Table 2-3: *Overview of the consolidated criteria for reporting qualitative research (COREQ) quality assessment*

Studies	Back et. al. (2017)	Clark et. al. (2004)	Cleary et. al. (2015)	Cooper et. al. (2005)	Dale et. al. (2015)	Galdas et. al. (2012)	Herber et. al. (2017)	Hird et. al. (2004)	Jones et. al. (2007)	McCorry et. al. (2009)	Robertson et. al. (2010)	Shaw et. al. (2012)
Domain 1: Research team and reflexivity												
Personal characteristics												
Interviewer/facilitator	x	x		x	x	x		x	x	x		x
Credentials	x	x	x	x	x	x	x		x	x		
Occupation	x	x	x		x		x		x	x		
Gender	x	x	x	x			x			x	x	
Experience & training	x						x			x		x
Relationship with participants												
Relationship established	x			x		x						
Participant knowledge of the interviewer	x			x		x						x
Interviewer characteristics	x						x			x		
Domain 2: Study design												
Theoretical framework												
Methodological orientation and Theory	x		x	x	x	x	x			x	x	
Sampling	x	x	x	x	x	x	x	x	x	x	x	x
Method of approach	x	x		x	x	x	x		x	x	x	x
Sample size	x	x	x	x	x	x	x	x	x	x	x	x
Non-participation			x	x					x	x	x	x

Setting												
Setting of data collection	x	x	x	x	x	x	x	x	x	x	x	x
Presence of non-participants									x			
Description of sample	x		x		x	x	x	x	x			x
Data collection												
Interview guide	x	x	x	x		x	x	x		x		x
Repeat interviews	x		x		x			x			x	
Audio/visual recording	x	x	x	x		x	x	x	x	x		x
Field notes									x			
Duration	x	x		x		x	x	x	x		x	x
Data saturation						x	x			x		
Transcripts returned												
Domain 3: Analysis and findings												
Data analysis												
Number of data coders	x	x		x	x		x	x	x	x	x	x
Description of the coding tree	x	x	x	x	x		x		x		x	
Derivation of themes	x	x	x	x	x		x		x	x	x	
Software					x	x						x
Participant checking			x									
Reporting												
Quotations presented	x	x	x	x	x	x	x	x	x	x	x	x
Data and findings consistent	x	x	x	x	x	x	x	x	x	x	x	x
Clarity of major themes	x	x	x	x	x	x	x	x	x	x	x	x
Clarity of minor themes			x	x	x		x					
Legend: X = discussed in publication												

Study Design

Most studies achieved positive ratings on elements of the study design (n=10) with missing items related to data collection methods. The most frequently reported items include sampling, sample size and setting of the data collection.

Four studies did not report the methodological orientation underpinning the study (Clark et al., 2004; Hird et al., 2004; Jones et al., 2007; Shaw et al., 2012). Interestingly, three studies collected data from participants recruited to a quantitative study yet did not mention the qualitative study to be included within a mixed methods design (Clark et al., 2004; Jones et al., 2007; Shaw et al., 2012).

All studies reported the sample size. Two studies did not report the method of approaching participants, resulting in the inability to assess selection bias (Cleary et al., 2015; Hird et al., 2004) . Fifty percent of studies failed to report non-participation (Bäck et al., 2017; Clark et al., 2004; Dale et al., 2015; Galdas et al., 2012; Herber et al., 2017; Hird et al., 2004).

All studies reported the setting for interviews. One study reported interviewing participants within the cardiac unit of the hospital, five days after CABG surgery (Hird et al., 2004). In this setting, multiple factors may have resulted in data being restricted. One study reported non-participants, i.e., family members, to be present during the interview (Jones et al., 2007).

Four studies did not report sample characteristics in the findings (Clark et al., 2004; Cooper et al., 2005; McCorry et al., 2009; Robertson et al., 2010).
From seven items related to data collection, reporting was poor, ranging from one to four items. Three studies did not report the interview guide (Dale et al.,

2015; Jones et al., 2007; Robertson et al., 2010), and three failed to report the duration of the interview (Cleary et al., 2015; Dale et al., 2015; McCorry et al., 2009). Nine studies did not report data saturation (Bäck et al., 2017; Clark et al., 2004; Cleary et al., 2015; Cooper et al., 2005; Dale et al., 2015; Hird et al., 2004; Jones et al., 2007; Robertson et al., 2010; Shaw et al., 2012).

Nine studies report capturing data from audio recordings (Bäck et al., 2017; Clark et al., 2004; Cleary et al., 2015; Cooper et al., 2005; Galdas et al., 2012; Herber et al., 2017; Jones et al., 2007; McCorry et al., 2009; Shaw et al., 2012), whilst one failed to report the method of recording the data (Dale et al., 2015). One study reported capturing the data with written notes whilst in the ward setting (Hird et al., 2004). This method of data collection may have increased the risk of data being compromised, i.e. the need for rapid handwriting resulting in missing data or undecipherable notes. None of the studies reported returning the transcripts to the participants for comment or correction.

Analysis and findings

Studies reported between one and four items of the five items in this domain. Four studies failed to report a description of the coding tree (Galdas et al., 2012; Hird et al., 2004; McCorry et al., 2009; Shaw et al., 2012), and three studies failed to report the derivation of themes (Galdas et al., 2012; Hird et al., 2004; Shaw et al., 2012). Two studies failed to report the number of coders or who coded the data (Cleary et al., 2015; Galdas et al., 2012). One study did not report all three items related to coding and theme development, items important to the credibility of the study findings (Galdas et al., 2012). All studies presented quotations within the results section. Eight studies failed to report minor themes (Bäck et al., 2017; Clark et al., 2004; Galdas et al., 2012; Hird et al., 2004;

Jones et al., 2007; McCorry et al., 2009; Robertson et al., 2010; Shaw et al., 2012).

This study did not exclude papers based on the quality of reporting.

2.5.3 Results of thematic synthesis

In the synthesis, previously active adults diagnosed with ACS, were influenced to engage in physical activity (PA) during CR by communication factors that involved both their self-perceptions of an exercise identity and their experience of CR. The overarching communication factors included two subthemes; ‘post event communication and advice’ and ‘expectations of exercise-based CR’. Advice given post event and during CR provided the context for decisions about engagement with exercise-based CR.

One of the two major themes involved with communication factors, ‘self-perceptions of an exercise identity’, influenced the perceived need for exercise-based CR. Exercise identity was formed by the influence of five subthemes: ‘motivators to exercise’, ‘self-confidence in physical ability’, ‘exercise self-reliance’, ‘perceptions of fitness identity’ and ‘perceptions of severity of cardiac condition’. The second major theme involved with communication factors ‘experience of exercise-based CR’ was formed by the influence of two subthemes: ‘age appropriateness of CR’ and ‘appropriateness of CR exercise’.

When communication factors, major themes and sub themes were combined, the novel model of engagement was developed (Figure 2-2). Depending on the interaction of ‘self-perceptions of an exercise identity’ and the ‘experience of exercise-based CR’, three resultant influences on physical activity were identified as knowledge of appropriate exercise levels and benefits of CR for

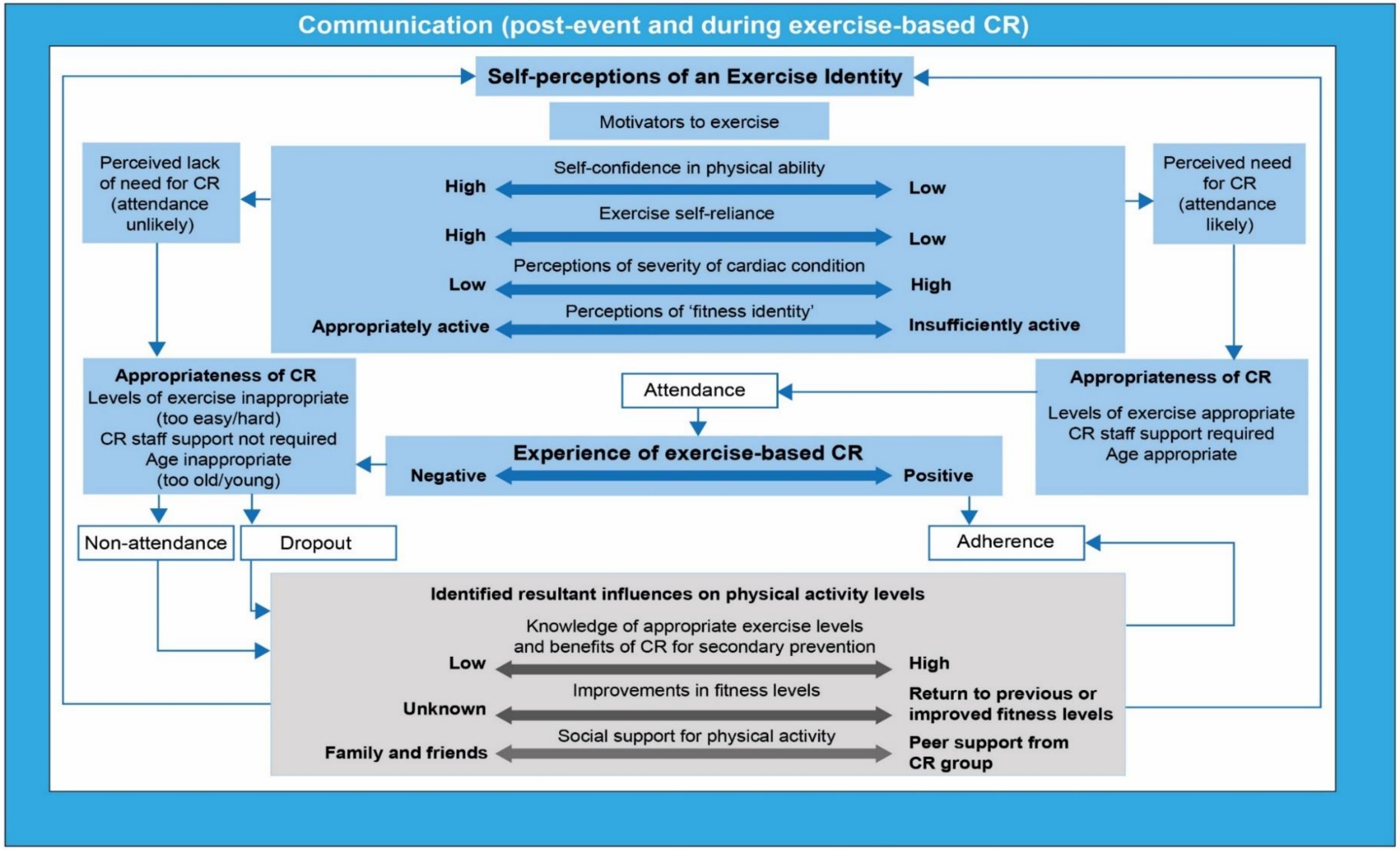


Figure 2-2: *Model of engagement in physical activity during CR*

secondary prevention, improvements in fitness level and social support for physical activity post cardiac event.

2.5.4 Descriptive overview of analytical themes and sub themes

Theme: Communication Factors

This theme refers to the experience of CR exercise communication post event and during exercise-based CR which provided the context for decisions about engagement with exercise-based CR.

Sub-theme: Post-event communication and advice

Post-event communication and advice represented participant reflections about the invitation to attend CR, and the information received from health professionals during the inpatient stay and period after discharge. Post-event communication issues included participants being uncertain about the purpose of CR (Cooper et al., 2005; Herber et al., 2017; Hird et al., 2004). When discussing communication during the inpatient stay, some referred to the "cardiac" element as indicating the programme to be about "the heart" (Herber et al., 2017; Hird et al., 2004). A few acknowledged the programme to include health education (Herber et al., 2017). Others did not view CR as a medium to foster long-term behaviour change and instead believed the aim was to return the individual to their normal level of functioning prior to the event (Herber et al., 2017; Hird et al., 2004; McCorry et al., 2009).

> "Non-completers and non-attenders were just as likely as completers to be uncertain about the purpose of the programme." (Herber et al., 2017)

When communication meant that participants associated CR primarily with exercise (Clark et al., 2004; Cooper et al., 2005; Hird et al., 2004), some felt embarrassment at the idea of group exercise (Clark et al., 2004; Cooper et al., 2005; Hird et al., 2004). For a few participants who felt able to exercise independently, this meant attendance was not considered necessary (Cooper et al., 2005; Herber et al., 2017)

> “…men who perceived cardiac rehabilitation as mainly 'gym-work' felt they could undertake this independently by joining a local gym or exercising at home.” (Cooper et al., 2005)

Communication factors that improved early decision-making and encouraged engagement included reinforcement of the benefits of attending exercise-based CR (Bäck et al., 2017; Cooper et al., 2005; McCorry et al., 2009). Other communication factors that positively contributed to attendance included information about types of exercise-based CR activity and reinforcement of the prospect of a supervised exercise environment (Bäck et al., 2017; Cooper et al., 2005). Participants who did not attend suggested improvements to initial communication could include specific details about the aims and objectives of the exercise sessions, including specific detail of the start date (Bäck et al., 2017; Clark et al., 2004; Herber et al., 2017; McCorry et al., 2009).

Sub-theme: Expectations of exercise-based cardiac rehabilitation

Post event communication and communication during CR influenced both prospective and reflective expectations of exercise-based CR. Participant expectations of the exercise programme were discussed within five studies (Bäck et al., 2017; Clark et al., 2004; Herber et al., 2017; Hird et al., 2004; Shaw et al., 2012). Expectations included accessing individualised exercise advice, regaining fitness, and support with identifying exertion levels (Clark et al., 2004; Herber et al., 2017; Hird et al., 2004; Shaw et al., 2012). For participants post

MI, accessing psychological and emotional support in relation to fears about exercise and trusting staff to be experts in exercise were important factors in engagement decisions (Bäck et al., 2017; Clark et al., 2004; Hird et al., 2004; Shaw et al., 2012).

> *"It was reassuring that the physiotherapists were present. I thought I would never dare to run because my heart would start beating faster."* (Back et. al. 2017)

When communication created expectations and when individual expectations corresponded with the CR experience, individuals engaged with CR exercise, for example individuals completing the CR programme expected and received moral support, encouragement and peer support (Herber et al., 2017; Shaw et al., 2012). In contrast, when expectations did not correspond with the individual's experience, the participants withdrew and stopped engaging in the exercise programme (Clark et al., 2004; Herber et al., 2017; Shaw et al., 2012). Some individuals expected their cardiovascular fitness to be monitored and to receive regular feedback related to the exercise sessions, for example individualised information regarding their exercise progress (Herber et al., 2017; Shaw et al., 2012). In addition, participants wanted individualised exercise sessions to accommodate ability, breathlessness and provide reassurance regarding levels of pain and discomfort (Herber et al., 2017). When the aforementioned expectations were not experienced, the participants dropped out of the programme (Herber et al., 2017).

For individuals who did not attend CR, the initial communication of the exercise-based CR failed to convince them that their expectations could be met (Bäck et al., 2017; Clark et al., 2004; Herber et al., 2017). Issues highlighted were if the information was conflicting or vague (Bäck et al., 2017; Clark et al., 2004). For some individuals who were seeking specific advice regarding individualised exercise goals, the communication before and/or during CR did not fulfil their expectations (Herber et al., 2017).

> “Non-attenders who had previously led active lives and considered themselves to be fitter than most CR patients wanted a regime that had goals tailored to their level.” (Herber et al., 2017)

A few participants reported disappointment in relation to their expectations (Shaw et al., 2012). Participants felt unsupported during the exercise sessions and found the exercise activities to be the same as their existing activities and of no additional value (Shaw et al., 2012).

Theme: Self-perceptions of an exercise identity

This theme refers to an individual’s perception of self that influences the perceived need to engage with physical activity during CR. Exercise identity is formed from the influence of the following five subthemes.

Sub-theme: Motivators to exercise

Motivators to exercise represented influences for re-engaging with previous exercise and attending exercise-based CR. Participants were motivated to return to previous activities (Cleary et al., 2015; McCorry et al., 2009), in which exercise was part of a previous ‘habit’ (Cleary et al., 2015) or routine (Bäck et al., 2017).

> *“I’ve just done it for so many years, I mean, it’s just my regular routine.”* (Cleary et al., 2015)

Previously active participants identified motivators to exercise, including social support from family or friends (Cleary et al., 2015; Galdas et al., 2012; McCorry et al., 2009) and goal setting (Bäck et al., 2017), for example weight control or increasing their fitness. For participants during the early stages of recovery who had not yet started CR, a self-driven motivation was to return to 'normal', and, for some, this included returning to previous activity levels (Bäck et al., 2017; Cleary et al., 2015; Hird et al., 2004). Participants who were not previously active lacked motivation to exercise and social support (Cleary et al., 2015).

A motivator to attend exercise-based CR was determining appropriate exertion levels (Hird et al., 2004; Shaw et al., 2012), and for those post-surgery, to improve physical health (Cleary et al., 2015; Hird et al., 2004).

> *"Doesn't bother me. I think it will be useful to get back to exercising to know how much to do"* (Hird et. al. 2004)

During attendance, motivators to exercise included enjoyment, familiar activities, feeing safe during exertion (Bäck et al., 2017; Dale et al., 2015; Galdas et al., 2012), and believing in the health benefits of exercise; for example, the contribution of exercise towards reducing secondary prevention risks (Bäck et al., 2017; Clark et al., 2004; Robertson et al., 2010).

> *"It has always been obvious to me to exercise regularly to feel good. But now it is even more important after the myocardial infarction, to make sure it does not happen again"* (Back et. al. 2017)

Some attenders suggested that post-programme motivational support could be beneficial for the longer-term maintenance of exercise (Bäck et al., 2017; Shaw et al., 2012).

Subtheme: Self-confidence in physical ability

Self-confidence in physical ability reflected perceptions of how participants felt about their ability to re-engage in physical activity after the cardiac event. Those communicating high self-confidence felt able to return to their previous physical activity and did not engage with exercise-based CR (Bäck et al., 2017; Cooper et al., 2005; Herber et al., 2017; McCorry et al., 2009). Higher levels of self-confidence reported in studies capturing data during the early weeks of the recovery process corresponded to participants who were likely to reject health professional support and information, instead believing in their own knowledge of exercise (Cooper et al., 2005; Herber et al., 2017). Participants who did not attend did not see value in exercise-based CR (Herber et al., 2017; McCorry et al., 2009).

> *"After I got over the initial period of fear, I got more confident so I didn't feel I needed any support and I didn't want to be runnin' to places where I hadn't time to go …."* (McCorry et al., 2009)

Exercise-based CR was rejected if it was perceived that the programme activities were similar to previous activities, resulting in confidence to return to activities independently (Cooper et al., 2005; Herber et al., 2017).

> *"I thought I could do better myself in a sense. I mean I've got an exercise bike, lots of work to do. I always looked upon physical work as exercise. That's what kept me fit all these years"* (Herber et al., 2017)

Lack of self-confidence to return to previous exercise intensity levels acted as a facilitator for participants to attend exercise-based CR (Bäck et al., 2017; Cooper et al., 2005; Hird et al., 2004). Those planning to attend exercise-based

CR were seeking to build confidence in their ability to exercise (Cooper et al., 2005; Hird et al., 2004), or support to regain confidence in fitness levels (Cooper et al., 2005; Hird et al., 2004). Participants who were not previously active lacked self-confidence to take part in exercise-based CR (Shaw et al., 2012). For participants attending CR, even for a few sessions, including the initial fitness assessment, the exercise component acted as a medium to rebuild self-confidence in physical activity (Bäck et al., 2017; Clark et al., 2004; Cleary et al., 2015; Jones et al., 2007; Robertson et al., 2010; Shaw et al., 2012). For example, individuals three months after CABG surgery reported feeling confident to adhere to post-surgical exercise recommendations (Cleary et al., 2015). Some gained confidence from the support received from CR staff and others perceived to be similar to themselves (Clark et al., 2004; Robertson et al., 2010).

> *"Coming to the exercise programme has made me confident enough to walk on my own on hills again now."* (Robertson et. al. 2010)

Sub-theme: Exercise self-reliance

Exercise self-reliance represented perceived capability to return to previous physical activity when considering information received from health professionals, or experience of exercise-based CR. Exercise self-reliance included the self-appraisal of previous exercise performance and when compared against the information communicating CR exercise intensity levels, influenced decisions of engagement with physical activity during CR (Bäck et al., 2017; Clark et al., 2004; Herber et al., 2017). Additionally, exercise self-reliance included perceptions of the participant's physical and/or psychological capability to return to previous exercise intensity levels (Bäck et al., 2017; Cleary et al., 2015; Cooper et al., 2005; Herber et al., 2017; Jones et al., 2007).

Decisions about non-attendance included participants perceiving themselves self-reliant, and having the physical and/or psychological capability to return to exercise independently (Bäck et al., 2017; Cooper et al., 2005; Herber et al., 2017; Jones et al., 2007; Shaw et al., 2012). Some participants reported having the resources to support their return to exercise, for example, being knowledgeable about exercise exertion levels (Shaw et al., 2012), feeling able to reproduce a better exercise programme (Herber et al., 2017), having access to gym equipment or gym memberships (Cooper et al., 2005; Jones et al., 2007), or perceiving themselves fitter than the intensity levels of exercise-based CR (Bäck et al., 2017; Clark et al., 2004; Herber et al., 2017).

> *"Some other non-attenders and non-completers felt that exercise intensity and duration were set far lower than their current level of physical fitness and so would be of little benefit."* (Herber et. al. 2017)

Interestingly, individuals reporting a reduced physical fitness level also based decisions of engagement with exercise-based CR on perceptions of exercise intensity (Cooper et al., 2005; Herber et al., 2017; Jones et al., 2007; Shaw et al., 2012).

Increasing the dose of exercise increased self-reliance and remained important throughout attendance (Cleary et al., 2015; Robertson et al., 2010), with a minority of participants reporting this conflicted with the aims of CR health professionals (Clark et al., 2004). For some, this resulted in discontinuing their attendance at exercise-based CR (Clark et al., 2004).

> *“You’re, trying to step up, you know, the exercise to your capabilities and they are giving you a row for turning things up too high, like the bike!”* (Clark et al., 2004)

Participants completing CR returned to similar, or improved, levels of fitness (Bäck et al., 2017; Clark et al., 2004; Robertson et al., 2010).

> *“I mean I’m probably working harder than I did before because I’m fitter”* (Robertson et al., 2010)

Males post-surgery acknowledged that an additional benefit of exercise-based CR was gaining an understanding about safe upper limits for exercise intensity (Robertson et al., 2010). The ability to self-pace was reported as a means of retaining control thereby increasing self-reliance (Robertson et al., 2010).

Sub-theme: Perceptions of severity of cardiac condition

Severity of illness referred to perceptions of the seriousness of illness either before or after the cardiac event and/or surgery (Dale et al., 2015; Robertson et al., 2010). Severity of illness included comparisons with others perceived to be more suited to the exercise-based CR (Bäck et al., 2017; Clark et al., 2004; Herber et al., 2017). Regardless of age, stage of recovery or whether the participants were post cardiac event or surgery, perceptions about illness severity were reduced if participants believed that physical activity had not been limited (Clark et al., 2004; Cleary et al., 2015).

> *“The doc doesn’t have me on any limits or anything ... I can pick up to 40 pounds ... I can move my arms up and down. So it hasn’t been physically straining to do something.”* (Cleary et al. 2015)

This was also the case for those who perceived that they could manage their condition, that their heart attack was ‘*mild*’ (Bäck et al., 2017; Herber et al., 2017; McCorry et al., 2009), and that medical management had helped recovery, meaning that exercise-based CR had no value (McCorry et al., 2009).

> “Such respondents (non-attenders and non-completers) often believed they have had a ‘mild heart attack’ less serious than other cardiac patients.” (Herber et al., 2017)

Individuals attributing their diagnosis to stress dismissed the cardiac event as merely an interruption and in playing down the threat of future events indicated these would be down to “*tough luck”* (Clark et al., 2004). Some participants reported seeing themselves as ‘slower’ or ‘weaker’ after their cardiac event and indicated the attendance at CR acted as a reminder of illness (Herber et al., 2017). Participants with no previous illness history reported that illness threatened their self-identity (Herber et al., 2017), and attendance at CR was perceived to accommodate individuals who were *“illness-focused”* (Clark et al., 2004).

In contrast, for some an awareness of mortality and a fear of death affected exertion levels, and was suggested to be both a facilitator and a barrier to attendance at CR (Bäck et al., 2017; Clark et al., 2004; Cooper et al., 2005). Non-engagers with exercise-based CR reported self-limiting exercise intensity due to fear and believing cardiovascular risks were negatively associated with exercise exertion (Cleary et al., 2015; Herber et al., 2017; McCorry et al., 2009). For participants post MI, attending exercise-based CR reduced fear about exertion levels (Bäck et al., 2017). Some males admitted to having previously reduced the severity of their illness symptoms prior to their cardiac event, indicating this action resulted in feelings of moral inadequacy and a desire to be "vigilant" to physical signs from within their body after the cardiac event (Dale et al., 2015; Robertson et al., 2010). These reflective accounts positively influenced decisions to attend exercise-based CR for support (Dale et al., 2015; Robertson et al., 2010). The existence of comorbidities was an issue for non-attendance (Jones et al., 2007).

Sub-theme: Perceptions of 'fitness identity'

Participants perceived they had a "*fitness identity"*. They referred to the 'self' to differentiate themselves and their abilities in relation to exercise-based CR, or during comparisons with others for whom they perceive the CR programme was more suited (Bäck et al., 2017; Clark et al., 2004; Dale et al., 2015; Herber et al., 2017). Participants not attending or not completing CR, described themselves as 'not the sporty type' (Bäck et al., 2017), or appraised themselves, '*fit*', '*fitter'* or more able than others (Clark et al., 2004; Dale et al., 2015; Herber et al., 2017).

> *"Because I was fit or back on the road within a week or back doing normal things within the week I didn't see the need for it [cardiac rehabilitation]"* (Herber et al., 2017)

During the decision-making process, a limited number of women perceived CR to include participants who were fitter than themselves (Cooper et al., 2005), (Cooper et al. 2005), whilst for others, the 'fitter' self was at the forefront of their decisions (Clark et al., 2004; Robertson et al., 2010).

> *"I: Why did you decide to attend the exercise class?"*

> R: "*To keep your body fit. I feel fitter than I did before."* (Robertson et al., 2010)

Attenders, including those post-surgery, described themselves as being 'unfit' prior to their cardiac event and considered themselves similar to others in exercise-based CR (Clark et al., 2004). For participants completing exercise-based CR, their fitness was at the core of their discussions (Robertson et al., 2010). For one group of men, CR exercise ignited feelings associated with "*fitter-self*" lost after the cardiac event (Robertson et al., 2010), while others describe their reclaimed self as being *"fitter"* (Clark et al., 2004; Robertson et al., 2010).

Some participants described how CR professionals did not take account of their perceived fitness levels which conflicted with their self-perceptions and negatively impacted their view of the exercise component of CR (Clark et al., 2004).

> *"It's absolutely crazy. No disregard to you, but if you've been a fit man, you're in there doing the exercises they're giving you as rehabilitation. Absolutely laughable"* (Clark et al., 2004)

Men with a prior diagnosis of type two diabetes resisted "*diagnostic labels*" perceived to be assigned during exercise-based CR, which conflicted with physical self-perceptions of strength and negatively impacted their views of advice, information and solutions offered by CR health professionals (Dale et al., 2015).

Theme: Experience of exercise-based cardiac rehabilitation

This theme refers to individual’s perceptions and experience of exercise-based cardiac rehabilitation which influenced the perceived appropriateness of CR.

Sub-theme: Age appropriateness of cardiac rehabilitation

Regardless of gender, participants compared their own age with the perceived age of others when referring to the appropriateness of CR. Those choosing not to attend exercise-based CR characterised participants who attended as either older, or younger than themselves (Bäck et al., 2017; Clark et al., 2004; Dale et al., 2015; Jones et al., 2007; McCorry et al., 2009).

> *“I’d another uncle had a heart attack… and he was saying about the age groups there and he put me off it even more ….”* (McCorry et al., 2009)

When participants considered themselves outside age norms, negative attitudes towards exercise-based CR were reported (Dale et al., 2015; Hird et al., 2004; Jones et al., 2007; McCorry et al., 2009). For younger working age men diagnosed with type 2 diabetes, the age image of exercise-based CR was a reminder of physical losses, resulting in participants choosing not to attend (Dale et al., 2015). For others, the participant’s age and the age-associated image of CR exercise resulted in participants deciding their existing physical activity regime was age appropriate (Bäck et al., 2017; Cleary et al., 2015). In one study, CR home exercise activities were deemed more suited to individuals either older or younger than themselves (Jones et al., 2007).

> *“Found home exercises too easy and aimed at older age group”* (Jones et al., 2007)

In referring to their preferred exercise activities, some, including those who were older, reported the physical demands of their familiar activities accommodated their age perceptions and influenced their adherence and non-adherence to exercise-based CR (Bäck et al., 2017; Cleary et al., 2015).

> *"Sometimes I say this to myself: 'I'm 77 years old and I have lived a good life and I do not think there is anything I need to change'. I think moderate physical activity, socialising with people and having a good time is important"* (Bäck et al., 2017)

Sub-theme: Appropriateness of cardiac rehabilitation exercise

Some participants perceived that CR exercises were inappropriate. Those who perceived themselves to be already active and "*doing enough*" did not attend exercise-based CR. Instead, they believed that alternative activities would be appropriate and sufficient when compared to their understanding of exercise-based CR (Cleary et al., 2015; Herber et al., 2017; Jones et al., 2007; McCorry et al., 2009; Shaw et al., 2012).

> *"They said about an exercise class but I was doing enough so I didn't go …"* (Shaw et al., 2012)

Alternative activities included walking, gym work, golf, daily chores and gardening (Galdas et al., 2012; Herber et al., 2017; Jones et al., 2007; McCorry et al., 2009). Participants perceived these activities to be less strenuous than exercise-based CR and emphasised that their chosen activity accommodated their physical ability (Herber et al., 2017; McCorry et al., 2009), lifestyle (Cleary et al., 2015; Jones et al., 2007), and social and cultural beliefs (Galdas et al., 2012; Jones et al., 2007). For example, walking was evaluated as an '*informal'* activity when compared to exercise during CR (Galdas et al., 2012; Jones et al., 2007). Individuals, identifying as Punjabi Sikh, preferred to engage in activities which were familiar and could be carried out within familiar settings (Galdas et al., 2012). Preference for these activities was also found in individuals who have no previous experience of exercise (Bäck et al., 2017).

Non-attendance and drop out of exercise-based CR related to participants who reported activity to be included within a physically demanding occupation (Bäck et al., 2017; Dale et al., 2015). Some participants believed exercise was part of their occupation and further exercise during their leisure time was not appropriate (Bäck et al., 2017). Furthermore, participants who did not believe in the health benefits of exercise did not view exercise-based CR as being necessary, instead believing medical intervention could prevent a further cardiac event (Herber et al., 2017; McCorry et al., 2009).

> *“Non-attenders who believed they were physically active before the event concluded that exercise would not be effective in preventing another event.”* (Herber et al., 2017)

Participants who dropped out suggest that exercise-based CR should be individualised (Herber et al., 2017).

2.6 Discussion

This review provides the first synthesis of qualitative studies to understand how previous history of physical activity, in adults diagnosed with ACS, influences engagement in physical activity during CR. Decisions of engagement in exercise-based CR were influenced by self-perceptions of an exercise identity and experience of exercise-based CR. Communication and advice given post event and during exercise-based CR provided the context for decisions about engagement. Exercise identity was formed by perceptions about motivators to exercise, exercise self-confidence, self-reliance, illness severity and a ‘fitness identity’. It influenced the perceived need for exercise-based CR. For those who attended, CR exercise experiences were important in encouraging or discouraging adherence. Factors influencing adherence include perceptions about age or exercise appropriateness and staff support.

Previous systematic reviews and meta-synthesis of qualitative evidence have explored individual factors influencing decisions of engagement in CR (Clark et al., 2013; Neubeck et al., 2012). A review of 1213 participants, including a majority admitted with a diagnosis of ACS, identified barriers and enablers of attendance to consist of system, service and personal barriers, including misunderstandings about the purpose of CR and believing themselves to be already physically active (Neubeck et al., 2012). Although the current review did not focus on the wider barriers and enablers to participation, the findings share similar service and personal level reasons affecting decisions of engagement. The findings of this review concur with Neubeck et al. (2012), highlighting that there is a need to clarify the multidisciplinary nature of CR, given that some participants perceived it to be primarily an exercise intervention (Clark et al., 2004; Cooper et al., 2005; Hird et al., 2004). This review adds to the findings of Neubeck et al. (2012) by exploring why individuals perceiving themselves active, or having previous experience of physical activity, is an important factor influencing decisions about engagement with exercise during CR.

This review supports previous findings, confirming self-perceptions of identity influence decisions about engagement in exercise services. For example, a qualitative study of exercise referral programmes confirmed exercise services provide a source for participants to assess their physical and psychological health and compare themselves to a perceived exercise identity (Pentecost & Taket, 2011). Perceptions of whether participants identified with an exercise identity, or not, influenced the uptake of exercise services (Pentecost & Taket, 2011). In addition, a previous systematic review and meta-synthesis of 1646 participants confirmed that CR programmes are a source of social comparison, providing a means for individuals to evaluate and measure their own health and progress (Clark et al., 2013). Although previous evidence confirms exercise programmes are a source for self-reflection, the current synthesis is unique in finding that CR communication and advice post event and during exercise-based CR provides a source for self-reflection.

CR communication contributes to the formation of self-perceptions of physical and psychological ability, which are influenced by previous PA levels. This review suggests that previous physical activity behaviour is central to self-perceptions of exercise identity. Communication between healthcare professionals and participants about exercise-based CR post event enabled participants to assess their physical and psychological ability, and decide whether to attend CR. Furthermore, decisions about engagement took place within the early days after the cardiac event or surgery, including the inpatient period. This highlights the importance of prompt initial contact from CR services, which needs to ensure an appropriate exchange of information about what support participants require to increase confidence and motivation to be active, and how CR services can provide this. The initial information exchange should include asking questions to identify which individuals identify as having been previously active. Discussions with these active individuals are likely to include highlighting the benefits of attending CR such as learning about safe exercise levels. For those who do not wish to attend formal CR, early conversations should provide information and support to determine appropriate exercise exertion levels. This is because those who engage and complete CR have reported these to be positive benefits of attendance (Bäck et al., 2017; Clark et al., 2004; Cleary et al., 2015; Cooper et al., 2005; Herber et al., 2017; Hird et al., 2004; Shaw et al., 2012).

Identity theory is useful in understanding how exercise-based CR communication can provide a source of self-reflection, and contribute to perceptions of exercise identity and decisions about engagement. Identity theory suggests individuals are motivated to maintain and affirm their sense of self and identity (Burke, 2009), constructed from reflecting upon one’s own behaviour (Bem, 1972). Reflecting upon the past performance of a behaviour can result in individuals making inferences based on self-perceptions (Rise et al., 2010) which result from interpretations of, or experiences with, an environment and influenced by the appraisal of one’s own attributes (Marsh & Shavelson, 1985; Shavelson et al., 1976). A meta-analysis examining 40 independent tests of self-identity, considering past behaviour and behavioural intentions, confirmed that individuals construct a perceived self-identity based on factors other than past behaviour, for example, social comparisons and self-reflection (Rise et al., 2010). Exercise self-identity and perceptions of one's ability have a direct effect on self-definition, indicating that a person can reflect upon their physical ability during their exercise performance to gain identity relevant information (Kendzierski & Morganstein, 2009). In light of this, and the findings of the systematic review, CR professionals should recognise the importance of the self-reflection process and how CR communication can contribute to the formation of self-perceptions. CR staff should ask questions that will encourage participants to consider past exercise behaviour and how this related to their current physical and psychological ability to re-engage with physical activity. CR staff should also address concern about the age appropriateness.

Within this review, self-confidence in physical ability after an ACS diagnosis influenced decisions to engage with physical activity during CR. Bandura's social cognitive theory (SCT) is another behavioural theory that has received significant attention in CR literature that has explored factors influencing engage with exercise-based CR (Bennett et al., 1999; Woodgate & Brawley, 2008). The SCT proposes there is a reciprocal relationship between the individual, the environment and the behaviour (Schunk & DiBenedetto, 2020), emphasising the relationship between the internal factors of cognition and symbolic processes, such as memory and motivation, and the external factors determining the behaviour, such as rewards. An important construct of SCT is self-efficacy, which refers to an individual's belief in one's own ability to engage in a specific action (Bandura, 1999). A previous positive experience of exercise is recognised to enhance self-efficacy because of past performance accomplishments (Bandura, 1997). Self-efficacy beliefs and outcome expectations can influence future behaviour, including engaging in exercise-based CR and exercise effort within a CR context (Alharbi, Bauman, et al., 2017; Blanchard et al., 2015; Flora et al., 2015; Woodgate & Brawley, 2008).

Previous research exploring self-efficacy, outcome expectancy and motivation to engage in CR has applied the Health Action Process Approach (HAPA) (Dohnke et al., 2010; Steca et al., 2017). The HAPA model is a framework to understand behaviour motivation and differentiates between a pre-intentional motivation phase that leads to behavioural intentions and a post-intentional volitional phase that leads to the actual behaviour (Schwarzer, 2008). A longitudinal study of 456 MI patients attending CR, found intentions to engage with CR were associated with higher attendance self-efficacy and expectations of positive consequences (Dohnke et al., 2010). Studies examining baseline self-efficacy for exercise in patient populations confirm high baseline self-efficacy for exercise is a strong determinant of attendance in exercise rehabilitation programs (Alharbi, Gallagher, et al., 2017; Selzler et al., 2016).

In the current review, participants with previous experience of physical activity were motivated to attend exercise-based CR and seeking support for their physical activity behaviour. Factors contributing to decisions of engagement included an awareness of mortality and fears of death which affected exertion levels. These findings contrast with those of a previous study of 198 ACS patients, and applying the HAPA framework to physical activity behaviour in the context of CR, reported that risk perceptions associated with physical activity were not a predictor of intentions to increase physical activity (Schwarzer, 2008; Schwarzer et al., 2008; Steca et al., 2017). Previous literature has confirmed risk perceptions alone are not a powerful predictor of behavioural intentions, instead risk perceptions facilitate thought processes related to individual competencies and consequences (Renner et al., 2000; Schwarzer, 2008; Sniehotta et al., 2005). The findings of this study are consistent with the previous literature confirming risk perceptions were negatively associated with exercise exertion and facilitated thought processes related to the physical and psychological self and contributed to decisions of perceived need for exercise-based CR.

For participants who dropped out exercise-based CR, participant’s experiences’ did not match their expectations. According to the HAPA model, individuals are in the initial stages of engagement and therefore need support and planning strategies in order to maintain the engagement behaviour and prevent drop out (Schwarzer et al., 2008; Steca et al., 2017). The current review suggests that CR participants have expectations of improved fitness, increased understanding of exertion levels, individualised exercise support, feedback and exercise (Clark et al., 2004; Herber et al., 2017; Shaw et al., 2012). Promoting personalised goals and providing individually relevant exercise information can enhance motivation for CR engagement and decrease negative outcome expectancies associated with perceptions of CR exercise exertion levels (Blanchard et al., 2015; Chu et al., 2016; Dohnke et al., 2010). Indeed, recent UK CR physical activity guidance emphasises that programmes should provide individualised structured exercise programmes, including documenting and reviewing exercise progression in line with personalised goals, and support individuals in developing self-management skills (British Association of Cardiovascular Prevention and Rehabilitation, 2017). However, it should be noted that across the included studies in this review, many participants were labelled according to the number of sessions attended and compared to the predetermined programme length (Jones et al., 2018). That said, the current review included studies pre-dating the aforementioned standards and core components. Where participants received individualised sessions, gained knowledge and understood exercise intensity progression, and felt confident in exercise trained staff, the reported improved fitness benefits for their exercise behaviour (Bäck et al., 2017; Herber et al., 2017; Shaw et al., 2012).

Whilst the results of this review indicate that individuals completing CR reported the ability to self-manage the intensity of their exercise, individuals also reported difficulty in maintaining the recommended exercise intensity outside of supported CR exercise sessions because of an inability to self-regulate exercise exertion levels (Galdas et al., 2012). Given the dose response relationship of CR exercise prescription required to improve secondary prevention outcomes, the inability to independently determine appropriate exercise intensity levels may cause disadvantage to the longer-term risk factor profile of individuals (Woodgate & Brawley, 2008). Consistent with previous systematic review recommendations, future studies are therefore required to explore individual ability to independently manage exercise intensity in accordance with national and international CR exercise guidelines for individuals completing CR.

This review could not confirm whether previous exercise was resumed at the same level of intensity as before an individual’s cardiac event. However, individuals believed that the intensity of their previous physical activities accommodated individual ability and understanding these decisions of engagement is essential. Furthermore, this population was motivated to return to a behaviour that was part of their previous habit or routine. Their outcome expectations did not include the health benefits of exercise and the review confirmed the initial communication of CR did not reinforce such benefits (Herber et al., 2017; McCorry et al., 2009). This highlights a need for services to promote how engaging with CR exercise prescription could help with a return to previous exercise levels.

2.6.1 Strengths and Limitations

A major strength of this review is the systematic and rigorous approach to identifying all studies with potential relevance to the review question. The comprehensive search strategy was tailored to each database to ensure retrieval of all published studies and, because of the small number of studies identified, it can be confirmed that this is the first systematic synthesis of qualitative primary studies to understand how previous experience of physical activity influences engagement in physical activity during CR.

A limitation of this review is the ability to generalise from the findings due to the small number of studies. Study recruitment included several geographical locations and a mixture of inpatient and outpatient CR services. The variation within the study settings may have implications for how participants responded. In addition, although all papers included data containing experiences and perceptions of participants believing themselves to be previously physically active, they did not directly assess the review question and may have implications for the review synthesis. The thematic synthesis methodology applied to this review offers a transparent process to the synthesis of the primary studies, however, to avoid overestimation, future research should collect data that both questions and measures how beliefs related to previous physical activity impact engagement in exercise during CR.

The review is restricted by the quality of the primary studies as assessed by the COREQ checklist (Tong et al., 2007). Although items most frequently reported support trustworthiness in the findings of the primary studies, missing items related to transparency and rigour within the research methods may affect the quality of the synthesised results. Although appraisal of qualitative studies remains a contentious issue, to improve confidence in the findings of studies exploring individual perspectives, experiences and views, future studies should aim to report all items related to the research team, study design, analysis and findings (Tong et al., 2007).

Furthermore, across the studies, there was limited data based on the views from a female perspective. Future research should consider whether gender influences the strength of the self-perceptions of exercise identity.

2.6.2 Implications for research

Future research should:

- Explore individuals’ previous physical activity behaviour and the fitness levels of individuals after a diagnosis of ACS to understand how their physical activity behaviour informs the decisions regarding the need for CR.

- Consider the self-appraisal relationship between the information received within the context of CR and the self-descriptions of physical and psychological fitness capability after a diagnosis of ACS but before the start of exercise-based CR.

- Consider whether demographic characteristics, such as sex and age, are associated with the perceptions of individual’s physical activity behaviour and fitness after a diagnosis of ACS. In particular research should focus on females, whose views were underrepresented in studies in this review.

- Focus on previous experiences of physical activity to understand the capability of individuals to engage in exercise at levels appropriate to gain secondary prevention benefits after a diagnosis of ACS and prior to the start of CR interventions.

2.6.3 Implications for practice

- Providers of exercise-based CR should promptly contact individuals diagnosed with ACS, assess perceptions related to previous exercise experience, in particular, motivations and beliefs related to previous intensity levels, and understand individual confidence to return to such levels.

- To reduce physical and psychological self-appraisal and decisions of non-engagement, exercise communication and information should be specific to the individual and based upon a measure of the individuals observed fitness ability.

- To improve retention during CR exercise interventions, CR health-care professionals should focus on supporting individuals to self-regulate exercise intensity independently and in accordance with national CR PA recommendations.

2.7 Chapter conclusions

In adults diagnosed with ACS, communication post event and during CR is an important factor in influencing initial and sustained engagement. CR communication and/or experience provides the context for a process of self-appraisal resulting in the formation of physical and psychological self-perceptions of exercise identity. Exertion levels are at the root of the self-perceptions of exercise identity and appraisals of self. In addition, perceptions of an exercise identity and experience of exercise-based CR influence decisions about engagement with CR. To improve uptake and adherence, health professionals need to recognise CR communication not only creates expectations of CR, but also is a source for self-appraisal. Health professionals need to tailor information and advice to accommodate the previous physical activity behaviour. Decisions about CR engagement are influenced by previous physical activity levels, which should be considered in the provision of interventions to optimise physical activity post event.

Important considerations for improving individual engagement are the content and the timing of exercise communication. The findings show decisions to return to the previous exercise behaviour are formed in the immediate period post cardiac event or surgery. The moderating factors to achieving the participant's desired outcome are perceptions of the severity of their cardiac condition and whether or not they want to be active. Health professionals need to understand an individual's knowledge, beliefs, prior physical activity experience and expectations in relation to exercise services. CR services need to communicate the value of CR to support individual exertion levels. This may improve engagement and have a spill over effect of reducing the emotions affecting activity level. This information needs to be individually relevant and assessed. Fitness assessment tools need to take account of the individual's self-reported capability to ensure that the exercise information is truly individualised.

Future studies are required to increase understanding of the relationship between the previous physical activity levels and the physical and psychological self-perceptions of physical ability and health in the context of the CR exercise communication. In addition, future studies should explore individual characteristics and whether gender is a factor in this relationship.

Chapter 3. Methodological approach

3.1 Introduction

The synthesised findings in chapter two indicated that CR uptake could be improved by considering the factors included in the model of engagement (Figure 2.2). Twenty percent of ACS survivors will experience a further cardiovascular event within two years of their initial diagnosis (Jernberg et al., 2015), but exercise-based CR can reduce the risk of cardiac related mortality and rehospitalisation (Anderson et al., 2016), Given this, it was important to explore factors influencing physical activity levels after a diagnosis of ACS and within the context of CR. Physical activity is a core component of CR practice and previous review evidence has confirmed that individual barriers to engaging with CR include individual beliefs of being already active (Neubeck et al., 2012). Further research was needed to inform CR practice and to provide an in-depth understanding of the contextual factors contributing to the individual physical activity levels of those believing themselves to be physically active prior to their ACS diagnosis and/or before the start of supervised exercise-based CR. In the absence of this evidence, survivors of ACS who believe themselves to be physically active may not achieve the recommended secondary prevention physical activity levels, or feel physically and psychologically competent to manage physical activity levels. At worst, they may be at risk of further cardiovascular events because they are under or over-exercising.

3.2 Context of research

This thesis originated from a research interest in ACS patients and their perceptions of physical activity after diagnosis. As an inexperienced researcher who had just completed an MRes study immediately prior to this PhD, the MRes findings motivated my curiosity and prompted my initial research thoughts for this PhD project.

The aim of the MRes was an exploration of the lived experience of how CHD patients (n=7) obtained emotional support post PCI. Three male participants diagnosed with ACS reported a perceived loss of identity after PCI treatment. This resulted in them gaining emotional control of illness related emotions from testing their maximum physical activity performance during, and in the absence of, exercise-based CR. The participants acknowledged receiving CR information but consciously not adhering to the physical activity information. The three participants included both attenders (n=2) and non-attenders (n=1) of an NHS exercise-based CR programme I worked in as an experienced British Association for Cardiovascular Prevention and Rehabilitation (BACPR) specialist exercise instructor. All three participants referred to themselves as having been previously “fit”. The concept that these patients were knowingly going against CR physical activity advice to test their physical levels during, or in the absence of, exercise-based CR, surprised me.

From my practice, I believed all participants had received a functional capacity test at the CR risk assessment appointment and had been at the centre of discussions regarding physical activity intensity levels. This approach was in line with common standards of best practice for CR programmes (Piepoli et al., 2014). My role within CR was to support patients’ understanding of appropriate physical activity levels and my practice incorporated BACPR’s research evidenced-based physical activity recommendations (Jones et al., 2020). I understood there could be several factors influencing participants’ physical activity behaviour and that factors were likely to vary between patients. My MRes finding that some men were testing their physical limits after ACS diagnosis and treatment could be interpreted as a means of coping with an illness diagnosis (Leventhal et al., 1992), preserving a health identity (Nymark et al., 2014), or a means to preserve a masculine identity (Dale et al., 2015). What I did not know was why participants wanted to test their physical activity levels in this way after an ACS diagnosis and PCI treatment. Additionally, I did not know why participants chose not to engage with CR physical activity intensity levels, and whether perceiving themselves to have been previously fit has been a factor of this behaviour. I wanted to explore this 'testing of physical limits' behaviour further, to inform my understanding and influence my practice within exercise-based CR. In view of the fact that my practice was intertwined with how I came to understand this research finding, I felt it was most appropriate to adopt a pragmatic approach to researching this problem (Morgan, 2014).

3.3 Philosophical approach

Pragmatism, a philosophy which includes several belief systems and assumptions, can offer a practical solution to solving real world problems in relation to human activity (Morgan, 2014). To improve understanding of a research problem, pragmatism, a single paradigm approach, as opposed to using a combination of positivism or constructivism as paradigms, supports the mixing of both quantitative and qualitative methods (Plano Clark, 2016; Tashakkori & Teddlie, 2010). In addition, pragmatism offers the flexibility to identify the most appropriate methods to answer research questions (Doyle et al., 2016). Previous studies using a mixed methods approach and including samples of cardiac populations have explored the motivation and barriers to participating in exercise interventions (Adsett et al., 2019; Huffman et al., 2015), and the experiences of a tele-rehabilitation programme (Hwang et al., 2017). At an individual level, studies have explored self-regulation behaviours (Jiwani et al., 2017), goal setting (Stamm-Balderjahn et al., 2016) and exercise improvements to quality of life (Milligan, 2013).

In the current study, the complexity of integrating quantitative and qualitative methods was considered (Tashakkori & Teddlie, 2010). Barbour suggests a well-designed and integrated mixed methods research study should provide "*a whole greater than the sum of its parts*" (Barbour, 1999). Specific challenges to achieving this include issues with transparency, the quality of data integrations and the inferences produced (Creswell & Plano Clark, 2011; Tashakkori & Teddlie, 2010). To avoid such issues, literature offers guidance to support the transparency and quality of integration (O'cathain et al., 2008). O'Cathian and colleagues suggest reporting guidance can improve the quality assessment of mixed methods studies and increase transparency of the aspects of integration. The following represents the guidance for good reporting of a mixed methods study (O'cathain et al., 2008).

- Describe the justification for using a mixed methods approach to the research question.
- Describe the design in terms of the purpose, priority and sequence of methods.
- Describe each method in terms of sampling, data collection and analysis.
- Describe where integration has occurred, how it has occurred and who has participated in it.

- Describe any limitation of one method associated with the presence of the other method.
- Describe any insights gained from mixing or integrating methods.

In accordance with the recommendations of O'Cathian and colleagues, the following sections will outline the research questions and justify the mixed methods approach.

3.4 Research questions

The results and limitations of the systematic review completed within chapter 2 were considered. Firstly, the twelve studies included in the review did not directly explore the specific characteristics of physical activity levels amongst adults after a diagnosis of ACS. The review therefore could not confirm what factors influenced engagement in physical activity post event and before the start of exercise-based CR. Second, CR communication was a source of self-appraisal for physical self-perceptions, such as capability, an active identity, and perceptions of cardiac illness severity. However, quantifiable evidence of participants' physical self-perceptions and illness perceptions, and their relationship to increased physical activity levels was unknown. Finally, the review findings did not confirm specific influences on engagement in physical activity post event for individuals who reported being physically active prior to their ACS diagnosis and treatment, nor what CR support this group required to return to physical activity.

Given the evidence gaps identified from the systematic review in chapter two, the research included in the studies in this thesis aimed to answer the following questions:

1. What are the self-reported physical activity levels of adults after a diagnosis of ACS prior to starting CR?
2. Are demographic and medical factors associated with self-reported physical activity levels among adults after a diagnosis of ACS prior to starting CR?
3. Are physical self-perceptions and illness perceptions associated with self-reported physical activity levels after a diagnosis of ACS prior to starting CR?
4. After a diagnosis of ACS, how are the influencing factors associated with moderate and high self-reported physical activity levels understood within the context of CR?
5. What CR support do those who self-report being moderately or high active after a diagnosis of ACS require?

3.5 Justification for a mixed methods approach

Different approaches were required to allow for a meaningful examination of the questions detailed in section 3.4. Quantitative methods were deemed most suitable to answer research question one (What are the self-reported physical activity levels of adults after a diagnosis of ACS?), two (Are demographic and medical factors associated with self-reported physical activity levels?) and three (Are physical self-perceptions and illness perceptions associated with self-reported physical activity levels?). This was because they required the collection of objective data to assess activity levels, demographic and medical characteristics and self/illness perceptions.

To answer questions two and three about the associations between variables and physical activity levels, it was necessary to collect data from a sample size large enough to investigate significance levels.

Qualitative methods were deemed most suitable to answer questions four (how are the influencing factors associated with moderate and high self-reported physical activity levels understood?) and five (what CR support do those self-reporting being moderately or highly active after a diagnosis of ACS require?). This was because talking to participants was the best way to explore their understanding of concepts and needs. Answering research question one identified a group of participants who self-reported being physically active after an ACS diagnosis. This provided a potential recruitment pool of active participants to answer questions four and five. Identifying such a sample using qualitative sampling methods alone would have posed a challenge in defining the sampling frame. Using a validated, objective measure of physical activity to define the sample to target for recruitment reduced the potential for researcher bias in defining the characteristics of an active individual.

To answer the questions detailed in 3.3, a mixed methods approach offered the ability to use both quantitative and qualitative methods to generate an understanding a research area not comprehensively explored before (Creswell, 2015). In this study, a mix of methods helped answer all five questions, and integrating methods offered the ability to identify a homogenous sample of participants self-reporting being active at moderate and high levels of self-reported physical activity (Creswell & Plano Clark, 2011). The combination of data collection, analysis and interpretations of quantitative and qualitative methods allowed for a deeper understanding of the contextual influences contributing to the profiles of individuals self-reporting being moderately or highly active after a diagnosis of ACS, and an understanding of what CR support this group require.

3.6 Research methods

The research methods and associated designs most suited to answer the research questions were considered (Moule & Goodman, 2009). Considerations included understanding each method's strengths and weaknesses and the ontological and epistemological assumptions associated with each research method (Moule & Goodman, 2009). In addition, techniques towards sampling, data collection and data analyses were examined (Ellis, 2010).

3.6.1 Quantitative research methods

Quantitative research methods are typically concerned with the observation of phenomena to enable inferences to be drawn from a sample of the population (Houghton et al., 2012). Research related to physical activity levels of ACS samples has predominantly employed quantitative methods (Hartung & Touchette, 2009). Quantitative methods are rooted in positivism, a philosophical system which views reality objectively and quantifiable (Houghton et al., 2012). Within the social sciences, positivist assumptions suggest "social objects", such as physical activity levels, are studied as "hard facts". Also, the relationships between these facts are viewed as "truth" (Crossan, 2003). Traditionally, positivism assumes social objects exist independently of the human mind, reducing human behaviour into discreet elements (Crossan, 2003). Quantitative methods are designed to analyse data for trends and relationships, as required by research questions one, two and three.

Quantitative methods can be categorised as experimental and observational. Each method has strengths and weaknesses, which have been examined in relation to the current study and concerning physical activity levels of ACS participants:

- Experimental studies aim to assess the effectiveness of an intervention introduced to an experimental group and compared to a control group (Hartung & Touchette, 2009). Randomised controlled trials, which are considered to be the gold standard of experimental studies, are criticised for having limited applicability to real world interventions (Craig et al., 2008). Experimental studies have been employed with CHD samples to assess the effects of training at differing exercise intensity levels (Chen et al., 2017; Price et al., 2020; Xie et al., 2017), but have not examined the relationship between physical activity levels and physical self-perceptions. An experimental approach was not considered to be suitable for this PhD study because before attempting to establish a causal relationship, there is a need to establish the extent of the relationship between physical activity levels and physical self-perceptions within an ACS sample from observational studies.

There were several possible observational research design options, for example, case-control, longitudinal and cross-sectional studies.

- Case-control studies typically recruit participants based on an outcome of interest (Setia, 2016a). For example, subjects sharing a diagnosed of ACS (cases), and being physically active, compared to those not being physically active. Within CHD samples, case-control studies addressing physical activity have included other lifestyle factors and examined their associations with the outcome of mortality or CHD (Khoramdad et al., 2020). A case-control research design was not considered suitable to answer questions in 3.4 because the questions are not comparing the physical activity levels of two groups of ACS samples. Instead, the questions were looking for a relationship between the stated variables and physical activity levels.

- Longitudinal studies recruit participants to assess the association between the exposure and the outcome at two or more time points to provide information about changes over time (Hartung & Touchette, 2009). For example, the design would be suitable for studying changes in physical activity up to twelve months after an ACS diagnosis (Steca et al., 2017). This design was not considered suitable for answering the current research questions as there is no requirement to compare the trends of physical activity levels. Also, this type of research can be expensive because of collecting data over lengthy periods, and can be associated with sample bias due to the loss of participants at follow-up points (Caruana et al., 2015).
- Cross-sectional studies assess the exposure and outcome at the same time, and at one time point, to explore variation between subjects (Hartung & Touchette, 2009). This type of research would be suitable to answer questions one, two and three of the current study questions in section 3.4. Cross-sectional studies generally take the form of a survey (Setia, 2016b). This type of design is useful when considering a previously unexplored area, such as physical activity behaviour and the

associations of physical self and illness -perceptions. Finally, the data collection is relatively inexpensive and time-efficient, therefore suited to a time constrained PhD project.

A quantitative research method using a cross-sectional study design was considered be useful to answer research questions one, two and three. However, quantitative methods cannot answer questions aimed at understanding human behaviour or experiences (Clark, 1998). This meant that questions four and five required consideration of alternative methods.

3.6.2 Qualitative research methods

Qualitative methods support research aimed at understanding human behaviour and traditionally generate knowledge from the interpretative paradigm (Lincoln & Guba, 1985). The interpretative paradigm offers frameworks from which to gain a knowledge of the ontological aspect of what is true (Strauss, 1998). In other words, the natural world is studied from the view of the participant in order to understand the nature of their behaviour or experiences (Crotty, 1998). Research seeking to explore the phenomena of human behaviour is subjective, where meanings and interpretations are constructed by the person from the interactions with the world around them (Moule & Goodman, 2009). Methodologies within the interpretative paradigm include theoretical perspectives which inform qualitative methods for data collection and analysis, and include criteria to reduce bias and support quality and credibility (Moule & Goodman, 2009).

Qualitative research methods fall broadly into four categories (ethnography, grounded theory, phenomenology and thematic analysis). The most appropriate method for this thesis was assessed by considering the knowledge being developed, and the strengths and weaknesses of each approach.

- Ethnography is best suited to studies aiming to understand the social and cultural norms of a specific population (Moule & Goodman, 2009). The experiences of an ACS population could be collected from methods which typically involve the researcher participating in the lived routines of the participants, and for an extended period (De Chesnay, 2015a). Although ethnographic studies can provide rich and holistic data, unless the ACS participants were living within one setting, for example, a physical rehabilitation centre, there could be implications for the sample size, and the time to generate and analyse data within a PhD timeframe (Moule & Goodman, 2009). An additional concern with this method is that there could be a risk of bias because participants could change their physical activity behaviour in the researcher's presence.

- Grounded theory is suited to studies where existing data or theories about a problem are limited (De Chesnay, 2015b). This design is suited to selecting a study sample from the setting where the problem has been identified. Data are analysed inductively and iteratively to generate in-depth information to develop theories (Moule & Goodman, 2009). Given the limited literature found within chapter two, grounded theory offered potential to further explore the model of engagement and build towards a theory. However, the identification of the sample population from the quantitative element of the study meant that there was a limited timescale in which to recruit participants for the qualitative element of the study. This was because the aim of the study was to understand physical activity post ACS diagnosis and treatment. A longer time lapse between completion of the quantitative element and recruitment to the qualitative element would increase the risk of recall bias. The iterative nature of data collection and analysis within Grounded Theory means that data collection is often conducted over a long period of time. For this reason, Grounded Theory was not considered suitable for the qualitative element of this thesis.

- Phenomenology offers a methodology to explore and understand the meaning of a phenomenon through the lived experience of the research participants (Moule & Goodman, 2009). There are several approaches to consider. Descriptive phenomenology includes the researcher remaining neutral, declaring any preconceived beliefs (bracketing) and describing the lived experience from the subjects' point of view (De Chesnay, 2015c). The interpretative approach encourages the researcher to engage with the process, continually exploring and analysing the data to understand the phenomenon rather than describe phenomena (Manen, 1990). Although both approaches can provide rich data and offer a deeper understanding of the lived experience of physical activity levels, this methodology cannot answer questions seeking an explanation (Lincoln & Guba, 1985).
- Thematic analysis offers a flexible method to recognise, analyse and interpret meaning within data (Braun, 2013). This method is untied to one specific methodology framework, meaning that can be applied across a range of theoretical frameworks and used with both inductive and deductive research methods (Nowell et al., 2017). This approach can support the researcher to generate insight into participant perspectives

and highlight the similarities and differences in the data (Braun, 2013). This method is well structured, includes a logical process to data analysis and is useful to answer questions four and five in section 3.4 (Nowell et al., 2017). Finally, thematic analysis requires no prior theoretical knowledge of application and is therefore suited to a novice researcher.

Qualitative methods could be used to explore questions four and five, but to answer all five research questions, both quantitative and qualitative methods needed to be considered within a mixed methods study design.

3.7 Mixed methods study design

Although there are several mixed method designs, the three basic designs are convergent, explanatory sequential and exploratory sequential (

Figure 3-1):

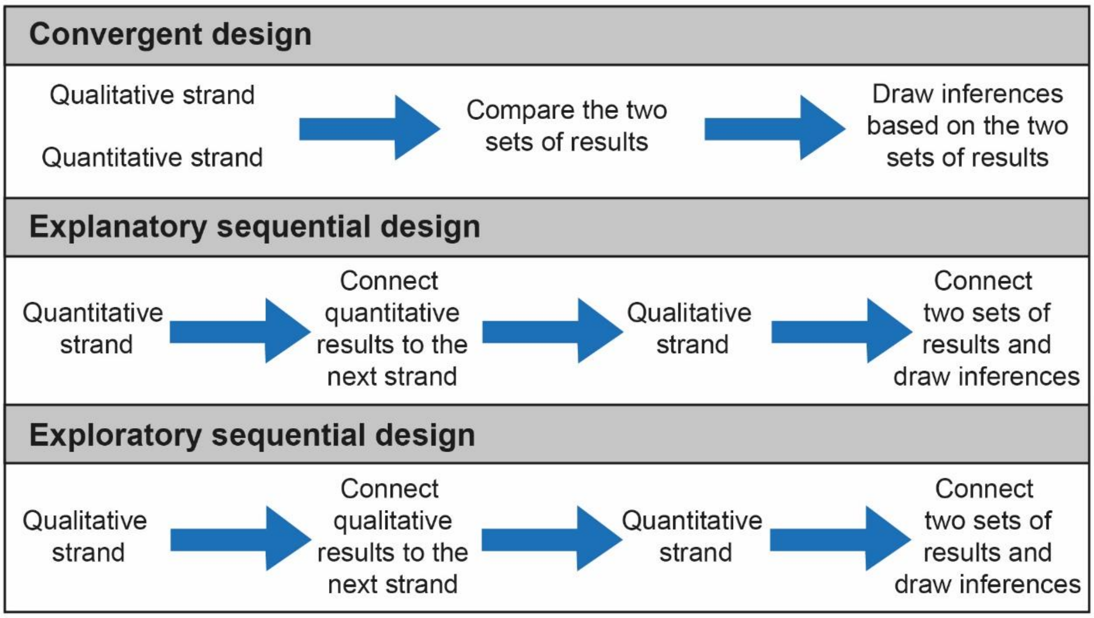


***Figure 3-1**: Basic mixed method designs (Plano Clark, 2016)*

Each model includes two strands, one quantitative and the other qualitative, representing a component of the mixed methods study. Each component includes research questions and the traditional methods of collecting and analysing data (Plano Clark, 2016). For example, in the quantitative strand, the quantitative data collection will guide the numerical data collection and analysis methods. All models feature the point where the two strands integrate.

Integration of the two methods is complex and must be considered at all stages of the research process, for example, at the design, methods, reporting and discussion stage (Creswell & Plano Clark, 2011; Doyle et al., 2016). At the design stage, challenges include ensuring the research questions support the mixed methods design. In the studies in this thesis, research questions one, two and three were answered using quantitative methods. Question four was and integrated question, and required qualitative methods which could only be answered from referring to the findings of questions one through to three. Additionally, question five required qualitative methods answered from referring to the sub-sample identified from question four. An explanatory sequential mixed methods design was considered to be the best suited to answer the research questions. This was because explanatory design is intended to initiate a quantitative study phase where the results can be further explained within a follow-up qualitative study phase (Creswell, 2015).

The quantitative component took precedence and explored questions one, two and three. A cross-sectional survey design offered an efficient method to collect data from a sample of ACS diagnosed patients within a short period of time, and at one-time point. This initial component examined physical activity levels and assessed the extent to which demographics, physical self-perceptions and illness perceptions were associated with physical activity levels. The results of the quantitative analysis were examined to determine significance levels and include options to explore unexpected results (Creswell, 2015). The quantitative data analysis informed the qualitative interview questions to provide a deeper understanding of the influencing factors associated with moderate and high self-reported physical activity levels. An important element of the mixed methods design was that the quantitative strand identified a sub-sample of participants who were at least moderately active to take part in the qualitative phase of the study and answer question four and five. Therefore, at the methods level, an explanatory sequential design informed the sampling frame for the qualitative phase.

The qualitative phase collected in-depth information from the purposive sub-sample of participants to answer question four and five in section 3.4. The sequential timing of the qualitative study was best suited to understand what CR support those who self-reported being moderately active or high active after a diagnosis of ACS require. The qualitative phase built upon the first phase to further explain the significant results, asking questions to discover the meanings of participants' physical activity levels, physical self-descriptions and CR support requirements after a diagnosis of ACS. In addition, this explanatory phase provided an opportunity to explore any unexpected results from the quantitative phase. The qualitative data collection and analysis drew inferences to explain the quantitative results (Creswell, 2015) (

Figure 3-2).

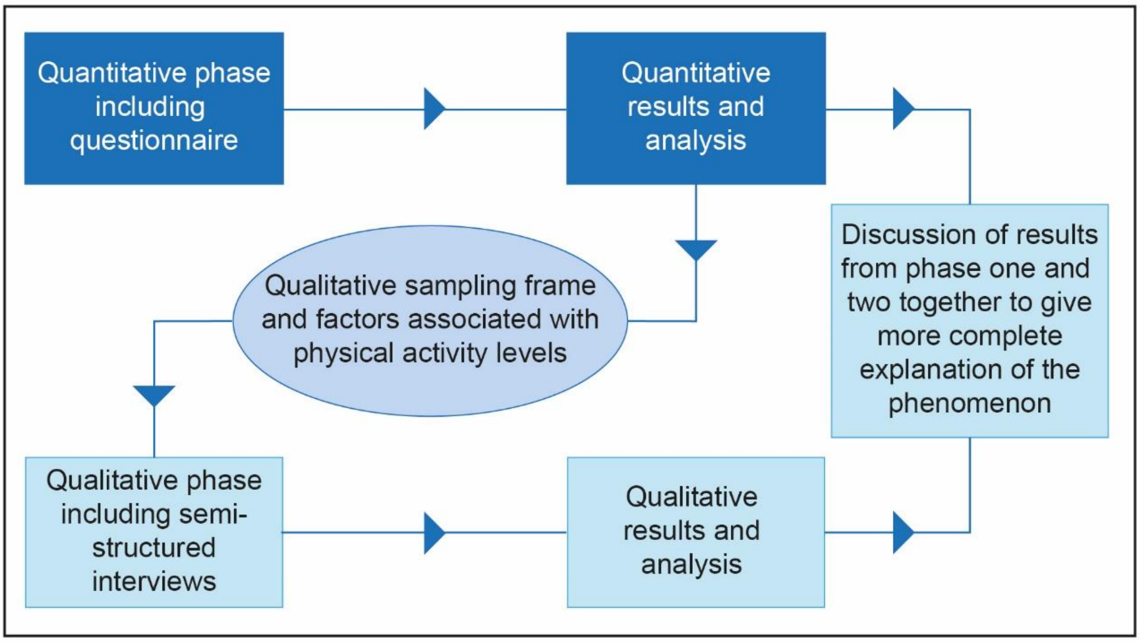


Figure 3-2: *Explanatory sequential design*

At the reporting level, the quantitative and qualitative results can be presented separately, but integrated at the discussion level. The integrated discussion can develop *"meta-inferences"* to answer the mixed methods questions (Doyle et al., 2016).

3.8 Approval to conduct research

To initiate a study involving NHS patients and to ensure potential participants were not exposed to psychological or physical harm, ethical review and approval were required from the University's School Research Integrity Committee, NHS Research Ethics Committee (REC) and NHS Research Scotland Permissions Co-ordinating Centre (NRSPCC) to access approval from NHS local Research and Development (R&D) centres.

University School Research Integrity Committee

The research study was undertaken as part of a postgraduate research degree within the School of Health and Social Care (SHSC) and was required to meet the governance standards set by Edinburgh Napier University (ENU). Recruiting NHS patients within a study required NHS REC approval. In this instance, ENU were required to act as a sponsor for the research and the SHSC research integrity committee were required to check the study was conducted per the ENU code of practice. The study met the requirements for SHSC sponsorship review and the ENU sponsor signed the IRAS application.

NHS Research Ethics Committee (REC)

This study aimed to involve potential participants who were current patients of four NHS CR services. The process for REC approval required the completion of an electronic application using the Integrated Research Application System (IRAS). The IRAS application was submitted and after completing two minor conditions, the Health Research Authority (HRA) issued a letter of favourable opinion on 28th August 2019 (**Appendix 6**).

NRSPCC and approval from NHS R&D centres

This study was a multi-centre study where the research was carried out in four NHS sites. NRSPCC offered a generic review for the sites with the individual NHS R & D centres reviewing local issues, for example, their capability to host the study. The NHS Site Specific Information (SSI) application form was completed and emailed to the designated local NHS R & D site (Fife). NHS Fife, distributed the SSI information to the NRSPCC and the remaining three sites. Upon completion of a Research Passport Application Form, all four NHS

R & D departments issued a letter of access and R & D management approval. The R & D management approval from Fife is included in **Appendix 6** as an example.

3.9 Chapter conclusions

This methods chapter has justified and explained the study rationale, epistemological stance and research methods best suited to answering the research questions. An overview of the explanatory sequential mixed methods study design, data integration points and sampling strategy have been detailed and illustrated. This chapter also explained the procedures for gaining ethical approval. Chapters four and five will detail the specific methods employed, and will describe where integration of the quantitative and qualitative methods have occurred. Chapter six will discuss the results from phase one and two to provide a more complete explanation of the phenomenon.

Chapter 4. Self-reported physical activity levels of adults after a diagnosis of ACS prior to starting CR

4.1 Introduction

Twenty percent of ACS survivors will experience a further cardiovascular event within two years after their initial diagnosis (Jernberg et al., 2015). CR secondary prevention lifestyle interventions are known to be effective in reducing the associated risks of a further event and improving participants' quality of life years (Anderson & Taylor, 2014; Clark et al., 2005). Physical activity is a core component of CR secondary prevention interventions and physical activity guidance is in line with global public health recommendations for the primary prevention of CHD (Piepoli et al., 2014). After a diagnosis of ACS all patients are supported to achieve a minimum of 150 minutes of moderate intensity endurance activity over 5 days, or 75 minutes of vigorous intensity activity per week over 3 days, and resistance training on at least two days of the week (Pelliccia et al., 2021). Following a risk-assessment to identify the likelihood of adverse events during physical activity, patients may be encouraged to gradually increase physical activity levels. For those able to achieve the minimum recommendations, additional cardiovascular benefits can be achieved from gradually increasing physical activity towards 300 minutes of moderated, or 150 minutes of vigorous intensity activity per week (Pelliccia et al., 2021). Additionally, CR secondary prevention guidelines recommend that exercise tailored to a level that improves cardio-respiratory fitness should be completed at least two or three times per week for between 20 and 60 minutes (not including warm up and cool-down)(American Association of Cardiovascular and Pulmonary Rehabilitation, 2021).

Early provision of a structured and individualised physical activity programme to increase physical activity levels is recommended within secondary prevention clinical guidelines (Ibanez et al., 2018). In the UK, 50% of eligible participants do not access early provision of CR physical activity interventions. In addition, approximately 40% of participants self-report meeting 150 minutes per week of moderate physical activity after a cardiac event at the start of CR. One potential reason for not accessing CR physical activity interventions is that participants are already active (British Heart Foundation, 2019; Clark et al., 2004; Herber et al., 2017). Factors known to influence physical activity levels after a cardiac event include sociodemographic correlates, such as sex and age (Blanchard et al., 2010), psychological correlates, such as attitudes, beliefs, motivation (Petter et al., 2009; Reid et al., 2012), and self-perceptions (Chen et al., 2015; Clark et al., 2013).

In the qualitative systematic review (Chapter 2), self-perceptions were central to participants' decisions to engage with exercise after a cardiac diagnosis and were important influences on physical activity levels. This has been previously reported amongst children (Marsh et al., 2006), adolescents, including individuals diagnosed with heart disease (Chen et al., 2015) and older adults, including those with disabilities (Amesberger et al., 2011; Fox & Wilson, 2008; Martin, 2007). Physical self-perceptions, including perceived physical ability, have yet to be tested using quantitative methods with adults after a diagnosis of ACS but prior to starting CR.

Self-perceptions of illness after a cardiac event were found to contribute to an exercise identity and decisions to engage with exercise-based CR (Chapter 2). Self-perceptions of illness have been associated with physical activity levels in cardiac patients (Holmes, 2016; Mosleh & Almalik, 2016; Reges et al., 2013; Sniehotta et al., 2010). However, illness perceptions remain to be explored in patients post ACS and prior to the start of supervised exercise-based CR.

Exploring physical activity levels post ACS diagnosis and their association with demographics, physical self-perceptions and illness perceptions is important. This is because the systematic review in this PhD (Chapter 2) identified elements of these factors as influential in decisions about CR engagement. Increased understanding of which elements are most important to patients could inform the provision of tailored information post cardiac event, future CR exercise-based interventions, and enhance the individualisation of early exercise support provided to ACS patients. Therefore, the aim of the quantitative component of this study was to explore physical activity levels and associations with demographic, physical self-perceptions and illness perceptions in adults after a diagnosis of ACS and in the context of CR.

Specifically, the objective of the quantitative element of this study were to answer the following research questions:

1. What are the self-reported physical activity levels of adults after a diagnosis of ACS but prior to starting CR?
2. Are demographic (age, gender, Scottish Index of Multiple Deprivation [SIMD], educational level and marital status) and medical (cardiac diagnosis and number of comorbidities) factors associated with self-reported physical activity levels among adults after a diagnosis of ACS but prior to starting CR?
3. Are physical self-perceptions (global physical self, global self-esteem, activity, health, co-ordination, body fat, sport, appearance, strength,

flexibility and endurance) and illness perceptions (perceived illness consequences, timeline, personal control, treatment control, identity [symptoms], concern, coherence and emotional representation) associated with self-reported physical activity levels after a diagnosis of ACS but prior to starting CR?

4.2 Methods

A cross sectional survey design was used to collect quantitative data to examine self-reported physical activity levels and factors that potentially contribute to decisions about being active (physical self-perceptions and illness perceptions) among adults diagnosed with ACS. This study is reported following the STROBE checklist (Strengthening the reporting of observational studies in epidemiology) included within **Appendix 14** (Von Elm et al., 2007).

4.2.1 Sampling and recruitment of participants

Context of the study

Scotland was an ideal choice for the recruitment of participants to examine physical activity levels and associations with demographic, and physical and illness perceptions in adults after a diagnosis of ACS and in the context of CR. This was for a number of reasons. Firstly, a Scottish wide scoping review of CR services reported ACS patients comprise the majority of eligible patient populations referred to CR, and CR programmes across Scotland include a similar model of exercise based delivery (Divers, 2015). Secondly, the researcher is a BACPR qualified exercise specialist instructor working in one community exercise-based CR programme within central Scotland. This meant the researcher had a good understanding of Scottish CR referral protocols and timelines.

The CR referral pathway was varied across all Scottish Health Boards (Divers, 2015). The usual care pathway involved patients being referred to CR services during their inpatient stay. After discharge from hospital, CR staff telephoned the patient within one week to arrange a one off appointment, referred to as an initial risk assessment appointment. The initial risk assessment appointment took place between two and five weeks post event (timeframes were dependent upon patient recovery) and included a face-to-face appointment with CR staff either at their home or within an NHS facility. During the appointment, CR staff completed an initial assessment of the patient’s needs and goals, and shared verbal and written information regarding psychosocial health, lifestyle risk factors and adherence to medication. In addition, CR staff stratified the risk of having another cardiac event during exercise from the patient’s clinical records.

In some services, risk stratification of patients took place prior to commencing supervised exercise-based CR. In those settings, approximately 15-20 patients attended per week for initial assessment and risk stratification. In other CR services, the risk assessment appointment was conducted between two and five weeks after hospital discharge and supervised exercise-based CR started between eight and twelve weeks after the cardiac event (timeframes differed to accommodate the recovery period for post CABG patients). The second group of services were considered suitable for inclusion as recruitment sites in this study, as the process allowed sufficient time for potential participants to be physically active post event and pre-supervised exercise-based CR. Four Scottish NHS CR services were therefore identified as suitable recruitment sites; NHS Fife, NHS Tayside, NHS Forth Valley and NHS Grampian. CR leads for these services and the researcher agreed that the risk assessment appointment offered the ideal opportunity for study recruitment.

Participants

Eligible study participants were adults (≥ 18 years of age) diagnosed with ACS, including MI ± revascularisation treatment with either percutaneous coronary intervention (PCI) and/or coronary artery bypass grafting (CABG) (Scottish Intercollegiate Guidelines Network 148, 2016) (**Table 4-1**). The participants were recruited whilst under the care of CR staff, prior to commencement of supervised exercise-based CR.

Table 4-1: *Phase one study inclusion and exclusion criteria*

Inclusion criteria	Exclusion criteria
Patients 18 years or over	Patients lacking capacity to provide informed consent, including children (i.e., those under 18 years of age)
Patients diagnosed with ACS, including ST elevated MI (STEMI), Non-ST elevated MI (NSTEMI) and unstable angina	Patients not diagnosed with ACS and diagnosed with other manifestations of CHD, such as stable angina.
Patients diagnosed with ACS ±revascularisation with PCI/CABG	Patients unable to speak/read English. Translation into another language may alter the meaning of the questions within the survey.
Patients under the care of cardiac rehabilitation staff, and not yet started exercise-based cardiac rehabilitation	Patients not under the care of cardiac rehabilitation staff

Sampling method

Convenience sampling was employed because the sampling techniques permitted recruitment of any patient who met the inclusion criteria and, a sample could be obtained in a quick and accessible manner (Moule & Goodman, 2009).

Recruitment of participants

CR staff identified eligible individuals and informed them about the study. CR staff referred to the information sheet developed by the researcher, which detailed the project, and the inclusion and exclusion criteria (**Appendix 7**). CR staff advised the patient about the study and gave potential participants the study invitation (**Appendix 8**). If participants expressed an interest in participating in the study, CR staff gave the participant the information sheet (**Appendix 9**) and a study pack. The study pack contained the informed consent sheet (**Appendix 10**), study questionnaire (**Appendix 11**) and a self-sealed return envelope addressed to the researcher. Study recruitment did not require the researcher to access patient records.

To ensure sufficient time to make an independent choice, potential participants were advised to take the study pack home for consideration (Doody & Noonan, 2016). Participants were asked to complete the informed consent, the questionnaire, and return the completed forms within the sealed envelope, either by post to the researcher or by hand directly to CR staff during their next routine appointment. Where the latter option was chosen, CR staff collected the sealed envelopes and placed them within a designated locked cabinet for collection by the researcher. All participants chose to return completed study documents by post.

The questionnaire contained an invitation paragraph for participants to take part in the qualitative phase of the study. The inclusion of this paragraph ensured participants were not being coerced, nor automatically recruited (Faden & Beauchamp, 1986). Participants were invited to re-read the participant information sheet, give voluntary consent and share their telephone number.

4.2.2 Data collection

Survey method

It was decided that survey methods were best suited to gain meaningful data and support answering the research questions. This decision considered the strengths and weaknesses of survey methods. The strengths include the ability to collect data from a large sample within a short amount of time and at low expense (Floyd & Fowler, 2013). In contrast, the weaknesses are associated with poor response rates (Moule & Goodman, 2009). To improve response rates, literature suggests being mindful of the intended respondents and, being considerate of the appropriateness of the content and the length of the questionnaire (Moule & Goodman, 2009). The average age of ACS patients entering CR in the UK is 67 years, of whom 30% are above 75 years and 56% are retired (British Heart Foundation, 2019). In view of this, an online survey was discounted because access to a computer and internet may pose a barrier to responses for this patient population. Instead it was decided that a paper copy of the questionnaire would be more appropriate, and for those preferring an electronic version, the option to receive an emailed version. In addition, survey response rates can be improved when instructions are clear, questions are logical, numbered and grouped according to subject (Kelley et al., 2003). The aforementioned factors were taken into account when designing the questionnaire.

Questionnaire design

To facilitate ease of participant response, the questionnaire was split into four sections (A-D) and questions numbered systematically within a tabled format. Questions captured self-related elements of participant's experiences and physical activity behaviour that may be influential in directing behaviour (Bandura, 1986). Questions were clustered under sections, placing non sensitive questions at the beginning and sensitive questions at the end (Rowley, 2014). The sensitive questions were related to participants' cardiac illness and placed in section D:

- **Section A**: 'about you'. This section included general demographic questions including education and medical history
- **Section B**: 'your physical activity levels'. This section included the International Physical Activity Questionnaire Short Form (IPAQ-SF).
- **Section C**: 'your description of your physical self'. This section included the Physical Self-Description Questionnaire Short Form (PSDQ-S).
- **Section D**: 'your description of your cardiac condition now'. This section included the Brief Illness Perception Questionnaire (BIPQ) (**Appendix 11**).

Central to questionnaire design, is ensuring that all questions represent the aim of the study, and are relevant to answer the research questions (Rowley, 2014). Participants were invited to complete the questionnaire any time after receipt of the questionnaire, which was issued at the initial risk assessment appointment (between two and five weeks post cardiac event), and before the start of supervised exercise-based CR (8-12 weeks post cardiac event). To ensure question relevance, a literature search was completed to explore the possible factors associated with physical activity levels in ACS patient's post diagnosis (**Table 4-2**).

Section A included demographic questions informed from the National Audit of CR (NACR) in England, Wales and Norther Ireland (British Heart Foundation, 2016) and, in relation to participant's postcode and highest level of educational achievement, the Scottish Household Survey (Scottish Government, 2018).

Section B consisted of physical activity questions representing the International Physical Activity Questionnaire Short Form (IPAQ-SF) (Craig et al., 2003). Participants were asked to recall their previous seven days of physical activity. The questionnaire contains six questions representing the total time spent being physically active in the previous seven days. The questions capture the time spent walking, and doing moderate and vigorous physical activity. The data collected from the questions is used to estimate the total physical activity expressed as Metabolic Equivalent of Task (MET) minutes per week. The benefits of utilising an existing set of questions included access to prior evidence of previous pilot testing, for example, information regarding the face validity and reliability of the questions. Validated tools are important to check consistency if the results when compared to published data (Floyd & Fowler, 2013).

Table 4-2: *Associated variables of physical activity*

Associated variables	Overview of evidence for inclusion of variables within questionnaire
Age	Age was associated with physical activity levels in patients diagnosed with CAD (Blanchard et al., 2014). Older age was associated with lower levels of physical activity (Blanchard et al., 2014; Brown, 1999; Jason et al., 2015; Reid et al., 2006), and no association was found in CHD patients (Petter et al., 2009)
Sex	Sex was associated with physical activity levels after a diagnosis of CHD (Petter et al., 2009), with women found less likely to be active when compared to men (Blanchard et al., 2014; Reid et al., 2006), being male was associated with moderate to vigorous physical activity levels (Blanchard et al., 2010).
Marital status	Marital status could be associated with physical activity levels but evidence is conflicting. Some evidence reported no association in individuals diagnosed with CHD (Petter et al., 2009; Raungratanaamporn et al., 2015), whereas spouse/partner was positively associated in men post MI (Conn et al., 1991).
Education	Educational level could be associated with physical activity levels but evidence is variable. One study stated no relationship (Petter et al., 2009), yet a relationship was found in others (Raungratanaamporn et al., 2015; Reid et al., 2006). One

	study found higher educational level associated with increased levels of physical activity (Reid et al., 2006).
Level of deprivation (postcode)	Living in areas with higher levels of deprivation could have an association with physical activity levels in CHD patients but evidence was conflicting. One study found a positive relationship with higher levels of physical activity (Macintyre & Mutrie, 2004). Another found no association (Lakshman et al., 2010). Evidence of a relationship was found in older women (Hillsdon et al., 2008), although, a relationship in ACS patients remains unknown.
Medical history	Having no comorbidities after a diagnosis of CHD was associated with increased physical activity levels (Blanchard et al., 2010; Petter et al., 2009; Reid et al., 2006). Having comorbidities was associated with reduced PA in women (Conn et al., 1991). CAD patients without diabetes were more active than patients with history of diabetes (Reid et al., 2006).
Physical self-perceptions	Physical self-perceptions could be associated with physical activity levels of ACS patients. Evidence confirmed an association with increased exercise tolerance in adolescent congenital heart disease patients (Chen et al., 2015), also related to older healthy adults (Amesberger et al., 2011; Marsh et al., 2010). The global factors of self-esteem and global physical, and the sub domains of attractiveness, endurance, being physically active and health, were significantly associated with physical activity levels in older adults (Moore et al., 2012; Sales et al., 2017).
Illness perceptions	Illness perceptions, particularly timeline, had a relationship with physical activity levels in MI patients (Sniehotta et al., 2010). Studies also found the cure/control components were associated with recovery strategies, including exercise participation and attendance at CR (French et al., 2006; Hagger & Orbell, 2003; Reges et al., 2013).

IPAQ-SF was selected because correlations are reported to be 0.80 (0.34 to 0.89) for reliability and 0.30 (0.14 to 0.53) for validity (Craig et al., 2003). This is considered to be acceptable and has been validated against the gold standard of doubly labelled water testing to confirm the IPAQ-SF has increased accuracy when identifying participants with high levels of physical activity (Lee et al., 2011). To incorporate datasets from participants under and over 65 years of age, the IPAQ-SF was selected as opposed to the IPAQ for the elderly (IPAQ-E).

Section C incorporated information about ACS patient's perceptions of their physical self in the context of CR. A person's perception of self is constructed from their experiences within a context, which encourages a process of self-reflection (Fox & Wilson, 2008; Shavelson et al., 1976). This is most relevant to patients in the weeks between an ACS diagnosis and the start of supervised exercise-based CR. After an illness diagnosis, such as an MI, patients reflect upon the impact of their illness to gain knowledge about themselves (Greenberg et al., 1997). The results presented in chapter two confirmed that participants reflected upon themselves after their cardiac diagnosis in order to understand their physical capabilities.

This section comprised of the Physical Self-Description Questionnaire – Short Form (PSDQ-S), which measures physical self-concept and is widely used in sport and exercise psychology research domains (Marsh et al., 2010). Incorporating the PSDQ-S enabled the collection of information regarding how the patients described their physical self after their diagnosis of ACS. The questionnaire contains 11 constructs; two global measures (global physical self and global self-esteem) and nine sub-factors (activity, health, co-ordination, body fat, sport, appearance, strength, flexibility and endurance) (Marsh et al., 2010). Each factor is represented by three to five items, made up of declarative statements. For example, within the active sub factor one declarative statement out of four reads, “I often do exercise or activities that make me breathe hard”. Each statement is answered from responding to a 6-point Likert scale; 1 representing false and 6 representing true (Marsh et al., 2010). In addition, to prevent respondents answering the questionnaire in a socially desirable way, ten negatively phrased questions are incorporated and include a reverse scoring method.

The PSDQ-S offered a reduced burden for participants, provided a reliable instrument (0.8 for each sub scale), good construct validity and internal consistency within a senior sample (median 0.91) (Marsh et al., 2010). In addition, the PSDQ-S has previously been validated for use in non-clinical older adults (Amesberger et al., 2011; Marsh et al., 2010), and younger adults with congenital heart disease (Chen et al., 2015).

Section D included questions about participant's perceptions of their ACS diagnosis. The Brief Illness Perceptions Questionnaire (BIPQ) was designed to capture patients' mental representations and ideas about their illness (Broadbent et al., 2015). The BIPQ has eight single items (perceived illness consequences, timeline, personal control, identity [symptoms], concern, coherence and emotional representation) providing an efficient, low burden questionnaire to administer to older participants (Broadbent et al., 2006). The questions are answered by circling a Likert scale between 0 and 10. The higher scores represent stronger perceptions of illness in each dimension. The BIPQ instrument demonstrates acceptable reliability and good psychometric properties (Broadbent et al., 2015). In addition, the BIPQ has good predictive validity for a number of outcomes in patients post MI and in the context of CR (Broadbent et al., 2006).

The BIPQ was deemed suitable to the current study, however, the questions refer to a generic term, "illness". To avoid difficulty with the meaning of the questions, and issues affecting the BIPQ validity and reliability, it was necessary to provide clarity of the word "illness". A sentence was added to the introduction of Section D of the survey; "The illness this next section refers to is your cardiac diagnosis of either a heart attack or unstable angina."

Piloting of the questionnaire

A pilot study of the questionnaire was undertaken to highlight potential issues for participant non-response (Rattray & Jones, 2007). Piloting the questionnaire provided an opportunity to check the acceptability of the questions, consider participant response and gain feedback from a small cohort of participants who were representative of the study sample (Kelley et al., 2003) (**Table 4-3**).

Table 4-3: *Pilot study of questionnaire*

Characteristics	Category	n
Sex	Male	3
	Female	3
Age group	<55	3
	55-64	3
Marital status	Married/permanent partnership	4
	Single/Divorced/Separated	2
Education	Secondary School	2
	College/vocational	4
	University	0

To improve internal validity, as recommended by Van Teijlingen & Hundley (2001), the following steps were taken:

1. *Administer the questionnaire to pilot participants in the same way as it will be administered in the main study*. Using a slight modification, the pilot study recruited individuals discharged from NHS Fife cardiac rehabilitation services and voluntarily participating in a private physical fitness session delivered by the researcher within a local community leisure setting. Similar to the recruitment plan for the main study, the researcher advised all participants within the fitness session of the pilot study and the need to seek volunteers to take part. Six out of ten individuals previously diagnosed with MI volunteered and completed the survey (three females and three males, with a mean age of 53).
2. *Ask participants for feedback to identify ambiguities and difficult questions.* One spelling error was identified within section D and corrected. Section C was spread over three pages, one participant suggested the heading at the start of the section C should be repeated over the following two pages to avoid continually looking back. Headings were added to each page of section C.

3. *Record the time taken to complete the questionnaire and decide whether it is reasonable*. Questionnaire completion time ranged between eight minutes and thirteen minutes, (mean = 9.7 minutes). An approximate completion time for the questionnaire was added to the PIS.
4. *Discard all unnecessary, difficult or ambiguous questions*. No participant reported difficulty with understanding or completion of the questionnaire.
5. *Assess whether each question gives an adequate range of responses*. Data were as expected.
6. *Establish that replies can be interpreted in terms of the information that is required*. The information provided could be correctly interpreted to score the questionnaire as recommended.
7. *Check all questions are answered*. After analysis, there were no missing responses.
8. *Re-word or re-scale any questions that are not answered as expected*. This step was not required.
9. *Shorten, revise and, if possible, pilot again*. This step was not required.

The data from the pilot study were retained separately from the main study (Rattray & Jones, 2007).

Data collection planning

The researcher attended a routine CR staff meeting in each of the four NHS areas to discuss the study and answer questions from staff who would help recruit study participants. During the meeting, the recruitment strategy and inclusion criteria were explained, and the researcher distributed a CR staff information sheet detailing the recruitment process and study packs for participants. CR staff asked questions and agreed to make the initial approach to interested participants. The information sheet included the researcher's contact details should CR staff wish to clarify points later.

4.2.3 Data analysis

Participants were allocated a unique study identification number. Data from all questionnaire sections were collated in a Microsoft Excel, 2016 spreadsheet (Microsoft Corporation, Redmond, Washington, US). Total weekly physical activity (MET-minutes/week) were calculated from IPAQ data and participants were categorised as low active, moderately active or high active using the cut points recommended in the IPAQ scoring protocol *(Craig et al., 2003) (*Cases with missing values are omitted from the analysis within SPSS (SPSS, IBM Corporation, Armonk, New York, US).

Table 4-4*).* Data were transferred to SPSS, version 26 (IBM Corporation, Armonk, New York, US) for analysis. Missing data were checked and not found to have a regular pattern *(Warner, 2008).* Cases with missing values are omitted from the analysis within SPSS (SPSS, IBM Corporation, Armonk, New York, US).

Table 4-4: *Physical activity level cut points*

Activity category	Amount of physical activity
Low active	Scoring LOW level physical activity on the IPAQ means that you are not meeting any of the criteria for either MODERATE or HIGH levels of physical activity.
Moderate active	5 or more days of any combination of walking, moderate intensity or vigorous intensity activities achieving a minimum total physical activity of at least 600 MET-minutes per week.
High active	7 or more days of any combination of walking, moderate intensity or vigorous intensity activities achieving a minimum total physical activity of at least 3000 MET-minutes a week.

Initial descriptive analysis examined demographic variables (age, gender, SIMD, educational level, marital status, cardiac diagnosis, number of comorbidities) and total weekly physical activity (MET-minutes/week).

In the second stage of analysis, for categorical variables a one-way ANOVA was used to test differences in total weekly physical activity (MET minutes/week) according to ACS treatment and marital status. A Mann-Whitney U test was used to examine differences in physical activity (MET-minutes/week) between genders. Bivariate correlational analysis were used to examine associations between total weekly physical activity (MET- minutes/week) and other demographics/personal factors (age group. SIMD quintile, education and comorbidities), self-perception constructs and illness perception constructs. The distribution of total weekly physical activity data were examined graphically using a histogram. Non-parametric statistical techniques (Spearman’s correlation and Mann-Whitney U test) were necessary to examine differences and associations. The strength of the differences and associations were determined by r_s (rho), F ratio or z score. A correlation coefficient close to 0, indicated a weaker association and if closer to 1, a stronger association, and $p<0.05$ was considered significant.

In the final stages of the analysis, standard multiple regression was conducted using the factors that were significant from bivariate analyses. All assumptions associated with the multiple regression model were considered and tested. Testing was completed for independence of linear relationships, homoscedasticity, multi-collinearity and normality of the data distribution.

4.3 Results

Participant recruitment took place between October 2019 and March 2020. CR staff distributed 396 study packs, of which 69 were returned to the researcher. Two participants were excluded, one was diagnosed with spontaneous coronary artery dissection (SCAD), and the other had received a valve replacement. The final analysis included 67 participants (**Figure 4-1**).

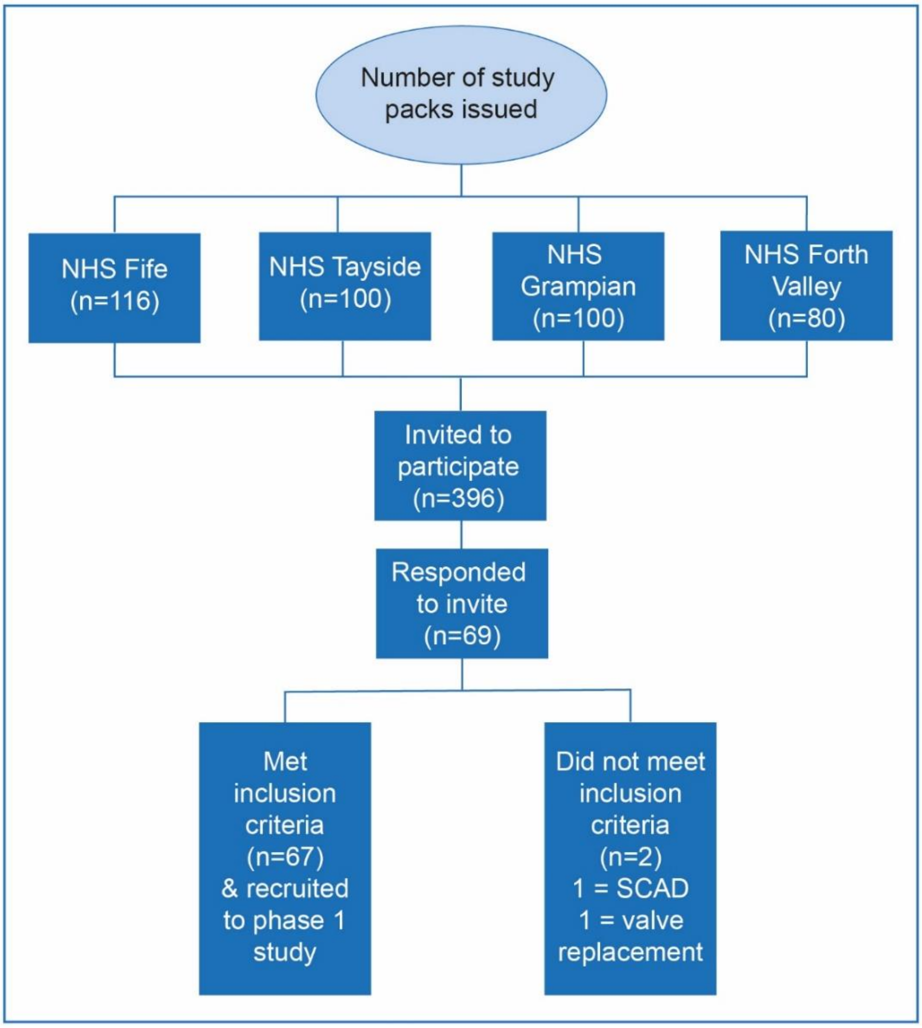


Figure 4-1: *Phase 1 participant recruitment*

4.3.1 Participant demographic and medical characteristics

The median age of participants was 63 (IQR = 56-71). Participants were predominantly male (72.2%), were moderately active (56.7%) and the majority had a diagnosis of MI treated with PCI (76.1%) (**Table 4-5**).

Table 4-5: *Participant demographics and medical characteristics*

Characteristic		**n**	**%**
Sex	Male	53	79.1
	Female	14	20.9
Age Group	<55	12	17.9
	55-64	24	35.8
	65-74	20	29.9
	75+	11	16.4
SIMD Quintile*	SIMD 1 (most deprived)	8	11.9
	SIMD 2	11	16.4
	SIMD 3	15	22.4
	SIMD 4	8	11.9
	SIMD 5 (Least deprived)	25	37.3
Education	Secondary School	29	43.3
	College/vocational	26	38.8
	University	11	16.4
Marital Status	Married/permanent partnership	47	70.1
	Single/divorced/ Separated/widowed	20	29.9
ACS ± treatment	MI	8	11.9
	MI & Stents	51	76.1
	MI & CABG	8	11.9
Comorbidities	zero	42	62.7
	one	20	29.9
	Two or more	5	7.5

***Scottish Index of multiple deprivation quintiles (SIMD = most deprived quintile and SIMD 5 = least deprived quintile)*

4.3.2 Self-reported levels of physical activity

Data represent self-reported physical activity levels collected between 2 weeks post cardiac event and the start of exercise-based CR (typically between 8-12 weeks post cardiac event). Data were not normally distributed. Inspection of a histogram revealed the distribution of sample scores demonstrated a positive skew with right tail due to scores being bunched together at the top and the presence of outliers of high activity levels (Skewness = 1.866, and the std. error of skewness = 0.293). Median weekly physical activity for the sample was 1386

(IQR 743-2772) MET-minutes/week. The majority of participants (n=38, 56.7%) were classified as moderately active (the UK Chief Medical Officers' physical activity guidelines) (Department of Health & Social Care, 2019) (**Table 4-6**).

Table 4-6: *Participant physical activity level by category*

Physical activity levels	n	%
Low active	17	25.4
Moderate active	38	56.7
High active	12	17.9

4.3.3. Correlation analysis

The data subjected to ANOVA were checked and outliers identified and retained, as assessed by boxplot. Additionally, there was homogeneity, as assessed by Leven's test for equal variances; marital status (p = .357) and ACS treatments (p = .914). Visual inspection of distribution of scores for Mann-Whitney U test indicated males and females were similar, and scatterplots for a monotonic relationship between variables indicated that assumptions of spearman's correlations were not violated (**Figure 4-2**).

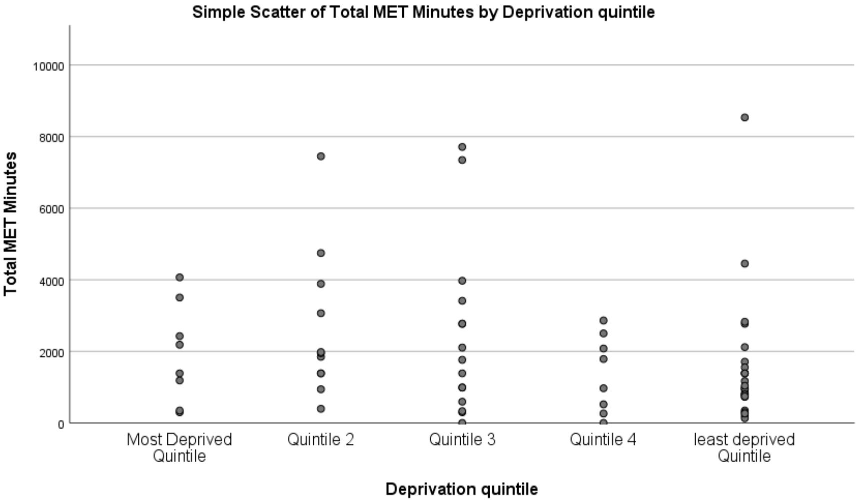


Figure 4-2: *Example scatterplot of monotonic relationship (SIMD deprivation quintile and total MET-minutes/week)*

Correlations between self-reported physical activity levels and participant demographic and medical characteristics

There was a significant negative correlation ($r_s = -.360$, $p = 0.003$) between age and self-reported physical activity levels. As MET-minutes/week scores increased, participant age scores decreased indicating that younger participants reported higher levels of physical activity after a diagnosis of ACS than older participants. There was also a significant negative correlation ($r_s = -.260$, $p = 0.034$) between SIMD quintile and self-reported physical activity levels. As MET-minutes/week scores increased, participants SIMD quintile scores decreased meaning that participants living in the most deprived SIMD quintiles reported higher physical activity levels than those living in the least deprived quintiles (**Table 4-7**).

Table 4-7: *Correlations between self-reported physical activity levels and participant characteristics*

Characteristics	n	Spearman's rho correlation coefficient	ANOVA F ratio	Mann-Whitney U z score	Sig. (2-tailed)
Participant age	**67**	**-0.360****	**-**	**-**	**0.003**
Sex	67	-	-	-0.648	0.517
ACS ± treatment	67	-	0.343	-	0.711
Comorbidities	67	-0.103	-	-	0.405
Marital Status	67	-	0.967	-	0.414
Education	66	0.119	-	-	0.343
SIMD Quintile	**67**	**-0.260***	**-**	**-**	**0.034**

*** Correlation is significant at the 0.01 level (2-tailed), * Correlation is significant at the 0.05 level (2-tailed)*

Correlation between self-reported physical activity levels and physical self-description constructs

Self-reported physical activity was positively correlated with the global scale item of self-esteem, having overall positive feelings about self ($r_s = .283$, $p =$

0.020), indicating participants who described having positive feelings about themselves were more likely to have increased physical activity levels. Additionally, there were positive correlations between self-reported physical activity and the physical self-description subscale items for not getting sick often (r_s = .313, *p* = 0.010), being physically active (r_s = .458, *p* = 0.001), being good at sports (r_s = .363, *p* = 0.003), being able to run a long way without stopping (r_s = .367, *p* = 0.002), and being strong (r_s = .301, *p* = 0.013). These findings indicate that as physical activity levels increased so did the likelihood that participants physical descriptions of themselves included not getting sick often, being physically active, being good at sports, being able to run a long way and being strong (**Table 4-8**).

Table 4-8: *Correlations between self-reported physical activity levels and physical self-description constructs*

Measure	**Constructs**	**n**	**Spearman's rho correlation coefficient**	**Sig. (2-tailed)**
Global measures	Feeling positive about ones physical self	67	0.091	0.462
	Overall positive feelings about self	**67**	**0.283***	**0.020**
Sub-factors	Being good at coordinated movements	67	0.173	0.161
	Not getting sick often	**67**	**0.313****	**0.010**
	Being physically active	**67**	**0.458****	**0.001**
	Not being overweight	67	-0.087	0.486
	Being good at sports	**67**	**0.363****	**0.003**
	Being good looking	63	-0.031	0.808
	Being strong	**67**	**0.301***	**0.013**
	Being able to bend and turn easily	67	0.153	0.218
	Being able to run a long way without stopping	**67**	**0.367****	**0.002**

*** Correlation is significant at the 0.01 level (2-tailed), * Correlation is significant at the 0.05 level (2-tailed)*

Correlations between self-reported physical activity levels and illness perceptions constructs

The positive correlation between physical activity levels and treatment control, (r_s = .313, *p* = 0.006), indicated that participants who perceived that treatment could help their cardiac illness had higher self-reported physical activity levels (**Table 4-9**).

Table 4-9: *Correlations between self-reported physical activity levels and illness perceptions constructs*

Construct	n	Spearman's rho correlation coefficient	Sig. (2-tailed)
Consequence	66	-0.151	0.228
Timeline	65	-0.075	0.554
Personal control	66	0.228	0.065
Treatment control	**66**	**0.335****	**0.006**
Identity	66	-0.063	0.614
Concern	66	-0.064	0.612
Illness comprehensibility	66	0.064	0.610
Emotions	66	0.000	0.998

*** Correlation is significant at the 0.01 level (2-tailed), * Correlation is significant at the 0.05 level (2-tailed)*

4.3.4 Regression analysis

Significant correlations examined in the regression analysis were age, SIMD quintile, the PDSQ-S constructs describing oneself as being physically active, healthy (not getting sick often), global self-esteem (overall positive feelings about self), being strong, good at sport, able to run a long way, and the illness perceptions construct treatment control item.

Preliminary data screening

Assumptions of normality associated with multilinear regression analysis were met. The data demonstrated independence of residuals, as assessed by a Durbin-Watson statistic with the value approximately close to 2 (value = 2.21). Inspection of Scatterplots confirmed all relationships between total weekly physical activity (MET-minutes/week) and the independent variables were linear. Assumptions for homoscedasticity (similar levels of variance) were met as assessed by visual inspection of a plot of standardized residuals versus standardized predicted values. There was no indication of multi collinearity as associations have correlation coefficients of less than 0.7 (Table 4.10). The Variance Inflation Factor (VIF) and Tolerance statistics for the preliminary analysis indicated no cause for concern as the VIF values were all less than 10 (1.266 – 3.072) and all tolerance values were more than 0.1 (.400 - .790). The normal probability plot (P-P Plot) was observed and residuals found to be normally distributed and, aligned along the diagonal line (

Figure 4-3).

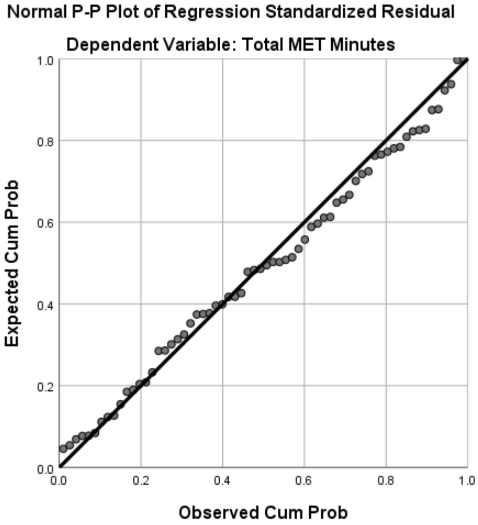


Figure 4-3: *P-P Plot of regression standardised residual linear regression analysis*

The regression model indicated a good model fit to predict self-reported physical activity levels (MET-minutes/week) F (9, 56) = 3.59, p < .0005. R^2. The overall model was 36.6% with an adjusted R^2 of 26.4%, indicating a medium size effect (Cohen, 2013), with the physical self-construct of being physically active having the only significant standardised beta weight (

Table 4-10).

Table 4-10: *Multiple regression results for physical activity (MET-minutes/week)*

Predictor variables	*B*	*95% CI for B*		*SE B*	β	Sig.	R^2	AR^2
		LL	UL					
Model							.36	.26
Constant	641.62	-3439.49	4722.74	2037.26				
Age	-26.15	-72.09	19.80	22.94	-.14	.259		
Deprivation quintile	-213.68	-523.50	96.14	154.66	-.17	.173		
Treatment control	19.60	-271.17	310.38	145.15	.02	.893		
Not getting sick often	424.31	-52.40	900.63	237.77	.22	.080		
Being physically active	544.24	122.99	965.49	210.28	.44	**.012***		
Overall positive feelings about self	166.90	-392.30	726.09	279.14	.80	.552		
Being strong	-291.57	-733.70	150.56	220.70	-.19	.192		
Being good at sports	311.74	-55.52	678.99	183.33	.271	.095		
Being able to run a long way	-328.10	-938.29	282.09	304.60	-.201	.286		

Note. Model = “Enter” method in SPSS statistics; *B* = unstandardized regression coefficient; *CI* = confidence interval; LL = lower limit; UL = upper limit; *SE B* = standard error of coefficient; β = standard coefficient; R^2 = coefficient of determination; AR^2 = adjusted R^2; Sig. =slope coefficients statistically significant if *p* is less than .05;

4.4 Discussion

This study is unique in exploring associations between self-reported physical activity and demographics, physical self-perceptions, and illness perceptions after a diagnosis of ACS and prior to the start of supervised CR. Median self-reported weekly physical activity for participants in this study was 1386 (IQR 743-2772) MET-minutes/week. Most participants (n=50, 74.6%) self-reported as moderately or high active and met the UK CMO physical activity guidelines. During regression analysis, the only significant predictor of self-reported weekly physical activity prior to the start of supervised exercise-based CR for patients diagnosed with ACS was physical self-concept for being physically active.

4.4.1 Self-reported physical activity levels

Fifty seven percent of the study sample reported achieving the recommended 150 minutes of moderate physical activity per week, and 18% did more. In contrast to data collected from post MI samples in 12 European (Benzer et al., 2017) and three UK countries (British Heart Foundation, 2019), the sample in this study were more active than the norm prior to the start of CR. The UK NACR (2019) reported fewer than 50% of participants were moderately active prior to CR (British Heart Foundation, 2019), whereas the current sample included more participants reporting at least moderate levels of physical activity prior to the start of exercise-based CR. Previous research investigating factors predicting physical activity levels three months after an ACS diagnosis, reported employment and pre-event physical activity to be significant factors (McKee et al., 2019). To understand the self-reported physical activity levels of participants in this study, qualitative methods in chapter five can further question those reporting higher levels of physical activity after an ACS diagnosis.

Physical activity at higher levels prior to the start of CR has been found to influence attitudes towards engagement with exercise-based CR (Bäck et al., 2017). Systematic review evidence (Clark et al., 2013; McHale et al., 2020) reported perceptions of personal physical activity levels influenced decisions not to access CR. For example, perceptions of being fitter than the perceived exercise intensity levels of CR resulted in a perceived lack of need for attendance. The current study did not explore whether this higher active group accessed CR, nor did it seek to understand whether participants' CR needs differed between those in different activity categories. These questions lend themselves to qualitative research and will be explored within the qualitative study in chapter five.

Over a quarter of the sample in this study did not report accumulating enough activity to be classified as moderately active prior to CR (25.4%). For those not achieving moderate activity levels, there is potential to enhance levels. CR clinical guidelines advise that patients with a diagnosis of ACS are offered individualised exercise support to adopt physical activity levels in accordance with CMO’s physical activity (Pelliccia et al., 2021) . Evidence confirms this group have the potential to gain the most health benefit from increasing physical activity levels (Stewart et al., 2017).

4.4.2 The influence of demographics on self-reported physical activity levels

Within this study, the sample was slightly younger than the NACR sample (mean age 64 vs mean age 67 for NACR) (British Heart Foundation, 2019), but was consistent with previous studies including Scottish samples of ACS patients post hospital discharge (Herber et al., 2017; Jones et al., 2018). The results of this study corroborate the findings of previous studies, that older age adults are less likely to be active after a cardiac diagnosis (Blanchard et al., 2014; Blanchard et al., 2010; Goodwin et al., 2019; Petter et al., 2009; Stewart et al., 2013). Additionally, the current study findings were similar to other studies reporting that younger adults with CHD are more likely to achieve the national minimum physical activity recommendations of 150 minutes per week (Blanchard et al., 2014; Blanchard et al., 2010). The younger population reported in this and other Scottish studies presents a challenge for Scottish CR services given that age has been reported to be a factor in decisions to attend

CR (Clark et al., 2013; Jones et al., 2007), with being active and younger influencing non-attendance at CR (McHale et al., 2020). Further research is required that seeks to understand how best to engage younger, more active ACS survivors in exercise-based CR to ensure that this group achieves sufficient levels of activity to gain secondary prevention benefits.

This study did not find gender to be associated with self-reported weekly physical activity prior to the start of CR in contrast to previous research that included 280 post MI patients (Blanchard et al., 2010). One possible explanations for this difference may be due to the small sample size of females within this study. It is also possible that there was no significant difference between men and women’s physical activity levels because women who engaged were more active. Future research should consider whether women’s physical activity levels before the start of CR influence female uptake.

Female representation (20.9%) within this study was in line with the 15% to 38% national variations reported across UK samples at entry to CR within England, Wales and Northern Ireland. The NACR (2019) quality outcomes report recognises female recruitment to early CR is poor (British Heart Foundation, 2019). NACR report 61.4% of the reasons females gave for not taking up the offer of CR was associated with the CR service (British Heart Foundation, 2019). For example, local CR exclusion criteria, not being referred, not needing rehabilitation, or rehabilitation not being appropriate. Additionally, the EUROSPIRE IV survey of 4009 participants reported that from those given advice to attend a CR programme, only 22% were female (Kotseva et al., 2018). Indeed, a lack of health professional endorsement to enrol in CR is reported to be a barrier to CR participation in women (Supervía et al., 2017).

Consistent with NACR, approximately two thirds of the current sample were married/living in a permanent relationship (70.1%) (British Heart Foundation, 2018). Similar to previous findings, marital status was not associated with increased physical activity levels (Petter et al., 2009; Raungratanaamporn et al., 2015), and comparable with the EUROASPIRE IV findings (Bruthans et al., 2016), the majority of this sample were educated to secondary school level (43.9%). Also consistent with previous evidence, this study showed a higher number of participants (37.3%) discharged from hospital after a diagnosis of ACS were living within the least deprived quintile of the Index of Multiple Deprivation (Sumner et al., 2016). Comparisons with previous research exploring deprivation levels and physical activity levels is difficult due to the heterogeneity of physical and social measures used within studies (Bauman et al., 2012; Sawyer et al., 2017). However, the relationship between deprivation level and physical activity levels found within the current study is interesting and worthy of further investigation. Future research should consider whether it is only the most active patients living within the most deprived areas that engage with CR.

4.4.3 Associations of self-reported physical activity

In the regression model, the only significant association of self-reported weekly physical activity prior to the start of supervised exercise-based CR for patients diagnosed with ACS was the physical self-concept for being physically active. The results of this study support previous findings from studies predicting physical activity levels within clinical samples. For example, within a sample of 413 adolescents aged between 12-20 years with mild congenital heart disease, describing oneself as active predicted higher levels of performance for an objective measure of cardiopulmonary fitness; the 3 minute step test (Chen et al., 2015). Similarly, within a sample aged between 60 and 90 years who had one or more previous falls and a fear of falling, findings identified describing oneself as physically active predicted higher levels of self-reported physical activity (Sales et al., 2017). Previously it was unknown whether describing oneself as active prior to the start of CR was related to physical activity levels.

This study is the first to identify adults after a diagnosis of ACS, who describe themselves as being physically active and self-report undertaking higher levels of physical activity prior to the start of supervised exercise-based CR. This study adds to the findings of the systematic review within chapter two and provides quantitative evidence to support the relationship between self-perceptions of being active and physical activity levels prior to the start of CR for those with an ACS diagnosis. This relationship is important because higher levels of physical activity were at the root of the self-perceptions of an exercise identity, which negatively influenced decisions to engage with exercise-based CR (McHale et al., 2020). To improve decisions of engagement, CR services should consider this relationship and identify the CR support needs of those perceiving themselves active before the start of CR. The qualitative study within chapter five will question moderately active adults describing themselves as active after a diagnosis of ACS to understand the meaning of this relationship and their support needs within the context of CR.

This study reported that increased levels of self-esteem were not a predictor of self-reported activity in the final regression model. This is in agreement with Sales et al., (2017), who also reported that global domain of self-esteem was not significant in predicating higher physical activity levels. However, increased self-esteem has long been associated with the motivation behind higher levels of physical activity (Fox, 2000). Whilst it is difficult to compare findings because of the lack of studies within adult clinical samples, one explanation of why self-esteem did not predict self-reported physical activity levels in this study is that physical activity levels may influence perceptions of health, which in turn may impact self-esteem (Moore et al., 2012). To explore this possible interaction further, there is a need to understand how participants feel about their physical activity levels after a diagnosis of ACS. This will be explored within the qualitative study in chapter five.

Physical self-description constructs from the PSDQ-S (the global measure of overall positive feelings about self and the sub-domain constructs of not getting sick often, being good at sports, being able to run a long way without stopping and being strong) were significantly related to self-reported physical activity during bivariate correlation but were not significant in the regression analysis. No other studies have been identified that examined the influence of global or subdomains of physical self-concept. This is surprising given that ACS patients who believe themselves as more active may feel more competent to engage in higher levels of physical activity. However, other intrapersonal correlates of higher exercise levels in people living with CHD identified from a review of 121 studies include better overall health, higher levels of self-regulatory self-efficacy, higher previous physical activity levels, higher intention to exercise, positive exercise beliefs and higher perceived behavioural control (Petter et al., 2009).

The authors of the PSDQ-S may offer one explanation for why the correlations were not significant in the regression analysis. When validating the physical self-concept questionnaire with a sample of older adults (mean age 63 years), physical self-concept across a number of domains was lower in the senior sample when compared to a younger sample (mean age 17 years) (Marsh et al., 2010). The authors suggest the self-concept sub-domains are closely linked with actual performance and influenced by physical decline (Marsh et al., 2010). It could be speculated that participants' performance may have been impacted by the ACS diagnosis, influencing their beliefs related physical activity levels. This suggestion will be considered within the qualitative study in chapter five. Furthermore, the statements in the being physically active domain include the option to refer to activities other than cardiovascular activities, which could be interpreted as including strength activities (another of the sub-domain concepts that was significant at the bivariate but not regression stage of the analysis). Additionally, the focus of IPAQ-SF measure of weekly self-reported physical activity assesses the number of days and time spent doing moderate and/or vigorous activities, including carrying light/heavy loads and digging (which could be interpreted as strength activities) to calculate a total activity score from metabolic equivalents for these activities (Craig et al., 2003). Therefore, the concept of being strong warrants further explanation. Previous studies have found significant decline in physical function after an acute coronary event (Dodson et al., 2012; Levine et al., 2014) but traditionally exercise-based CR has focused on cardiovascular activities as a means of encouraging increased physical activity levels. Recent guidance from the World Health Organisation recommends that the weekly physical activity levels for all adults should include muscle-strengthening activity on two or more days per week to improve health outcomes (Bull et al., 2020). Therefore, exploring participants' self-concept for being strong may inform future CR exercise interventions aimed at increasing weekly physical activity levels. The qualitative phase within chapter five will explore this relationship further.

4.4.4 Strengths and limitations

Whilst this study provides useful information about the significant associations of self-reported weekly physical activity among adults after a diagnosis of ACS, there are several limitations. Data were collected from participants who had one meeting with CR staff (initial risk assessment appointment) where discussions about physical activity were likely and from participants between two and twelve weeks post cardiac event. Data collection time points may have implications for the physical activity levels reported in this study (i.e., those for whom more time has elapsed since the ACS diagnosis may be more active than those earlier in the process).

The use of a small convenience sample limits the generalisability of the findings. A critical factor impacting the sample size of this study was the global outbreak of coronavirus (COVID 19) (World Health Organisation, 2020). Study recruitment was suspended by Scottish NHS Research and Development in all regions on 16th March, 2020 (**Appendix 12**). The premature ending of recruitment had implications for the multiple regression analysis. A regression analysis completed with nine variables was underpowered, but sufficient when compared to a recently published study reporting the results of a multiple regression analysis including ten predictor variables with a sample size of 66 participants (Ambridge et al., 2020). In view if this, the results of this study should be interpreted with caution and future studies exploring self-reported physical activity and physical self-perceptions and illness perceptions, should include a larger sample size.

Finally, the cross-sectional nature of this study does not allow for a test of directional relationships between the global and sub-domains of physical self-perceptions and increased physical activity levels and it is likely there is a reciprocal relationship between physical self-concept for being physically active and self-reported physical activity levels.

4.5 Chapter conclusions

Seventy five percent of the study sample self-reported being moderately active or higher prior to the start of supervised exercise-based CR. Among adults after a diagnosis of ACS, only higher levels of physical self-concept for being physically active predicted self-reported physical activity prior to the start of supervised exercise-based CR in regression analysis. The regression results should be treated with caution due to the small convenience sample. The qualitative study in chapter five will build upon the first phase of this explanatory mixed-methods study, to explore what describing oneself as active means to those who self-report being at least moderately active after a diagnosis of ACS. This will include exploring the bivariate correlations found within this study and understanding what this higher active group need from CR.

Chapter 5. Perceptions of physical activity levels after a diagnosis of ACS in in the context of CR

5.1 Introduction

Physical activity levels prior to diagnosis of ACS are one important influence on decisions about whether to engage in supervised exercise-based CR (McHale et al., 2020). Those who consider themselves sufficiently active are less likely to engage in current delivery modes of supervised exercise-based CR (Herber et al., 2017; Jones et al., 2007; McCorry et al., 2009; Shaw et al., 2012). Therefore it is important to understand what this group require to ensure that they can return to physical activity at a level that will give secondary prevention benefits.

Regression analysis in the previous chapter indicated only one factor was significantly associated with self-reported physical activity levels after ACS diagnosis but prior to CR. This was describing oneself as active. The concept of ‘describing oneself as active’ contained several sub-factors that related to the frequency, intensity and type of physical activity undertaken; doing exercise that increased breathing rate (intensity), doing activities like jogging, or dancing (type), doing sport and exercise almost every day (frequency), doing lots of sports or other physical activities (type). These sub-factors may relate to the evidence based FITT principle of exercise prescription, i.e., frequency (how often), intensity (how hard), time (how long) and type (what mode) (American Association of Cardiovascular and Pulmonary Rehabilitation, 2021). The FITT principle of exercise prescription offers a structured approach to guide CR health professionals when developing an individualised exercise prescription to improve cardiovascular fitness and secondary prevention health (American

Association of Cardiovascular and Pulmonary Rehabilitation, 2021; British Association of Cardiovascular Prevention and Rehabilitation, 2017). Whilst supervised exercise-based CR promotes the CMO's physical activity recommendations, the CR exercise prescription includes specific guidance to improve cardiovascular fitness. Within the UK, after a diagnosis of ACS, individuals are recommended to achieve the following BACPR FITT principle exercise prescription (**Table 5-1**):

Table 5-1: *BACPR exercise prescription*

Characteristic	**Prescription**
Frequency	2-3 time per week Other days walk or undertake alternative leisure activities
Intensity	40-70% Hear Rate Reserve (HRR) 11-14 Rating of Perceived Exertion (RPE) Borg Scale 2-4 Rating of Perceived Exertion Category Ratio (CR) 10 Scale
Time	20-60 minutes (not including warm up and cool-down)
Type	Aerobic endurance training

However, it is unknown how those describing themselves as active understood being active after a diagnosis of ACS. For example, how did this group understand how hard they were breathing during moderate level physical activity? Exploring the perception of those describing themselves as physically active will help gain a greater understanding of how this group interpreted being active after a diagnosis of ACS and whether interpretations of being active were similar to the CR FITT principle exercise prescription recommendations (British Association of Cardiovascular Prevention and Rehabilitation, 2017).

The aims of the qualitative phase were twofold. First, to explore how the influencing factors associated with self-reported physical activity levels were understood within the context of CR. Secondly, what CR support do those self-reporting being moderately or high active after a diagnosis of ACS require?

5.2 Methods

The explanatory qualitative study design included semi-structured telephone interviews in order to reach a broad spectrum of participants across a geographically disparate area. This study is reported following the consolidated criteria for reporting qualitative research (COREQ) checklist included within **Appendix 15** (Tong et al., 2007).

Context

The qualitative study formed part of the mixed-methods sequential study design detailed in chapter three. The sequential study design supported the ability to identify a sub sample of participants self-reporting at least moderate levels of physical activity from the quantitative results within the previous chapter. Consequently, the qualitative study within this chapter included moderately active individuals accessed from CR services within the Scottish areas of NHS Fife, NHS Tayside, NHS Forth Valley and NHS Grampian.

The sequential timing between the quantitative and qualitative studies supported the temporal relationship between the quantitative data analysis and qualitative data collection (Creswell & Plano Clark, 2011). Quantitative data analysis was completed at the end of March 2020, six months after the commencement of the quantitative study. The usual care CR pathway for the four Scottish NHS areas involved patients having the opportunity to start supervised exercise-based CR between eight and twelve weeks after the cardiac event. Thereafter, the duration of supervised exercise-based CR was between ten and twelve weeks. Thus, the sequential timing meant that some participants of the quantitative study were six months post ACS event, and had completed supervised exercise-based CR at the point when invited to take part in the qualitative phase. Therefore, the qualitative study represents moderately active individuals within six months from referral to supervised exercise-based CR.

5.2.1 Sampling and recruitment

Participants who completed the quantitative study were invited to take part in phase two. An invitation paragraph, found after section D of the questionnaire (**Appendix 11**), asked participants to reread the participant information sheet, give voluntary consent and share their telephone number. To answer the study questions, a purposive sample of those who reported at least moderate levels according to cut points of the International Physical Activity Questionnaire – Short Form (IPAQ-SF) (Craig et al., 2003) were eligible to take part in the study (Table 4.4). Recruitment took place between April and May 2020. All eligible participants were invited to take part in the qualitative phase via text message or telephone call. Potential participants were reminded of their prior informed consent and their ability to decline the invitation. A convenient date and time for the telephone interview was arranged.

5.2.2 Data collection

Since participants were geographically dispersed across Scotland, it was decided semi structured telephone interview techniques were best suited to collecting data within this study (Moule & Goodman, 2009). This decision considered the strengths and weaknesses of telephone interviewing techniques and was made before the social distancing restrictions of the COVID-19 global pandemic (World Health Organisation, 2020). The strengths include the ability to collect data without requiring the participant to attend an interview site, or host an interview within their own home (Braun, 2013; Moule & Goodman, 2009). In contrast, the weaknesses are associated with the absence of face to face contact and issues with non-verbal communication (Musselwhite et al., 2007), for example, the inability to build rapport with participants or detect non-verbal cues, such as emotions. Prior training is recommended to develop knowledge and skills to conduct qualitative interviews, to avoid miscommunication and ensure effective telephone interviews (Moule & Goodman, 2009). I completed regular qualitative interview training workshops and completed two previous telephone interview studies prior to data collection.

Pre-planning of the interview schedule

The semi-structured interview schedule was loosely structured to guide the ‘conversation’ with the study participants (Braun, 2013). The interview questions were developed from the findings of chapter four and took account of the systematic review detailed in chapter two. The questions reflected the “model of engagement” and formation of an exercise identity, for example, from the theory of identity, the concept of describing oneself as being physically active is formed from participants’ perceptions, meanings, feelings, self-views and their view of others (Burke & Stryker, 2016). Opening questions were broad, non-sensitive, and related to physical activity levels. Questions thereafter were funnelled towards specific areas related to personal perceptions and the meanings of participants physical self-description of being active after their cardiac event (**Appendix 13**) (McIntosh & Morse, 2015). Prompts and probes were included within each question to gain further information when it was felt necessary or helpful. The semi-structured interview schedule in appendix 13 was updated to address question 5 and was consistently applied across all telephone interviews to ensure the interview data could validate the data collected in phase one (Plano Clark, 2016).

The telephone interviews were conducted from a private office by SMcH. The interviews were recorded using a digital voice recorder with encryption, downloaded to Edinburgh Napier University secure password protected drives and then transcribed verbatim.

Qualitative data gathering

The interview started with verbally greeting the participant, checking their willingness to take part and clarifying their informed consent in order to establish trust and build a rapport (Braun, 2013). In addition, participants were reminded of their ability to stop the interview at any time and asked if they had any questions they wished to be answered.

During the interview, verbal cues were used to provide participant reassurance and maintain conversation momentum, for example, “I hear you”, “please continue”, “are you ok to continue?” (Braun, 2013). Note taking provided additional insights to support and develop a more meaningful data analysis, and offered a record of key points that happened during the interview (Moule & Goodman, 2009). Interview notes documented emotions conveyed by the participants and reflections regarding the context surrounding such emotions. The telephone interviews took place between April and May 2020 and during the COVID-19 pandemic. The notes document the impact COVID-19 had on participant’s lives, for example, the impact of being furloughed from work.

5.2.3 Data management and analysis

A unique code was given to identify each participant taking part in the qualitative interviews.

Participant data and interview notes were coded and immediately downloaded to a secure folder within the University secure ‘v’ drive upon completion of the interview. The audio recording was then deleted from the digital voice recorder. The audio recordings were fully transcribed into written text to gain familiarity of the data and establish initial analytical ideas, and imported into NVivo12® (QSR International, Melbourne, Australia) (Braun, 2013; De Chesnay, 2015b; Moule & Goodman, 2009). All laughter, pauses and verbal utterances, for example, “erm” and “mm”, were retained within the transcribed text to maintain the meanings and paralinguistic features within the audio data. The NVivo12® file was stored within a password protected secure drive of Edinburgh Napier University.

Data analysis plan and trustworthiness strategies

The transcripts were analysed using thematic analysis (Braun, 2013) in order to retain the flexibility to be guided by the quantitative results within chapter four and explore themes inductively developed from the qualitative data. Transcripts were read multiple times to identify initial codes and become familiar with the data. Three transcripts were checked and independently coded by two supervisors (FA & CH) to support the trustworthiness of the data analysis process (Lincoln & Guba, 1985; Plano Clark, 2016). Preliminary codes were discussed in a meeting and modifications made accordingly. The final coding frame was then applied across the entire data set. A record of 124 initial inductive data codes, and semantic level themes were generated. The initial generation of codes was reviewed and revisited as the codes were grouped into themes to produce a thematic map of final themes and sub-themes.

Seven stages of coding and analysis were conducted during thematic analysis (**Table 5-2**) (Braun, 2013).

Table 5-2: *Stages of coding and analysis*

Stage	Thematic Analysis
1	Transcription
2	Reading and familiarisation: taking note of items of potential interest and relevant to the research question
3	Coding: complete; across entire data set
4	Searching for themes
5	Reviewing themes (producing a thematic map of the provisional themes and subthemes, and relationships between them)
6	Defining and naming the themes
7	Writing – finishing analysis

5.3 Results

Forty-seven participants consented to take part in the qualitative study if selected (**Figure 5-1**).

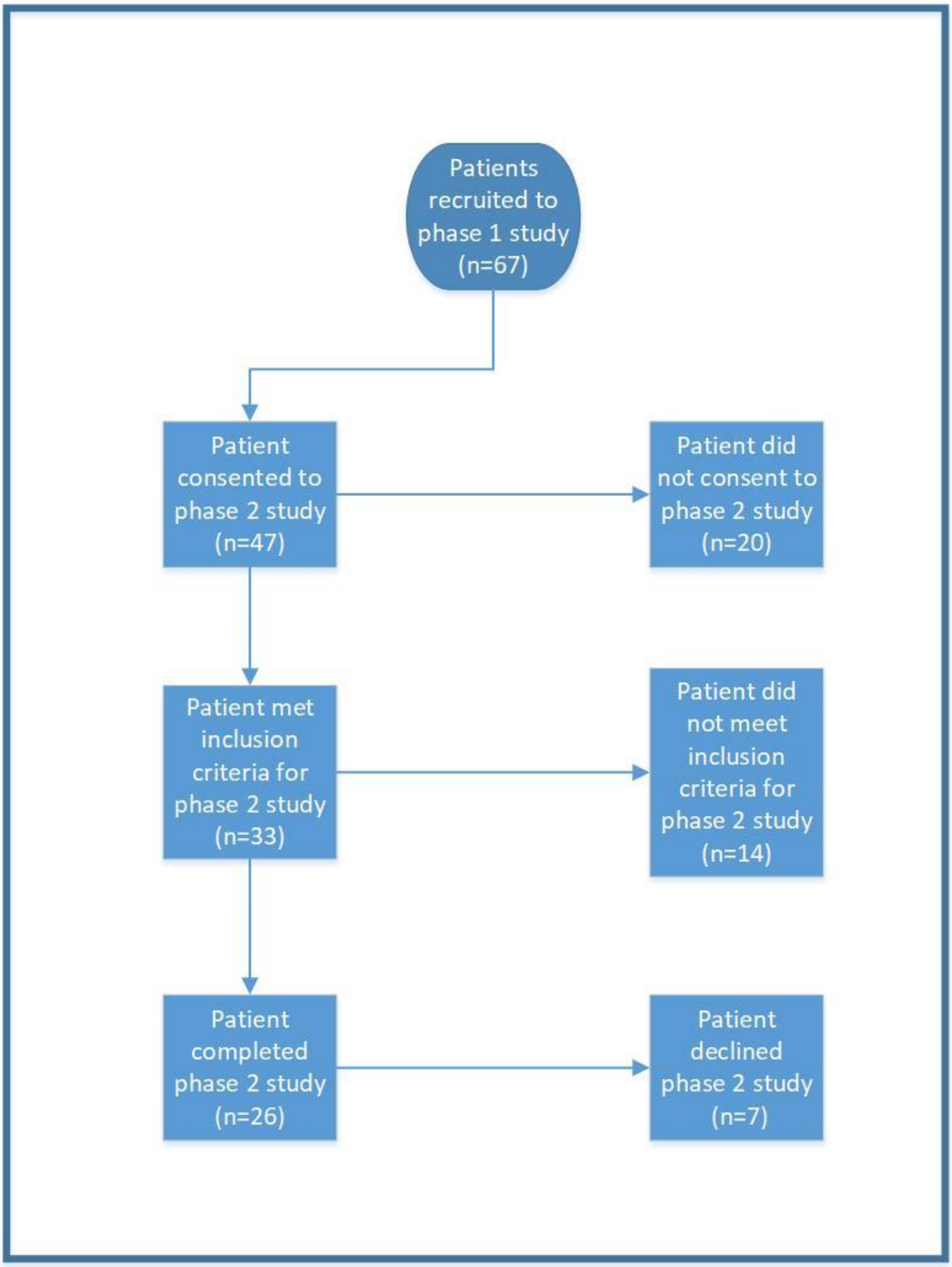


Figure 5-1: *Phase 2 participant recruitment*

A purposive sample of 33 potential participants who reported being moderately active in the quantitative study were invited to participate. The final sample comprised 26 participants (78.8% of those invited) with a median age of 65 years (range 44-77). Median interview duration was 31.22 minutes (range

21.15 and 52.23 minutes). The majority of participants (85%) were male and had an MI & PCI (**Table 5-3**).

Table 5-3: *Participant characteristics*

Characteristic	Category	n	%
Sex	Male	22	85
	Female	4	15
Age group	<55	6	23
	55-64	9	35
	65+	11	42
ACS ± treatment	MI	2	8
	MI & PCI	20	77
	MI & CABG	4	15

The data analysis process identified three overarching themes; 1) reflections of previous physical activity, 2) self-evaluation of fitness and health and 3) support to return to physical activity. These were supported by eleven categories (**Figure 5-2**).

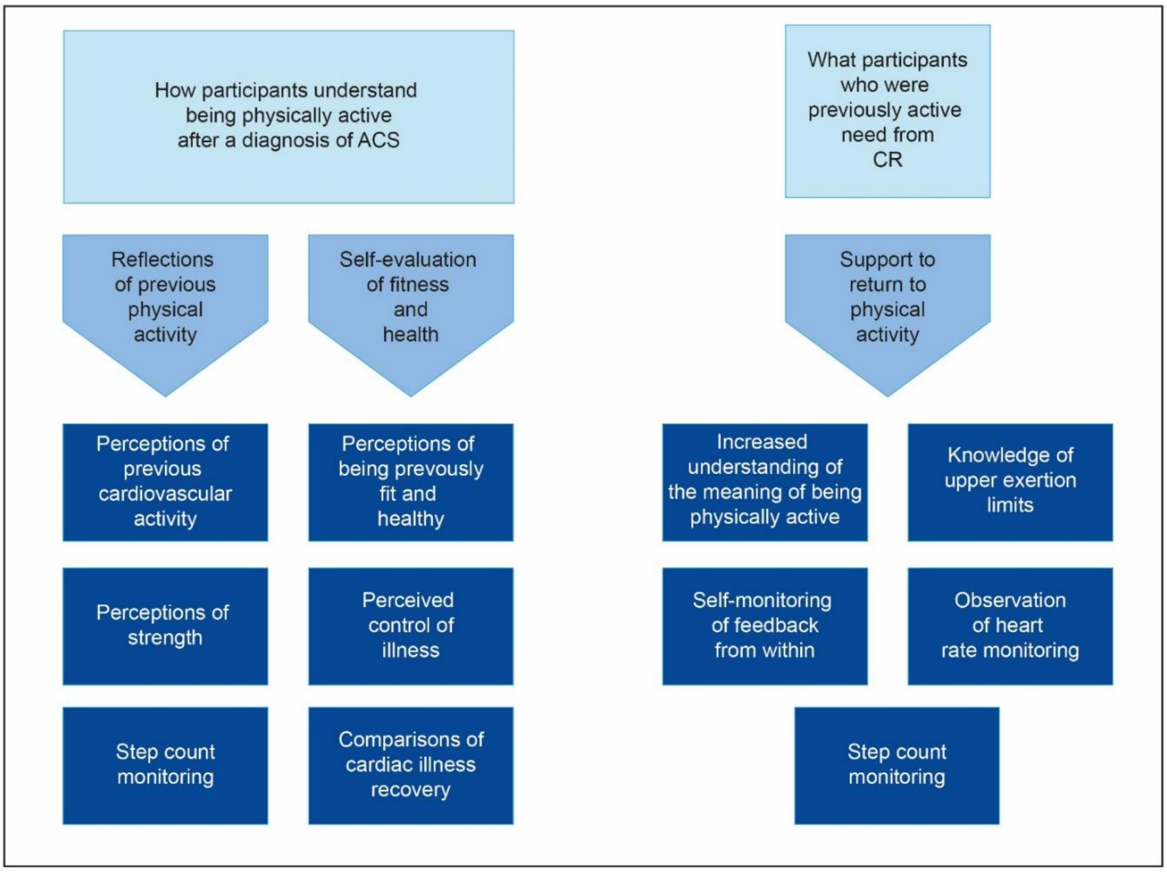


Figure 5-2: *Thematic map: How participants understand being physically active after an ACS diagnosis and what do they need from cardiac rehabilitation?*

Study participants reported that their understanding of being physically active was based on reflections of previous cardiovascular and strength activity, step count monitoring and self-evaluation of health against CR information. Moderately active adults required CR support after a diagnosis of ACS to return to previous physical activities, overcome anxiety and understand capability to increase physical activity exertion.

5.3.1 Descriptive overview of thematic analysis

Indented quotations have been placed separately to main text to enhance readability and be inclusive of participant’s points of view. Verbatim quotations are included alongside analytical commentary.

Theme: Reflections of previous physical activity

Participants considered physical activity to have two core elements, cardiovascular and strength activities. Participants’ reflections of how active they were prior to their cardiac event informed present and future physical activity behaviour. Those who perceived themselves as being previously active were motivated to set goals to return to the physical activities that they enjoyed prior to their cardiac event. Different behaviour change techniques were employed to help achieve this. For example, participants who previously monitored step counts returned to this to enhance motivation and encourage progression. Reflections of being strong helped participants understand a loss of muscular strength felt during physical activity after the ACS diagnosis. Understanding loss of muscular strength prompted motivation to increase physical strength building activity.

Sub-theme: Perceptions of previous cardiovascular activity

Cardiovascular activity was foremost in discussions about what it meant to be physically active. There was considerable variation in participants' understanding of the concept of being physically active. Broadly, participants were split into two groups. 1) Those who considered themselves active and who had previously taken part in regular sporting activities that were often of high intensity. 2) Those who considered themselves active and who had previously taken part in regular moderate intensity activities such as walking, golf and occupational activities.

The first group of participants described undertaking regular weekly sporting activities, such as endurance running, badminton, cycling, or attending fitness classes and going to the gym:

> *"I played probably about seven hours of what I would call pretty competitive badminton in a week." (Participant 14)*

In this group, the majority defined themselves as having a sporting identity, for example, being a runner or an athlete and reflections from previous activities such as running and cycling motivated these participants to set specific distance goals to regain fitness levels. Many discussed maintaining their self-defined activity status and were more likely to discuss plans to return to previous physical activities where they were part of a group, for example, playing badminton. Participants in this group discussed previous enjoyment of physical activities and, for some, this included enjoying control over their physical body during activities of high effort.

> *"When you have been as physically fit as I have all your life, you know exactly what your body can take" (Participant 12).*

This group avoided sedentary time, and discussed feeling fit and able to complete everyday tasks with minimal effort. For example, one participant explained how his level of fitness meant he did not have to worry about his ability to complete physical tasks:

> *"If you need to go and do gardening or some building work, you can go and do it without worrying about it, you are in a reasonably fit state to do that because you are keeping yourself at a certain level." (Participant 4)*

The second group of participants described previous activities of walking, including dog walking, golf, bowling and completing everyday tasks, including occupational activities. Some in this group questioned whether being active referred only to participating in structured activities such as attending a gym session. One participant described himself as always being on the go and asked:

> *"Do you need to be going to a gym, do you need to be doing the running, and do you need to be doing this, that and the next thing, to be described as active? I have always been an active person." (Participant 7).*

Most participants in this group discussed improving their definition of self, for example, becoming more active and making decisions to start new additional physical activities for the benefit of increasing their personal fitness. Some discussed plans to reengage with activities previously experienced many years ago or undertake new activities. One participant had recently increased his walking to running and explained his twelve-month goal was to be *“fit enough to run a marathon” (Participant 3).*

Sub-theme: Perceptions of strength

Participant perceptions of being strong were formed from reflections of past physical strength in relation to everyday physical tasks or specific strength related activities. They also compared strength performance for the same activities pre and post cardiac event.

The cardiac event left most feeling an initial loss of physical strength and a sense of weakness when trying to complete tasks such as carrying shopping or lifting gardening and household items. For example, one participant reflected upon his previous strength in relation to daily household chores explaining *“I could have lifted that no bother, the strength you have in your inner body doesn’t seem to be there anymore” (Participant 15).* Some perceived everyday activities formed part of a physically active lifestyle and contributed to their strength exercise, for example one participant who delivered home shopping explained *“I am lugging these crates of groceries weighing about 20kg up four flights of stairs…. so I consider that my weights” (Participant 13).*

Retaining an identity of being strong after the cardiac event was important, especially for males and those returning to physical jobs. Reflections of being strong and able to complete the heavy manual elements of their job conflicted with the perceptions of others, such as family and colleagues. A few reported feeling frustrated with themselves when colleagues acquired their manual tasks. Offers of help and perceiving others viewed them as weak, also evoked frustration. Some reported avoiding situations where physical weakness might be exposed to preserve self-perceptions of being strong. For example, one participant explained *"I do try to avoid going to the shops with her" (Participant 1).* These same physical chores were perceived important in helping participants rebuild their strength.

A few participants reflected upon planned and structured strength activities such as the use of weights at home, or within a private/public gym setting. Some participants discussed their strength activities as a past behaviour, performed in the earlier years of their life, whilst others discussed strength activities performed in the weeks immediately prior to their cardiac event.

Participants were motivated to rebuild strength after the cardiac event. This included returning to previous gym activities, or resistance activities within their home. One female, with a previous history of using weights at home, discussed her motivation to regain strength after her heart attack:

> *"My motive, just really to keep my strength up because this is one thing that I have found since the heart attack, I am not as strong as I used to be…. walking is ok but if I am doing heavier kind of housework then you know I do find that I am tired and I have to sit down." (Participant 17)*

In contrast, a few were apprehensive of progressing such activities for fear that they might *"put pressure on the heart" (Participant 15).*

Sub-theme: Step count monitoring

Thirteen participants discussed reflections from step count monitoring. The majority of these (10) were from the group who reported undertaking moderate activities. Phones, wearable devices and walking apps provide a source of feedback about daily step counts for walking or running. Reflections from current step count feedback, for example, number of steps, or steps accumulated over a period of time, motivated future physical activity behaviour. For example: One participant described how before returning to his house after a walk he would check his step count feedback and "*sometimes push myself a bit further because I hadn't done the steps that I had normally done*" *(Participant 16).* Another, reflecting upon the accuracy of step count feedback indicated *"some days it tells me I have walked ten thousand steps and I wonder where I have been." (Participant 9).* Participants discussed setting themselves frequent step-count goals to encourage motivation and consistently maintain, or improve physical activity performance. When asked why setting frequent step-count goals was important, one participant explained he was *"driven by goals" (Participant 6).*

Step count progress over time provided a source of self-motivation, encouraging participants to compete with their past performance and increase their future performance:

> *"I was also trying to hit the ten thousand steps… but now, actually when I am doing my running, my ten thousand steps are done by eleven o'clock. So that kind of shows you that I am probably averaging about seventeen thousand steps a day now." (Participant 3).*

Data produced within step count tracking apps provided rewards and badges for achieving step-count goals and milestones. Reflections from performance feedback and rewards provided a source of both intrinsic and extrinsic motivation.

Theme: Self-evaluation of fitness and health

Self-evaluation of fitness and health represented participant's understanding of previous perceptions of fitness and health, cardiac illness and recovery against CR information received after a diagnosis of ACS. CR information included secondary prevention, clinical treatment information and self-comparison against CR peers. Some participants defined their previous health as synonymous with their perceived fitness and the absence of illness symptoms. Participants planned secondary prevention cardiovascular health goals, including increasing physical fitness, by evaluating their previous lifestyle against secondary prevention risk factor information. Participants also reduced anxiety from comparisons with CR peers and increased perceptions of being in control of future cardiac illness from understanding clinical treatments via information shared by CR.

Sub-theme: Perceptions of being previously healthy

Perceptions of being previously healthy represented self-evaluation of past health against secondary prevention risk factor information received during the period immediately after the cardiac event. Participants discussed their previous health prior to the cardiac event synonymously with their perceived fitness. For example, one participant felt *"I was quite fit and healthy before the heart attack"* (Participant 2) indicating that they believed fitness implied health. Others discussed previous health in relation to having had an active lifestyle. For some, perceptions of being previously healthy were defined from not having a history of visiting their general practitioner (GP), feeling unwell, or experiencing symptoms of illness:

> *"I am not an ill person, you know, I am really quite a healthy person and very seldom at the doctors." (Participant 16)*

Some perceived they had been previously healthy, suggesting their "*healthy lifestyle"* was in line with secondary prevention risk factor information, and improvements to lifestyle were small. In contrast, others understood their previous perceptions of being healthy were incorrect. A number of participants acknowledged the need to increase their fitness, whilst others understood the need to address specific aspects of lifestyle such smoking habits, alcohol intake, and diet:

> *"It was really only my lifestyle and not my exercise..., the eating and drinking was on a scale that it shouldn't of been" (Participant 25).*

Secondary prevention information enabled participants to gain a renewed sense of what it meant to be healthy. Some reported personal achievements of weight loss, improved diet, increased fitness and energy levels, and for a few stopping smoking.

Sub-theme: Perceived control of future cardiac illness

Perceived control of future cardiac illness represented participant's self-evaluation of their revascularisation treatment or medication against information received from cardiologists and/or CR staff. Some participants reported receiving verbal and visual information about their treatment from cardiologists, including seeing a recording of their coronary arteries. Others explained receiving verbal and written information of their treatment from CR staff during the hospital stay, or during home visits. Evaluation of this information enabled some to perceive they were "*fixed*", or in control of their future cardiac illness.

Others believed they had no control or believed their clinical treatments would control future cardiac events.

The majority of those who believed they were in control of future cardiac illness reported that the symptoms of their heart attack were fixed from the revascularisation treatment or medication, and future cardiac events could be controlled from addressing secondary prevention risk factors. Those who had perceived control over future cardiac illness were better able to manage anxiety related to the thoughts of a future cardiac event, and plan secondary prevention goals.

> *"so the control comes from… the professor was really clear on the problems that I had are fixed, so they did two operations (stents), and that's fixed that problem, so there is nothing evident which is beyond a controllable risk factor, so I think from that you can manage stress levels and anxiety" (Participant 11)*

Secondary prevention goals included increasing physical fitness. When participants were asked how their perceptions of control over future cardiac illness helped with increasing their fitness and physical activity levels, one participant explained how *"it gives me a background of confidence" (Participant 17)*.

Where participants' perceived future cardiac events could not be controlled, anxiety remained. In these cases, secondary prevention goal planning did not include increasing their fitness nor physical activity levels; instead, some were reliant upon medication or the revascularisation treatment. For example, one participant explained feeling anxious when he stopped his medication after advice from a cardiologist and discovered *"there is still something wrong if when*

I come off the beta blockers my heart rate goes away up again" (Participant 23). Another, who had recently experienced percutaneous coronary intervention treatment for a second time understood the "*lifetime"* of his *"stents"* were limited. He explained; *"I am good for another ten years at least, but then after that I am not sure what the options would be" (Participant 8).* The same participant did not discuss secondary prevention lifestyle goals as being an option. Where participants discussed worry about experiencing future symptoms of cardiac illness, they reported anxiety in relation to increasing their fitness levels. For example, medication such as the glyceryl trinitrate (GTN) spray was perceived as an aid to retain control and manage anxiety in relation to thoughts of future cardiac symptoms during physical activity. One participant, was reliant upon his GTN spray as an aid to manage anxiety when resuming his usual outside physical activities. The participant reported carrying the *"GTN spray in my pocket, not that I used it, but it was almost like a rabbit's foot talisman" (Participant 20).* The participant had experienced the cardiac event whilst outside running.

Sub-theme: Comparisons of cardiac illness recovery

Participants compared their recovery from cardiac illness by evaluating physical and mental recovery against CR peers who were active. Peers were defined as being either similar or different. Feeling similar enabled some to reduce anxiety, accept the impact of their cardiac event and feel positive about their perceptions of fitness and their stage of illness recovery:

> *"That kind of put my mind at ease because there was another guy that kind of was always out and about and buzzing about and everything and*

> *he was struggling to come to terms with it you know, having to slow down and I was kind of the same as him." (Participant 3).*

Feeling different also helped reduced anxiety about fitness and provided feelings of positivity in relation to their illness recovery. Participants struggled to understand why being fit had not protected them from having a cardiac event. For one participant who perceived the need to increase his moderate physical activity levels, comparing himself to a peer enabled him to feel positive about his perceptions of fitness by understanding that a heart attack can happen to anyone:

> *"Because you are wondering why the heart attack happened to you, so the good thing was that when I was there (CR) they said it could happen to anybody. There was guy I knew who was really fit and he had a heart attack too so that made me understand." (Participant 5).*

Talking with CR peers and comparing the physical and mental challenges of their cardiac event, including the impact to their daily living activities, enabled a number of participants to understand their cardiac recovery was better than that of peers. A number of participants felt being fit supported a quicker recovery. For example, one participant when comparing himself to others during the hospital stay explained "*I am not as bad as them"* (Participant 19). Another discussed feeling lucky:

> *"That was lucky, that you can have a heart attack that you can walk away from" (Participant 1).*

In contrast, feeling different provided negative feelings of illness recovery. Peer comparisons helped a few understand their recovery was not progressing as well as others. One participant described how she had to *"keep up appearances and put on a face"* when around her peers during exercise-based CR *(Participant 17)*, suggesting she would have benefited from "*one to one"* CR support to address her challenges. This same participant explained she was not a group person and dropped out of the exercise-based CR programme after four sessions. Others who chose not to attend CR, or dropped out, and described themselves as being previously high active, explained their desire to meet other fit patients recovering from a cardiac event, and suggested the need for an alternative version of CR, for example a "*fit*" persons' CR:

> *"Because the struggle for me was the mental side of why did it happen to me …it would be nice if there was more specific, not athletes, but fit person rehab" (Participant 20).*

Theme: Support to return to physical activity

Participants discussed several things that supported a return to being physically active. Many participants had attended CR due to the time elapsed between the quantitative and qualitative elements of the study. These participants highlighted how CR can support people who were at least moderately active prior to their cardiac event return to higher levels of physical activity.

Sub-theme: Increased understanding of the meaning of being physically active

Some participants gained an increased understanding of what it meant to be physically active after attending exercise-based CR. When asked if perceptions of being previously active had changed since attending CR, some confirmed they understood the difference between previously performed physical activity and exercise performed during exercise-based CR. For example, one respondent confirmed; *"I worked in a very busy (named service) and so I was up and down and I could do ten to twelve thousand steps in a day no problem, but it wasn't good exercise." (Participant 18)*. When asked how they described their previous activity to CR staff prior to starting exercise based CR most confirmed they had told staff they were active:

> *"I would probably say, I don't know, whether I was honest or not, I would have thought at the time I wasn't inactive, I didn't sit around watching TV so I would have said I was active." (Participant 11).*

The same participant confirmed that since attending CR, his physical activity behaviour had been altered from previously including daily living activities within his physical activity levels to including regular structured exercise, for example, using home gym equipment and increased walking on most days of the week.

Sub-theme: Knowledge of upper exertion limits

Understanding upper exertion limits helped participants gain awareness of their ability to increase physical activity levels after a diagnosis of ACS. Participants required support from CR to reduce anxiety surrounding negative thoughts associated with physical exertion, and understand perceived capability to increase physical activity intensity. This was achieved via self-monitoring of physical feedback during exertion, and utilising heart rate monitoring to gain mental and physical control of exertion during physical activity.

Participants were motivated to seek information and reassurance from CR to understand their perceived capability to increase physical exertion. Thoughts of increasing their heart rate influenced negative emotions, such as fear or anxiety. Participants reported being cautious, limiting physical activity intensity due to these emotions and feeling unsure about how much stress they could place upon their "*heart*".

Seventeen participants reported attending CR to gain knowledge and understand their "*maximum*" level of physical exertion. Motivators to attend included seeking "*expert*" advice and a fitness appraisal of physical capability to return to previous physical activity levels. Because of this, many were motivated to attend the initial CR assessment meeting. For one high active participant, the CR assessment of his physical capability to return to running was sufficient to address concerns regarding increasing intensity levels. The same participant chose not to attend supervised exercise-based CR, instead requesting a further one-to-one meeting six weeks after the first, to gain reassurance of his physical activity progress:

> *"I wanted that reassurance six weeks later with somebody, to say well since we last met, I have taken into account what you said about warm ups, I have been doing that and this is what my running is doing" (Participant 20)*

Attending supervised exercise-based CR enabled some to understand they had been limiting their physical exertion and were capable of more than they had initially thought. Regaining self-confidence and feeling reassured of capability enabled some to return to previous activities early on in the CR programme. A few who had taken part in high intensity activities did not complete the recommended number of CR exercise sessions. After performing CR exercise activities similar to previous activities, one participant explains how she *"thought* *if I can do that (walk on treadmill) then I can go back onto my treadmill". (Participant 26).* The same participant held a membership with a private gym.

A number of participants reported the supervised environment of exercise-based CR offered a safe place for "*testing*" physical exertion potential. Participating in CR exercise activities offered the ideal medium to assess perceived physical and emotional limitations. One participant experienced unusual fatigue during high intensity exercise a few weeks prior to his cardiac event. The same participant explained how he tested himself to gain knowledge of his upper limits of physical capability:

> *"…when I am there it is like I am testing my body…to see how far I can push myself before I actually got tired, because that's what I found before I had the heart attack." (Participant 14).*

Understanding physical capability of exertion enabled participants to reflect upon their ability to return to previous physical activities. This was especially important to those returning to activities requiring a higher level of physical effort, such as physical occupations, gym activities and sport. Gaining an awareness of physical capability resulted in many realising the need to gradually "*build-up*" physical activity levels, for example, one participant realised he "*wasn't bullet proof" (Participant 25)*.

Performance feedback from CR staff during exertion in supervised activities helped address negative emotions and gain realistic expectations of physical capability. In contrast, where performance feedback during physical activity exertion was not provided, physical capability to increase heart rate during such activities was unknown and negative emotions unaddressed. This was the case for those advised against the immediate return to previous activities such as hill walking and swimming:

> *"prior to the stent I would go swimming probably once or twice a week quite comfortably but then having had the stents and then going onto the cardiac rehab they said oh no don't do swimming, so I have not done swimming for a fear that you know what happens if I (silence)…" (Participant 13).*

Sub-theme: Self-monitoring feedback from within

Participants' gained an awareness of exertion from self-monitoring physical feedback from within their body. When asked to explain the physical feedback they were monitoring, some explained feedback from sensations of *"muscle fatigue and breathlessness" (Participant 12)*. Variations in answers included physiological sensations from their *"heart"*, for example, palpitations, feelings of "*sweating*", and for participants post CABG surgery, chest and muscle tightness. Self-monitoring feedback from within the body enabled some to manage physical activity levels and make adjustments to the intensity. For participants who were listening to physiological sensations from their heart, feedback interpretation resulted in physical activity being terminated until they perceived their heart had recovered.

Participants confirmed receiving CR staff guidance to understand techniques for self-monitoring physical feedback during physical activity. A few participants, who took part in moderate activities, reported that the talk test provided an awareness of physical exertion from breathlessness and that they should be able to hold a conversation or speak in a sentence. One participant perceived his ability to have a conversation without being breathless during physical exertion was a *"good level". (Participant 6).* The rating of perceived exertion (RPE) scale was also reported to be a useful method for self-monitoring exertion, incorporating an awareness of breathlessness and physical sensations of muscle fatigue. One participant explained his understanding of the RPE scale from CR guidance:

> *"I was listening to my own body as well as what they (CR staff) were saying. When you compared the two with the chart, and what your body was saying, you got a better understanding of where you were on the chart." (Participant 12).*

Participants who were confident in the use of RPE were able to self-manage physical exertion independently of CR staff. A few were able to transfer their understanding to physical activity in contexts outside of the CR environment. In contrast, where the use of the RPE scale was perceived as a monitoring scale for use by CR staff, it was not used as a monitoring scale to support self-management of physical exertion:

> *"they give you a sheet that asks you where on the level it is, whether you are finding it difficult to breathe, or whether you are finding it difficult to do the exercises, and they are altering it to suit you" (Participant 22)*

This resulted in a reliance upon CR staff to tell participants when to adjust physical exertion. For example, one participant described CR staff asking him *"have you had enough yet? And I said yes a wee bit and then that's when I kind of stopped" (Participant 15).*

Sub-theme: Observing heart rate monitoring

The use of heart rate monitoring helped participants understand physical activity exertion and reduce anxiety. This anxiety was reported to be in response to a perceived risk associated with increasing heart rate. According to one participant, monitoring heart rate provided *"reassurance that I wasn't going to drop dead if my pulse went up to one hundred and ten" (Participant 17).* Heart rate monitoring offered a means of controlling physical exertion from observing heart rate responses and adjusting physical effort.

CR staff calculated individualised heart rate zones, which when monitored during exercise-based CR enabled participants to self-manage their upper exertion levels. A number of participants who discussed taking part in sport and high intensity activities reported previous experience of using individualised heart rate zones. In general, heart rate monitoring motivated most to increase the intensity of physical effort towards upper exertion levels. As a result, a few, and their family members, were motivated to purchase personal wearable heart rate devices to gain reassurance of exertion, and understand what was happening to the heart. For example, one participant explained his motivation to observe heart rate during physical activity was because without monitoring, his heart *"was not a visible thing" (Participant 11).* Observing heart rate during exertion did not accomplish reassurance for all. Five participants reported distrusting the accuracy of heart rate monitoring devices due to observing erratic heart rate responses during physical exertion. For example, one female participant felt it was not giving her *"a feeling of security so I just ditched it." (Participant 10).* Two others, observed erratic heart rate responses during high intensity exercise in the weeks leading up to their heart attack. Both felt the need to regularly check the accuracy of their wearable device against a number of pulse-oximeters during the inpatient stay and, for one, during supervised exercise-based CR.

Participants reported feeling able to self-manage physical exertion out-with the supervised CR environment where CR staff engaged with personal monitoring devices and calculated exertion limits were set within devices. For example, one high active participant reported setting his wearable fitness device to vibrate when his heart rate reached his upper exertion limits. Not all participants understood CR calculated exertion limits and a number confirmed receiving no CR staff engagement with their personal wearable device. For example, one participant set his own exertion limit within his wearable device and explains checking this with a source from outside of CR:

> *"No, they didn't give me the numbers but I know a professional runner who said that that was fine at that I'm at that standard of where I am." (Participant 3)*

The same participant confirmed his physical activity exertion felt higher than it did during supervised exercise-based CR.

Sub-theme: Monitoring step count

Participants reported using wearable devices for monitoring step count during attendance at exercise-based CR. Comparing step count performance with other people's performance was a source of extrinsic motivation by way of competition. A few found step count competition a positive motivation, whilst others, a negative. For example, one participant removed her wearable device during physical activity within CR to avoid others *"knowing that I had a* *(commercial wearable device), because they all had (commercial wearable devices) and I thought no, I don't need people in my face like that, because they were saying how many steps they did" (Participant 16).* Participants reported CR staff did not discuss personal step count progress and did not engage with personal step count monitoring during exercise-based CR.

5.3.2 The impact of the Covid-19 pandemic

During the telephone interviews participants discussed the Covid-19 pandemic and explained the impact it had had on their physical activity levels. The closure of fitness, sport and leisure centres resulted in several participants being unable to access their regular sport, swimming, gym, and fitness sessions. A few participants adopted new activities to maintain physical activity levels. For example, two participants purchased home gym equipment; some started cycling, whilst others discussed gardening.

Participant's reported the UK wide national lockdown restricted their previous physical activity levels. The restriction of outdoor physical activity to one hour per day resulted in the duration of running and walking activities being limited. Those in rural areas discussed the repetitiveness of walking the same routes every day. For those furloughed from work, participants discussed the loss of active travel and incidental physical activity within the workplace. For example, one participant explained his fitness levels had previously been *"a lot better because I was working every day, I was on my feet because I am a (physical job role) so I was walking about there" (Participant 22)*. A few discussed feeling vulnerable and concerned about going outside for physical activity. When asked why, one participant explained *"There is a difference especially with the*

> *COVID19 at the moment, because now they are saying I am a vulnerable person, you shouldn’t be going out.” (Participant 3)*

A number of participants were attending CR when exercise-based CR stopped due to the pandemic. When asked how this impacted their physical activity levels, some reported maintaining physical activity levels from following written guidance from CR staff. A few had memorised the exercise-based CR routine and talked about continuing CR activities within their home. Others, discharged early from CR without completing the recommended number of CR exercise sessions, reported walking as their main mode of maintaining physical activity levels. One participant, felt frustrated by the loss of CR and suggested a desire for options to access CR support in the future:

> *“For me it is just frustrating, and it is beyond our control, but I am very much on my own now … it would have been good if I could go to the GP and had any concerns and he could refer me.” (Participant No 6)*

5.4 Discussion

This qualitative study aimed to understand the relationship between describing oneself as active and self-reported physical activity levels of moderate and above. Study participants reported that their understanding of being physically active was based on reflections of previous cardiovascular and strength activity, step count monitoring and self-evaluation of fitness and health against CR information. Participants considered themselves previously healthy, and their previous physical activity to include both cardiovascular and strength activities. Self-reflections and evaluations informed future secondary prevention and physical activity goals. Moderate and high active adults required CR support after a diagnosis of ACS to return to previous physical activities, overcome anxiety and understand capability to increase physical activity exertion. In particular, participants required CR help to return to both cardiovascular and strength activities, and to understand appropriate intensity levels and how to self-monitor these effectively.

5.4.1 The influence of physical activity levels prior to diagnosis of ACS

In this study, reflections about previous physical activity behaviour informed present and future physical activity. Participants constructed a sense of being active from reflections of their previous cardiovascular and/or strength activity. Many participants were motivated to return to previous physical activities that were part of their self-descriptions. The theory of identity, which provides a behaviour framework to explain results, suggests that an identity derived from a previous behaviour will drive future behaviour due to the formation of a strong intrinsic motivation (Burke, 2009). This appears to be true in the current study, but one exception was where self-descriptions were interrupted due to the physical effects of the cardiac illness, for example, a disrupted sense of being strong. Participants reported feeling frustrated when they felt their identity of being strong was not maintained in their physical performance post diagnosis of ACS. Identify theory suggests that when a person cannot regain their previous self-perceptions, they will experience distress that will result in an increased effort to restore a sense of self (Burke, 2009). In this study, those affected avoided strength-based activities in order to regain a sense of self. This is a novel finding within the context of CR. This study highlights the importance of thoroughly exploring what participants mean when they say they are physically active and of addressing participant’s concerns regarding a loss of strength. Resistance activities performed two to three times per week at moderate intensity levels can improve muscular strength for those diagnosed with ACS (Pelliccia et al., 2021). Participants could benefit from individualised CR staff support to understand how to rebuild task specific muscular strength after a diagnosis of ACS.

5.4.2 Monitoring physical activity levels

Moderate and some high active participants in this study had previous experience of monitoring their physical activity. Those who have previously used step-count monitors were able to compare step activity pre and post ACS diagnosis and this motivated a return to previous activity levels. These findings support those of previous studies that reflections from past step-count performance prompt self-awareness of current physical activity, and increase intrinsic motivation to improve future step-count activity (Mercer et al., 2016; Nguyen et al., 2017; O'brien et al., 2015). However, in the current study, participants report that step-count monitoring was not a focus of CR staff, despite the fact that other studies have found regular self-monitoring of step count in CR can significantly increase cardiovascular fitness benefits for ACS patients (Duscha et al., 2018; Frederix et al., 2015; Vogel et al., 2017). Indeed, one randomised study of 29 patients, aged 44–77 years, during early outpatient CR reported the use of self-monitoring of step count contributed to a significant increase in maximum cardiovascular fitness performance as measured by cardiac stress tests, including ECG and lactate measurement (Vogel et al., 2017). Over a period of 12 weeks, the study group showed a 15% higher overall improvement in cardiovascular fitness performance and an 18% increase in moderate to vigorous physical activity per week when compared to the control group. Improvements in cardiovascular fitness are important in the secondary prevention of ACS (Pelliccia et al., 2021). To gain improvement in physical activity capacity, benefits are best achieved when CR participants receive CR staff support, in combination with home-based CR plus the use of physical activity self-monitoring technologies, such as step-count tracking (Meinhart et al., 2021). Meinhart and colleagues report that increased physical activity capacity was not achieved where CR participants did not receive this combined approach to physical activity self-monitoring.

In the absence of CR staff support, participants in this study judged their step count performance relative to others in exercise-based CR. In previous studies, peer comparisons were reported to be an extrinsic source of motivation which can result in physical activity motivation being short lived (Biddle et al., 2015; Schunk & DiBenedetto, 2020). Peer comparison of step count activity within this study resulted in the cessation of step-count monitoring for some during exercise-based CR. To increase intrinsic motivation to start or continue step-count monitoring, adults after a diagnosis of ACS could benefit from CR staff support during supervised exercise-based CR. The implementation of step-count monitoring within routinely delivered CR as an aid to supporting an increase or return to previous levels of physical activity is worthy of future exploration. This could be especially beneficial to support adults unable to access centre-based CR after a diagnosis of ACS during the COVID-19 pandemic.

5.4.3 Perceptions of fitness and health

In this study, self-evaluations of health informed secondary prevention and physical activity goals. Adults self-reporting physical activity levels of moderate and above associated their previous fitness synonymously with their previous health after a diagnosis of ACS. Previous research has questioned whether fitness alone can maintain health. Several studies report that fitness is an independent predictor of health. For example, self-reported health and self-reported fitness were found to be independent predictors of mortality when addressing fitness (the state of being physically fit) and health (illness, body-mass index (BMI), smoking status) in relation to all-cause mortality (Phillips et al., 2010). Additionally, a twenty year longitudinal study by Harkinson et al., (2010) reported that increased levels of fitness are associated with improved cardiovascular health when compared to sedentary populations (Hankinson et al., 2010). However, other studies have suggested that without adherence to a healthy diet, moderate intensity physical activity levels over time will not prevent increased changes in BMI, waist circumference and weight gain (Church et al., 2007; Hankinson et al., 2010; Thorogood et al., 2011), leading to an increased risk of poor health. In adults after a diagnosis of ACS, improved secondary prevention health can be achieved from adherence to a lifestyle of moderate to vigorous levels of physical activity and the maintenance of a healthy weight (Collet et al., 2020).

In the current study adults self-reporting physical activity levels of moderate and above improved their understanding of what constitutes health from evaluating previous perceptions of health against secondary prevention and clinical treatment information. Self-evaluation of health against clinical information has been shown to motivate positive health behaviour change, but only where the person believes a change in their behaviour can reduce negative emotions and improve the threat of illness (Leventhal, 1970; Thoolen et al., 2008; van ‘t Riet & Ruiter, 2013). Where a person perceives an inability to reduce an illness threat, unaddressed negative emotions can impair effective decision making, and can result in defensive reactions to regulate emotions (van ‘t Riet & Ruiter, 2013). In this study, where participants’ felt their cardiac illness recovery was not comparative to peers within CR, this resulted in non-attendance at CR. Where participants perceived a lack of control over future cardiac illness there was an over reliance upon clinical treatments. After a diagnosis of ACS, adults could benefit from knowledge of personal risk factors to address negative emotions and improve future illness threat, and to help plan secondary prevention lifestyle goals. In addition, this group could benefit from understanding how physical activity at increased levels can contribute to reducing the risks of future cardiovascular disease.

Participants who evaluated their illness recovery as being different to CR peers after a diagnosis of ACS, desired an alternative model to the current CR group based rehabilitation sessions. In the UK, BACPR standards and core components recommend all patients receive an individualised assessment to form a CR treatment plan (British Association of Cardiovascular Prevention and Rehabilitation, 2017). In Scotland it is recommended the CR treatment plan is formed from a shared decision process between the CR staff and the patient (Scottish Intercollegiate Guidelines Network, 2017). The findings of this study support the CR assessment as an important factor in the decision to attend CR, but highlight the limitation in setting individualised support plans. For those who dropped out of supervised exercise-based CR after discovering it was not suitable to support their needs, revisiting the individualised plan to explore what the participant understands about being active and their perceptions of being fit and healthy, may help to establish a personalised approach to CR.

5.4.4 Monitoring intensity of physical activity

Adults after a diagnosis of ACS required support to return to previous physical activity levels. Participants in the current study reported negative emotions related to thoughts of increasing heart rate during physical activity. The need to understand physical activity exertion levels was an important reason to attend CR. This is in agreement with previous research in cardiac patients, that fearful thoughts of straining the heart after a cardiac event culminated in the desire to seek knowledge of appropriate exertion levels (Albert et al., 2015; Bay et al., 2018; Rogerson et al., 2012). Participants in the current study experienced a loss of confidence in their physical capability and sought knowledge to understand their physical exertion limitations. CR staff support, even for a limited time and including from the initial CR assessment, increased confidence in capability and benefit knowledge to understand and overcome perceived limitations of physical exertion.

Participants in this study reported self-management of physical activity from understanding the RPE scale and interpreting signs of breathing and muscle fatigue. RPE appears to be effective in guiding exercise intensity levels (Tang et al., 2017), however, some participants in the current study were unable to self-manage physical activity exertion from the use of the RPE scale. This issue has been previously identified in a study of CHD patients, which reported that non-adherence to RPE recommendations was due to a lack of understanding of how to apply the self-monitoring tool to physical activity exertion (Elrod, 2007). At one month post cardiac event or surgical intervention, Elrod (2007) identified 71% of participants self-reported monitoring symptoms of cardiac distress during increased levels of physical activity as opposed to signs of breathing and muscle fatigue. Participants in the current study terminated physical activity at increased levels when self-monitoring of exertion included interpreting physiological signs of chest tightness or possible angina, as opposed to breathing and muscle fatigue. CR staff need to ensure that participants have a good understanding of the RPE scale if this is their intensity monitoring tool of choice.

Heart rate monitoring against the specified CR heart rate ranges increased knowledge of exertion and enabled participants in his study to self-manage increased of physical activity levels. This was the case only where the knowledge of exertion level was obtained from a source perceived to be credible. Participants experienced negative emotions about physical activity exertion where information was perceived to be untrustworthy, for example, observing erratic heart rate responses during exertion where reasons for this remained unaddressed. Erratic heart rate monitoring responses during increased levels of physical activity is commonly reported in previous research. For example, a study of 142 amateur runners and cyclists observing unexplained heart rate abnormalities during heart rate monitoring found 85% of erratic heart rate monitoring responses were not detectable by a Holter ECG (Gajda et al., 2018). Instead, erratic heart rate monitoring responses were attributed to the quality of the monitoring device and interference issues with heart rate monitor data transmission (Gajda et al., 2018). Contemporary evidence recommends further testing is required to ensure the accuracy and safe use of consumer wearable heart rate monitoring devices within clinical populations (Cosoli et al., 2020; Etiwy et al., 2019; Mühlen et al., 2021). The current study highlights the benefits to ACS patients of trusting heart rate monitoring data to self-manage physical activity exertion. After a diagnosis of

ACS, adults self-reporting physical activity of moderate levels and above could benefit from specific reassurance regarding erratic heart rate monitoring responses, for example, requesting ECG monitoring where deemed necessary (American Association of Cardiovascular and Pulmonary Rehabilitation, 2021). In addition, and to avoid exclusive use of HR monitoring, adults self-reporting physical activity of moderate and above could benefit from CR support to understand RPE and use a combination of HR monitoring and the RPE scale to self-assess their upper exertion levels after a diagnosis of ACS.

5.4.5 Theoretical perspectives

Bandura’s theory of self-efficacy is relevant to understand individuals self-reporting physical activity levels of moderate and above after a diagnosis of ACS. Bandura (1997) hypothesised that efficacy judgements of capability are informed by mastery experience, emotional states, vicarious experience and social persuasion. In the current study reflections about past experiences of cardiovascular and strength activities informed beliefs of being physical active post ACS diagnosis. In accordance with Bandura’s construct of mastery experience, it is likely that the previous experience of physical activity influenced efficacy beliefs of capability. Participants confirm experiencing enjoyment during previous activities and being motivated to return to such activities but report a loss of confidence in their capability to increase physical activity towards previous intensity levels. This reflects efficacy judgments of capability informed by emotional states (Bandura, 1997). For example, anxiety experienced during physical activity performance post ACS event is related to negative thoughts associated with physical exertion.

For some participants attending CR, social comparisons against CR peers (vicarious experiences) and positive performance feedback from CR staff (social persuasion) provided efficacy information that increased beliefs in capability to increase physical activity exertion levels after a diagnosis of ACS. For high active participants who dropped out of CR, social comparisons were discussed in relation to a desire to meet CR peers similar to themselves. This resulted in participants suggesting an alternative model of CR (a fit persons CR). This finding suggests vicarious experiences are an important source of self-efficacy information for individuals who considered themselves active and who had previously taken part in regular high intensity activities prior to their ACS diagnosis.

Additionally, self-regulatory efficacy strategies (barrier self-efficacy), such as gaining knowledge and understanding of upper exertion levels, appear to be an important factor for increasing participants' physical activity confidence. Self-regulatory activities, such as self-monitoring of heart rate and RPE, influenced participants' self-efficacy to overcome emotional barriers and increase their physical activity performance capability (Bandura, 1997).

5.4.6 Strength and limitations

Although this study included an acceptable sample size of participants representing different ages, the study under recruited female participants. The findings of this study may not be transferrable to moderately active females after a diagnosis of ACS. From the total number of females recruited to the quantitative phase, and eligible for the qualitative phase, 64% did not consent to participate in the telephone interview. In future research, a concerted effort is required to recruit female participants and explore whether their needs are different to male participants after a diagnosis of ACS.

Furthermore, the findings should be interpreted against the backdrop of a global pandemic, coronavirus disease 2019 (COVID-19) (World Health Organisation, 2020). Recruitment to the qualitative phase took place during the early days of the COVID-19 pandemic, and during a period of national lockdown. It is possible at that time, the telephone interviews captured descriptions of moderate physical activity levels which may be different to descriptions collected at a different time. To improve the credibility of the findings, moderately active levels of physical activity self-reported in the quantitative phase formed the base for telephone interview questions in the qualitative phase. Finally, the transcripts were not returned to participants for comment and participants were not invited to provide feedback on the findings. Criteria recommended to enhance accuracy and trustworthiness in qualitative study design and analysis (Tong et al., 2007). Instead, to reinforce research rigour and enhance trustworthiness in the study findings, three transcripts, and codes and themes generated during data analysis, were discussed, and checked with two supervisors (FA & CH) (Smith & McGannon, 2018).

5.5 Chapter conclusions

Adults self-reporting physical activity levels of moderate levels and above understood being physically active after a diagnosis of ACS from reflections of previous cardiovascular and strength activity, step count monitoring and self-evaluation of fitness and health against CR information. Participants considered themselves healthy and either high or moderately active. Previous physical activity included both cardiovascular and strength activities. For those previously monitoring step counts, participants described returning to this to monitor the frequency and duration of their physical activity levels.

Self-reflections and evaluations informed future secondary prevention and physical activity goals. Moderately active adults required CR support after a diagnosis of ACS to return to previous physical activities, overcome anxiety and understand capability to increase physical activity exertion. In particular, participants required CR help to return to both cardiovascular and strength activities, and to understand appropriate intensity levels and how to self-monitor these effectively.

To support moderately active adults return to previous physical activity, CR staff support was required for self-monitoring of heart rate, step count, and physical activity from RPE. The CR assessment and supervised exercise-based CR, even for a limited time, can reduce anxiety associated with increasing heart rate and increase understanding of what it is means to be active after a diagnosis of ACS. In addition, for those evaluating their cardiac illness recovery as different to that of CR peers, an alternative approach to supervised-exercise based CR could benefit fitness levels for adults self-reporting physical activity of moderate levels and above after a diagnosis of ACS.

This study has answered the qualitative questions and explained how participants understood the frequency, intensity, type and duration of their moderate levels of physical activity. Building upon the first phase of the explanatory mixed-methods study, chapter six will explain the factors influencing higher levels of physical activity in adults after a diagnosis of ACS explain how the influencing factors of moderate physical activity levels and above were understood in the context of CR.

Chapter 6. The whole is greater than the sum of the parts: integration of the qualitative and quantitative findings

6.1 Introduction

The benefit of mixed-methods research is the integration of two methods to generate findings that could not be achieved from applying quantitative or qualitative methods alone (Tashakkori & Teddlie, 2010). The quantitative and qualitative methods within the explanatory sequential design used in this thesis were integrated at two points within the research process:

1) The quantitative findings informed the sampling frame for the qualitative study enabling participants self-reporting physical activity levels of moderate and above to be purposively selected.
2) Qualitative methods were then used to explain the significant findings from the quantitative analysis; that described oneself as being active predicted higher physical activity levels.

Using both sets of data, the relationship between describing one-self as being active and higher levels of physical activity can be explained in adults after a diagnosis with ACS within the context of CR.

6.2 Methods

A triangulation approach was applied to the interpretation stage to consider the unique insights gained from the integration of quantitative and qualitative methods (O'cathain et al., 2008). Although the qualitative analysis (Chapter 5) explained the quantitative results (Chapter 4), a triangulation protocol can build "*meta-inferences*", referred to as the *"third effort*", which spans the results from each study (Doyle et al., 2016; Moran-Ellis et al., 2006). The triangulation protocol offered by O'Cathain and colleagues supports a logical process and highlights where the findings from the quantitative and qualitative methods offer similar (convergent), complimentary or contradictory information (O'cathain et al., 2008). Contradictory information between the study results can identify inter-method discrepancy and can result in a greater understanding of the research questions. Additionally, since the regression results in chapter four were limited by the small sample size, triangulating the data in this way can offer transparency and provide confidence in trustworthiness of the findings (Lincoln & Guba, 1985).

6.2.1 Triangulation protocol

To complete the triangulation protocol (Table 6.1), the following steps were taken (O'cathain et al., 2008):

1. The findings from each study concerning the research questions were listed (excluding question 5, this was not an integrated question but a sequential question)
2. The findings from each study were determined to be either convergent, complimentary, or contradictory.
3. Explicit disagreements between the findings were explored.

6.3 Results

Table 6-1: *Triangulation protocol*

Study question	**Do the findings from each study agree (convergence), offer complementary information or contradictory information?**		
	Quantitative findings:	**Qualitative findings**	**Convergence/ complimentary/ contradictory**
What are the self-reported physical activity levels of adults after a diagnosis of ACS but prior to starting CR?	56.7% were moderately active and 17.9% were high active.	The theme ‘reflections of previous physical activity’ revealed that participants described previous cardiovascular activity in two different ways. These were those describing participation in moderate activities and those describing participation in sporting activities. This theme also found participants included strength activities and step count monitoring within their self-reported physical activity levels.	Convergence
Are demographic and medical factors associated with self-reported physical activity levels among adults after a diagnosis of ACS but prior to starting CR?	Bivariate correlations revealed age and SIMD quintile were negatively associated with physical activity levels but these were not found to be significant predictors of physical activity levels in regression analysis.	Themes did not include views regarding age and SIMD factors contributing to physical activity levels	Convergence
Are physical self-perceptions and illness perceptions associated with self-reported physical activity levels after a diagnosis of ACS but prior to starting CR?	Physical self-perceptions of being active was significant in regression analysis and predicted higher physical activity levels.	The theme ‘perceptions of previous physical activity’ revealed moderate and high active participants described previous cardiovascular activity, perceptions of strength and step count monitoring contributed to physical activity levels	Convergence
After a diagnosis of ACS, how are the influencing factors associated with higher levels of self-reported physical activity understood within the context of CR?	The only factor associated with self-reported physical levels was physical self-concept for being active.	Themes reveal moderate and high active participants understood being active from: - reflections of previous physical activity -self-evaluation of fitness and health - needing support to return to previous physical activity levels – in particular, physical activity intensity levels	Convergence Complimentary Contradictory

6.4 Discussion

The mixed-method integration used to compare the quantitative and qualitative results, provided only two incidences where the results did not converge with each other. Both of these areas concerned question four. In the first instance, the quantitative result is complemented by the qualitative theme, ‘self-evaluation of fitness and health’. Physical self-concept for being active predicted self-reported weekly physical activity levels after a diagnosis of ACS but before the start of exercise-based CR. This finding is complemented by qualitative reports that self-evaluation of health against secondary prevention information in the immediate days after the ACS diagnosis interlinked with participant perceptions of being previously fit and/or having an active lifestyle. Qualitative study participants considered themselves physically active before their cardiac event and CR information prompted some to improve levels of physical activity post ACS diagnosis.

The second instance of non-convergence concerned the quantitative result and the qualitative theme; ‘needing support to return to previous physical activity levels’. This theme was in answer to the sequential question number five (What CR support do those who self-report being moderately or high active after a diagnosis of ACS require?). Participants reported needing CR support to understand the upper limits of physical activity exertion. This contradicts the quantitative finding; physical self-concept for being active predicted self-reported weekly physical activity levels. A possible explanation for this is the limitations of data collection methods for the quantitative study. The PDSQ-S for the physical self-concept for being active questioned participants’ frequencies and activity choices, but not intensity. The IPAQ-SF collected physical activity intensity level data in addition to frequency. However, the overall scoring mechanism used to calculate IPAQ-SF weekly activity levels combined moderate and vigorous activity, without recording whether participants understood upper limits of exertion. Additionally, the quantitative study did not ask what support participants needed to be active after ACS diagnosis. Qualitative data collection methods can probe the quantitative data results. The qualitative sub-theme, ‘knowledge of upper exertion limits’ added insight into the reasons that participants required CR support. This theme was characterised by reports of anxiety in relation to thoughts of physical exertion after a diagnosis of ACS. Participants acknowledged being active but they limited physical activity intensity levels. Furthermore, participants reported being motivated to return to previous levels of physical activity experienced before the cardiac event. For the group wanting to return to previous sport, gym and occupational activity, previous physical activity intensity levels were higher than self-reported levels after a diagnosis of ACS.

The qualitative interviews captured information about physical activity levels that were not observable from the quantitative data results. Previously active participants sought CR support to understand their maximum level of physical activity exertion after a diagnosis of ACS. This group were self-motivated to return to previously established behaviours and were seeking help from CR to understand the capability element of their behaviour, for example, to overcome beliefs about their capability to, and the consequences of, increasing physical activity intensity levels. These findings reflect behaviour change theories that monitoring, rehearsing and demonstrating the behaviour, and receiving persuasive communication support individuals to understand the capability of exertion (Knittle et al., 2018; Michie et al., 2011; Woodgate & Brawley, 2008).

The sequential timing between the quantitative and qualitative data collection meant several participants had attended the CR assessment and/or exercise-based CR. Participants understood their upper exertion limits from participating in the exercise component of CR, information about the use of the RPE scale, and CR staff support to monitor heart rate following CR physical activity intensity guidelines. These findings demonstrate an important reason to attend CR, given that these methods can determine a level of physical activity effort relative to an individual’s cardiorespiratory fitness or an estimation of their maximum heart rate (Piepoli et al., 2016). Additionally, these methods are recognised behaviour change techniques providing knowledge and skills to monitor, regulate and gain feedback on the behaviour (French et al., 2012).

The qualitative results of this study confirmed that some participants did not understand how to determine their upper exertion limits. Also, some participants did not receive support to understand their upper exertion limits after a diagnosis of ACS. This was a missed opportunity on the part of the CR staff and is disappointing, given that understanding how to determine upper physical exertion levels and improve cardiorespiratory fitness is a core component of exercise-based CR within the UK (British Association of Cardiovascular Prevention and Rehabilitation, 2017).

Performing physical activity at CR recommended intensity levels can reduce cardiovascular mortality risks after a diagnosis of ACS (Anderson et al., 2016; Piepoli et al., 2016; Sattelmair et al., 2011). Where participants did not understand their upper heart rate intensity limits, individuals were unable to self-manage physical activity exertion independently of CR staff and, in one case, information to predict upper-intensity parameters was sought from someone outside of exercise-based CR. Specific information about upper heart rate limit is required by participants to support their return to physical activity at levels that promote secondary prevention benefits. An essential consideration when calculating intensity levels is the impact of medication upon heart rate responses, for example, beta-blockers have the effect of reducing heart rate (Díaz-Buschmann et al., 2014). Participants must understand such important differences in calculating appropriate target heart rates pre and post ACS. In the absence of a formal CR calculation of fitness levels, individuals may find it difficult to reach their upper exertion limits during physical activity (American Association of Cardiovascular and Pulmonary Rehabilitation, 2021). Furthermore, some individuals may be placing excessive demands upon their heart after a diagnosis of ACS (Franklin et al., 2020). For those describing themselves as highly active, CR exertion heart rates observed on wearable heart rate monitoring devices may be different to heart rates observed during physical activity exertion before their cardiac event. Within the qualitative study sub-theme, ‘observing heart rate monitoring’, one participant confirmed physical activity exertion felt higher than CR exercise when referring to heart rate monitoring levels calculated without CR staff support. To avoid possible adverse effects of physical activity, clinical guidance suggests risk assessment of adults after a diagnosis of ACS should take account of the individual’s physical profile, cardiac risk, and habitual and intended level of physical activity (Piepoli et al., 2016).

The results of the current study would suggest the intensity levels of physical activity is a key factor in non-convergence between the quantitative and qualitative results. Participants became more conscious of the intensity element of previous physical activity behaviour after a diagnosis of ACS. The use of wearable heart rate monitoring technology meant many participants in the qualitative study had evidence of previous physical activity exertion levels and were motivated to return to these levels. This group wanted to use their heart rate monitoring devices after a diagnosis of ACS and information within their wearable devices could be useful in helping them to achieve intended levels of physical activity. Within CR, studies have investigated the usefulness of wearable devices to increase CR recommended physical activity levels. In a recent review of 9 RCT's investigating the effects of wearable devices with CR exercise prescription and advice, it was reported that cardio respiratory fitness was improved in participants wearing physical activity monitoring devices compared with controls (mean difference 1.65 mL/kg/min; 95% confidence interval [CI;0.64-2.66]; p = 0.001) (Hannan et al., 2019). In addition, Hannan and colleagues identified that use of wearable devices can significantly contribute to an increased time spent in moderate to vigorous physical activity levels. In home-based CR, the use of wearable devices and CR exercise guidance for physical activity intensity, time and duration has been shown to be an effective alternative to a 12 week centre-based CR programme (Avila et al., 2018). The fact that Avila and colleagues did not provide guidance on the type of exercise activity may mean participants were able to choose forms of physical activity which accommodated their existing physical activity behaviour. Wearable devices are an important addition to other self-monitoring methods such as physical activity diaries and records that have long been found to be useful in raising awareness of existing behaviour (Artinian et al., 2010). This is an important consideration for CR staff, as feedback from stored data about prior physical activity behaviour can form the basis of physical activity discussions.

There was evidence in the qualitative study, that CR staff were not initiating a new physical activity behaviour, but modifying an existing behaviour to exercise at increased or decreased intensity levels to accommodate new heart rate goals. Previous evidence has suggested that behavioural interventions are more successful at motivating changes in physical activity behaviours when they include techniques to motivate an individual's sense of behaviour control and autonomy (Knittle et al., 2018). Facilitating self-regulation skills from self-monitoring of goals can provide strategies to help individuals overcome behavioural barriers and promote maintenance of a behaviour (Kwasnicka et al., 2016). In the current study, where CR staff engaged with heart rate self-monitoring and the individuals understood their heart rate parameters, participants developed strategies to control negative emotions and reported being able to self-regulate physical activity exertion independently of CR staff. To support self-regulation and overcome capability to increase physical activity levels, CR staff should engage with heart rate self-monitoring and support adults after a diagnosis of ACS to understand heart rate intensity parameters.

6.4.1 Recommendations for cardiac rehabilitation delivery

In accordance with clinical guidance, adults self-reporting moderate physical activity levels or higher and describing themselves as being physically active should be supported to understand how to increase physical activity levels after a diagnosis of ACS (Piepoli et al., 2016). Based on the findings of this study, the following are recommended:

- The initial CR assessment can take account of intended levels of physical activity, and how patients understand such levels after a diagnosis of ACS.

- CR staff are encouraged to provide personalised support to help patients understand what CR calculated heart rate exertion limits are, the impact of medication and why exertion limits are important after a diagnosis of ACS.
- For those with prior experience of heart rate monitoring from wearable devices, CR staff can engage with evidence of previous exercising heart rates to support discussion about heart rate parameters after a diagnosis of ACS.
- CR staff are encouraged to provide information and support to individuals that will promote self-monitoring of physical activity intensity levels, help understanding of how to rate exertion from the RPE scale, talk test and heart rate monitoring.
- CR staff can discuss self-monitoring goals to increase physical activity intensity levels in order to encourage participants to self-regulate physical activity and overcome beliefs about the exertion capability.

6.4.2 Recommendations for research

Adults self-reporting physical activity at moderate levels or above and describing themselves as being physically active after a diagnosis of ACS were motivated to attend CR to gain support to return to physical activity at higher levels. Despite this, some moderate and high active participants desired an alternative model to the current CR group-based rehabilitation sessions after a diagnosis of ACS. To increase options for CR support, research should explore alternative models of CR and recognise the previous use of wearable devices found to contribute to increased levels of physical activity for moderate and high active adults after a diagnosis of ACS. In addition, widening access to support physical activity at moderate and vigorous levels is a recommendation of the European clinical guidelines for the prevention of cardiovascular disease (Piepoli et al., 2016). Based on the findings of this study, future research should:

- Explore alternative models of CR that are based on remote support to increase physical activity levels for moderate and high active ACS patients using wearable devices such as step count and/or heart rate monitors.
- Test the effect of support for heart rate monitoring education within CR.
- Examine how CR staff can use personal wearable heart rate monitoring devices to motivate moderate and high active ACS patients to independently self-manage physical activity within recommended secondary prevention levels.
- Explore the effect of using evidence from data collected within personal wearable heart rate monitoring devices to raise awareness of the intensity difference between a physical activity behaviour prior to and after a diagnosis of ACS in adults self-reporting moderate intensity levels or above.

6.5 Chapter conclusions

This mixed-methods study identified that adults describing themselves as active and self-reporting at least moderate levels of physical activity understood being active from reflections of previous physical activity and self-evaluation of fitness and health. The self-reported physical activity levels found within the quantitative study did not reflect the intended levels of active adults’ physical activity levels after a diagnosis of ACS. To return to previous physical activity, active adults required CR support to overcome beliefs about their ability to, and the consequences of, increasing physical activity intensity levels. Exercise-based CR, even for a limited number of sessions, supported some active adults to return to physical activity. For others, there was a desire for alternative models of CR support after a diagnosis of ACS. The use of wearable heart rate and step count monitors contributed to participants' understanding of being active and should be considered in future models of CR support.

The next chapter will provide an overview of this thesis and consider the meaning and implications of the findings from each chapter. A discussion of chapter findings will inform future directions for research and clinical practice.

Chapter 7. Discussion

The overall aim of this thesis was to explore how previous experience of physical activity influenced engagement with physical activity after a diagnosis of ACS and in the context of CR. This chapter provides an overview and summary of the main findings, and acknowledgement of the contributions to knowledge and implications for practice and research. Additionally, the strengths and limitations to the doctoral study and reflections of the research process have been discussed. This chapter concludes with a summary statement.

7.1 Overview of thesis chapters

This thesis presents a qualitative systematic review and a mixed-methods explanatory sequential study integrating a quantitative and a qualitative phase. The systematic review examined qualitative literature describing patients' perceptions and experiences of CR, and synthesised what was known about how previous experience of physical activity in adults diagnosed with ACS influenced engagement with physical activity during CR. The mixed-methods explanatory sequential study included a quantitative phase that examined physical activity levels and associations with demographic, physical self-perceptions and illness perceptions in adults after a diagnosis of ACS and in the context of CR. The qualitative phase explored what describing oneself as physically active meant for those who self-reported being at least moderately active and identified what this group needed from CR following a diagnosis of ACS.

7.2 Discussion

7.2.1 Evidence-practice gap

Globally, CHD remains a leading cause of death and disability (McAloon et al., 2016). International guidelines recommend participating in CR (Piepoli et al., 2016). Despite the strong recommendations to participate in CR, attendance rates are typically low, with only 50% of people eligible for CR actually attending a programme (British Heart Foundation, 2019). Reasons for non-attendance are complicated, and include distance to centre, embarrassment about participating in a group, and beliefs about ability to make changes to health (Neubeck et al., 2012). Most CR programmes include group-based supervised exercise, and include participants on the basis of their health condition rather than physical functioning. Prior beliefs about physical ability and capacity may influence the intention to participate, but this has not been previously tested. Therefore beliefs about physical ability in patients who have survived an ACS have been explored through a body of work contained in this thesis.

7.2.2 Views, experiences and perceptions of physical activity

The systematic review in Chapter 2 of this thesis was undertaken to explore what was known in the literature about physical activity beliefs. Thematic synthesis of the 12 studies was undertaken to develop one overall theme, two major themes and seven sub-themes, which contributed to the development of a novel model of engagement. Communication post-event and during CR were identified as a source of self-appraisal and created expectations of CR. The overarching theme, communication factors, included two subthemes, post-event communication and advice and expectations of exercise-based CR. Advice, given post-event and during CR, provided the context for decisions about engagement with exercise-based CR. Additionally, the two major themes, perceptions of an exercise identity and experience of exercise-based CR, influenced the perceived need for exercise-based CR.

The findings from this systematic review support previous qualitative findings, confirming self-appraisal processes and self-perceptions of identity influence decisions of engagement with exercise services (Clark et al., 2013; Pentecost & Taket, 2011). Uniquely, the current qualitative systematic review found the previous experience of physical activity and self-perceptions about fitness levels were central to perceptions of an exercise identity, which influenced the perceived need for CR.

The finding was echoed in the qualitative work presented in Chapter 5. For adults self-reporting at least moderate levels of physical activity before the start of exercise-based CR, the meaning of being physically active after a diagnosis of ACS was explained from two overarching themes; reflections of previous physical activity and self-evaluation of fitness and health. Additionally, it was identified that CR support was needed to return to previous physical activity.

Being physically active after a diagnosis of ACS included two groups of participants who reflected upon previous cardiovascular and strength activity, and step count monitoring. Both groups considered themselves to have been previously active before their cardiac event. One group had previously taken part in regular sporting activities, often of high intensity, and the other group had previously taken part in regular moderate-intensity activities such a walking. The majority of those previously taking part in step count monitoring activities, had previously taken part in moderate-intensity activities. Using pedometers or digital trackers has been shown to increase motivation to be physically active in people with CHD (Houle et al., 2012). Activity trackers have also been shown to be accurate when compared to ‘gold-standard’ accelerometers in cardiac patients (Alharbi et al., 2016). Trackers have also been shown to have a range of psychological benefits as they enhance feelings of autonomy as people gain more control about their exercise regime (Karapanos et al., 2016).

One disadvantage of trackers is they may not capture all elements of physical fitness, such as strength and flexibility. Participants in the qualitative study (Chapter 5) reported that prior physical activity levels before the ACS had included strength activities. However, after their cardiac event, participants reported a loss of strength. This has previously been reported in women (Smith et al., 2017), and may be a cause for concern in older adults, as a loss of strength can be an indication of frailty (Tonet et al., 2019). In the quantitative study, prior perceptions of strength may explain why the physical self-concept for strength did not achieve significance within the multiple regression analysis.

Participant’s reflections of how active they were before their cardiac event informed their physical activity behaviour after their cardiac event and motivated their future physical activity goals. This was consistent with the quantitative study (Chapter 4), where the physical self-concept for being active predicted physical activity levels. The findings of this study suggest that the sub-group identified from the quantitative sample as at least moderately active had previously been active and were motivated to return to being active after their cardiac event. Goals to direct their motivation included improving their physical activity performance after a diagnosis of ACS, for example, increasing strength levels and step count levels. Participants who engaged in step count monitoring were competing with past performances. Performance goals represented the tasks participants wanted to complete to return to their previous physical activity levels (Schunk & DiBenedetto, 2020).

Understanding being physically active after a diagnosis of ACS was achieved from self-evaluation of fitness and health against CR health information received after their cardiac event. The qualitative study found CR secondary prevention and clinical treatment information, and self-comparisons against CR peers enabled participants to gain knowledge about their previous fitness and health. Understanding that previous perceptions of being fit and/or healthy were inaccurate focused the attention of some towards lifestyle changes, such as improving physical fitness. Similar to previous findings, where participants felt they could control their future cardiac illness, this study reported that a reduction in negative emotions supported the capability to set secondary prevention goals (Leventhal, 1970; Thoolen et al., 2008; van ‘t Riet & Ruiter, 2013). Indeed, patient centred care has been shown to increase goal attainment and previous history is a key element to goal setting (Wolf et al., 2019). In contrast, where participants did not believe they could control future cardiac illness, anxiety remained concerning future cardiac illness, and there was an over-reliance on treatment and medication as opposed to setting secondary prevention goals. The belief that the individual is unable to control CHD is a known predictor of non-attendance at CR (Neubeck et al., 2012), and a predictor on non-adherence to CR for those who do attend (Gaalema et al., 2017). The findings of the qualitative study add to the findings of the systematic review within this thesis. The systematic review (Chapter 2) found decisions regarding the appropriateness of exercise-based CR were influenced by self-evaluation of age within the group-based rehabilitation sessions. The qualitative study (Chapter 5) reported self-evaluation of illness recovery was also a factor in decisions regarding the appropriateness of exercise-based CR. This study identified that self-evaluation of illness recovery against CR peers resulted in some moderate and high active participants reporting a desire for an alternative model to the current CR group-based rehabilitation sessions after a diagnosis of ACS. Peer support has been shown to be of benefit for people who attend CR (Clark et al., 2012), so this finding is of interest. It is perhaps more reflective of comments from younger participants who express dismay that participants of CR are older and not designed for them (Gaalema et al., 2017).

Moderate and high active participants required CR support after a diagnosis of ACS to return to physical activities at higher levels. This study found that CR support, even for a limited period, can reduce anxiety for adults after a diagnosis of ACS by providing knowledge about the meaning of being physically active and the skills to increase physical activity levels and self-monitor physical activity exertion. Previous studies have found that the psychological support CR provides is critical to patients (Turner et al., 2017). Where CR support did not provide the aforementioned knowledge and skills, this study reported that moderately and high active participants were unable to reduce anxiety about returning to physical activity at higher levels after a diagnosis of ACS. Additionally, participants were unable to return to physical activity levels at secondary prevention intensity levels and were unable to self-monitor physical activity independently of CR staff, and unable to continue the use of step-count monitoring to increase physical activity levels whilst within exercise-based CR sessions.

7.2.3 Self-reported physical activity

Most participants in the quantitative study (Chapter 4) (n=50, 74.6%) self-reported their physical activity at moderate intensity levels or higher after a diagnosis of ACS and before the start of exercise-based CR. This study examined the associations between physical activity levels and demographic factors, physical self-perceptions and illness perceptions after a diagnosis of ACS. As physical activity levels increased so did the likelihood that participants were younger and lived in the most deprived SIMD quintiles. In addition, they perceived that treatment could help their cardiac illness. They provided physical descriptions of themselves, which included not getting sick often, feeling positive, being physically active, being good at sports, being able to run a long way and being strong. Interestingly, the sex of participants was not found to have an association with self-reported weekly physical activity levels after a diagnosis of ACS and before the start of exercise-based CR. This is in contrast to the published literature which suggests that women face barriers to CR that include older age, lower levels of physical activity, and other social constraints (Supervía et al., 2017). The likely reason for the finding of no association in this study is due to the small number of women recruited to this study.

In the regression analysis, for patients diagnosed with ACS, the only significant predictor of self-reported weekly physical activity was physical self-concept for being physically active. This finding adds to a small body of literature that has predicted physical activity levels in other clinical samples from regression models including physical self-concept for being physically active (Chen et al., 2015; Sales et al., 2017). This result adds to the findings of the qualitative systematic review (Chapter 2) and provides quantitative evidence to support the relationship between self-perceptions of being active and higher levels of physical activity. Understanding the predictive association between the concept of being active and physical activity levels requires further exploration. It was plausible in this study that some of the other variables within the multiple regression analysis may have been able to predict physical activity levels but may not have been able to reach statistical significance due to challenges with recruitment related to the COVID-19 pandemic.

7.2.4 Self-concept of being physically active

The mixed-methods integration (Chapter 6) explained that adults describing themselves as active and self-reporting at least moderate levels of physical activity after a diagnosis of ACS understood being active from reflections of previous physical activity and self-evaluation of fitness and health. From data triangulation techniques, the self-reported physical activity levels found within the quantitative study did not reflect the intended levels of participant’s physical activity levels found within the qualitative study. The sequential timing of the qualitative study supported the explanation of this finding.

Participants needed support to return to physical activity after a diagnosis of ACS. This is a core tenet of CR programmes, recognising the challenges that participants have in knowing what is safe for them to do following ACS (Gardiner et al., 2018). In the qualitative study (Chapter 5) ACS diagnosis resulted in participants becoming more conscious of their ability to increase their heart rate during physical activity. Within the theme, ‘knowledge of upper exertion limits’ participants reported limiting their physical activity levels. To return to previously established physical activity behaviours, active adults required CR support to overcome anxiety about their capability to increase physical activity intensity levels after a diagnosis of ACS. The benefits of CR on reduction of anxiety has been demonstrated in a recent systematic review and meta-analysis (Zheng et al., 2019), which is important, as depression and anxiety are predictors of lower levels of physical activity (Choi et al., 2019). Furthermore, the relationship between physical activity and depression is bi-directional, with increased levels of physical activity reducing depression to a similar degree to antidepressant medication (Dinas et al., 2011).

CR staff support included behaviour change techniques to determine safe upper exertion limits and helped some active adults to return to physical activity. For others, this study suggests CR staff should use persuasive communication to understand safe upper exertion limits and support active adults to self-monitor physical activity levels. Additionally, some active adults desire alternative models of CR support after a diagnosis of ACS. Further, the use of wearable heart rate and step count devices contributed to participant's understanding of their physical activity levels and should be considered in future models of CR support, as discussed earlier in this chapter. Indeed, during the COVID-19 pandemic, many CR programmes were able to transition to online services, with wearable trackers providing an essential component to monitor, motivate, and maintain physical activity (Moulson et al., 2020).

7.3 Contribution to knowledge

The consolidated findings of this thesis will be interpreted through a theoretical lens to explain the meaning behind the knowledge generated from this doctoral study.

7.3.1 Main findings and theoretical explanations

Overall, the work contained within this thesis explains that after a diagnosis of ACS, previous experience of physical activity influences perceptions related to previous physical activity levels. This subsequently influenced engagement with exercise-based CR. The knowledge base understanding how previous experience of physical activity influenced engagement with physical activity after a diagnosis of ACS, was found to be limited. It was evident that previous qualitative research had mostly captured participant perceptions and experiences of previous physical activity as a consequence of understanding the decisions of engagement with CR (McHale et al., 2020). While the systematic review (Chapter 2) did reveal that adults after a diagnosis of ACS were influenced to engage in physical activity during CR by communication factors, self-perceptions of an exercise-identity and experience of exercise-based CR provided the context for decisions about engagement with CR. The findings of the review resulted in the development of a novel ‘model of engagement’ representing the influences of decision making on physical activity during CR.

Bandura’s SCT and self-efficacy theories offer relevant frameworks to explain the main findings of this thesis. After a diagnosis of ACS, this thesis reports a previous experience of physical activity influences perceptions related to previous physical activity levels. In accordance with self-efficacy theory, Bandura (1997) hypothesised that individual’s gain information from previous experiences (mastery experiences) to inform efficacy beliefs about capability. Participants’ experiences of previous physical activity contributed to self-perceptions of an exercise identity which influenced decisions related to the perceived need for exercise-based CR. This finding reflects the influence of past behaviour. From the findings of this thesis, it can be suggested that a previous experience of physical activity informed the strength of self-efficacy beliefs related to physical and psychological capability to achieve a certain level of exercise performance after a diagnosis of ACS. The interpretation of performance capability after the diagnosis of ACS is at the root of self-perceptions of an exercise identity which influenced decisions to engage with physical activity during CR.

A key finding of this thesis is that participants became more conscious of the intensity element of their previous physical activity behaviour after a diagnosis of ACS (chapter 5). It was demonstrated in some participants, that physical activity intensity levels were limited after their ACS diagnosis due to anxiety regarding increasing heart rate. Self-efficacy theory explains that efficacy appraisal of performance from physiological and emotional feedback influences what an individual feels they can accomplish, referred to as barrier self-efficacy (Bandura, 1997). From the emotional experiences reported in this thesis it may be suggested that active adults after a diagnosis of ACS do not feel efficacious about their capability to perform physical activity at increased exertion levels. Self-efficacy is a predictor of effort and exercise intensity (Bandura, 1997). From the findings of this thesis, emotions impact self-efficacy for physical activity exertion after a diagnosis of ACS.

In this thesis, the motive for engagement with exercise-based CR was to understand maximum physical activity exertion levels. Further, participants were motivated to return to previous physical activity perceived to be at higher levels. It should be recognised that personal influences, such as perceptions and emotions, help bring about goal-directed activities that influence motivation outcomes (Schunk & DiBenedetto, 2020). The key concepts from behaviour change theories about motivational processes confirm that people are motivated to engage with environments that they believe will support their learning (Bandura, 1997). In referring to Banduras' SCT concepts, outcome expectations played a clear role in influencing decisions to attend CR (Bandura, 1986). For example, ACS patients self-reporting to be at least moderately active believed attending exercise-based CR would lead to them understanding their upper physical activity exertion levels and support their return to previous physical activity behaviour. Participants' desired outcomes for physical activity had implications for the motive to attend CR and the type of CR support required during CR.

To positively affect behaviour, previous studies report the importance of encouraging participants' beliefs and capability to self-regulate behaviour performances through counselling and skill learning (Brawley et al., 2012; Locke et al., 2020; Woodgate & Brawley, 2008). Participants who were taught to understand self-monitoring of CR physical activity intensity levels, had improved emotional coping and capability of increasing physical activity exertion levels (Chapter 5). Additionally, participants reported being confident to self-monitor physical activity intensity independently of CR staff. These findings indicate that, for some, CR improved self-regulatory efficacy for coping with anxiety related to exertion and provided confidence in capability to self-manage their behaviour (Locke et al., 2020). This was not the case where participants did not understand self-monitoring of CR physical activity intensity levels and this reflects a lack of self-regulatory efficacy to self-manage physical activity levels (Locke et al., 2020).

Behaviour change theories suggest self-regulatory confidence can be improved if individuals believe they can self-manage their behaviour from the use of learning strategies (Bandura, 2004). The qualitative study (chapter 5) found some participants were able to self-monitor heart rate, RPE, and performance of CR activities at CR recommended intensity levels. These techniques were found to be unsuccessful for those unable to independently self-monitor physical activity intensity levels. A consistent recommendation for CR theoretical research is to consider CR participants' self-regulatory efficacy to engage or maintain physical activity during CR (Locke et al., 2020; Woodgate & Brawley, 2008). The collective findings of this thesis suggest that physical activity behaviour is a complex behaviour, including several specific elements, for example, the intensity of the behaviour. Future CR theoretical research should consider these elements of physical activity behaviour, and recognise that each element may have and require additional supporting behaviours. Many of the participants' previous physical activity behaviour included an experience of self-monitoring behaviour for intensity levels and step count (Chapter 5). Examining the intensity element of the behaviour, and additional supporting behaviours maybe of theoretical importance to SCT and self-regulatory efficacy. Since contemporary research has questioned the efficacy of exercise-base CR to improve physical activity to the levels needed to reduce CVD mortality risks (Powell et al., 2018; ter Hoeve et al., 2015; West et al., 2012), more attention needs to be given to the previous experience of physical activity and the perceptions related to previous intensity levels of adults self-reporting physical activity levels of moderate and above. Additionally, to improve engagement and maintenance of exercise-based CR, consideration must be given to the motive for engagement with CR. A successful outcome of

CR should not be a measure of the number of weekly sessions attended, but of the participant's health outcomes, including physical activity behavioural goals.

Finally, the research in this thesis has highlighted a desire from some participants for alternative models to the current CR group-based exercise CR. For individuals reporting themselves as different to CR peers, this thesis has found that the current model negatively influenced motivation to continue engagement with CR. This reflects self-processes, such as social comparison, which can affect self-efficacy beliefs in capability and influence motivational outcomes positively or negatively (Bandura, 1986). Social comparisons were an important source of self-efficacy information for ACS patients within the current studies (chapter 2 and 5). Given the diversity of factors highlighted to influence the appropriateness of the current models of CR within this thesis, exploring effective model options remains an important research direction. It is recommended that self-processes concerning the CR environment and sources of communication are key factors that should be considered when planning alternative exercise interventions for perceived active adults after a diagnosis of ACS.

7.3.2 Contribution to the literature

Prior to undertaking this thesis, qualitative evidence had captured prior exercise experience research via exploration of engagement factors with physical activity during CR (Bäck et al., 2017; Galdas et al., 2012; McCorry et al., 2009). Previous systematic review evidence had focused on individual barriers and facilitators to CR and found believing oneself to be already active in daily life influenced engagement with CR (Neubeck et al., 2012). A systematic review methodology can gather all available studies about a question and a qualitative synthesis can support a summary of the findings, and facilitate communication of the findings between researchers and practitioners (Dixon-Woods et al., 2006). The published systematic review and thematic synthesis in this thesis communicated a novel model of engagement and gave insight into how communication factors, self-perceptions of an exercise identity and experience of CR influence engagement decisions in physical activity during CR. In completing this study, the review demonstrated the need to explain the self-perceptions of individuals who were active before the start of exercise-based CR. These factors were central to the individual's decisions of engagement.

The development of an explanatory mixed method study to purposively sample a sub-population of active individuals offered methodological advancement within the field of exercise-based CR. This reflects the wider use of mixed-methods designs to evaluate CR intervention experiences (Gallagher et al., 2020; Hwang et al., 2017; Milligan, 2013), however, only one study adopted an explanatory design to identify a purposive sample of intervention participants (Gallagher et al., 2020). This thesis has demonstrated that the use of a mixed-methods explanatory design within exercise-based CR research can increase the knowledge base about sub-populations previously unidentified within qualitative studies. This methodology has been able to provide more conclusive answers to questions seeking to understand how previous experience of physical activity influenced engagement with physical activity during CR. Additionally, the mixed-methods design contributed to a better understanding of adults self-reporting themselves active at moderate levels and above after a diagnosis of ACS, and the exercise-based CR support needs of this sub-group to aid return to previous physical activity.

7.4 Implications for practice

The findings of this PhD thesis suggest that perceptions related to previous physical activity levels influenced engagement with exercise-based CR in adults after diagnosis of ACS. Believing oneself to be active after a CHD diagnosis influenced decisions about engagement with the exercise element of CR. From the studies presented in this thesis, the following are recommended:

- CR secondary prevention information post ACS may be personalised to help patients understand personal risk factors and plan secondary prevention lifestyle goals to improve decisions about engagement and avoid self-evaluation of health and fitness against standardised CR communication.
- CR staff are encouraged to revisit the initial CR treatment plan to review physical activity goals and establish a personalised approach to exercise-based CR to improve CR adherence for individuals who self-evaluated themselves different to CR peers.
- CR staff can explore with patients what they mean when they say they are physically active prior to the start of exercise-based CR, and address concerns regarding physical capability, for example, a loss of strength.
- CR staff are encouraged to ensure patients have a good understanding of their upper exertion levels from the use of heart rate monitoring and the RPE scale to increase confidence in capability to self-regulate physical activity and return to previous activity perceived to be at higher levels than those self-reported before the start of exercise-based CR.

- CR staff can support ACS patients to improve motivation to maintain or continue step-count monitoring activities and reduce negative peer comparisons.
- CR staff can support ACS patients with a prior experience of heart rate monitoring from wearable devices to understand individualised CR heart rate exertion parameters so that they are able to self-regulate physical activity exertion independently.

7.5 Strength and limitations

A major strength of this thesis is that it draws from both qualitative and quantitative approaches to provide a comprehensive and rich account of how adults with previous experience of physical activity engage with physical activity after a diagnosis of ACS and in the context of CR (Creswell, 2015; Plano Clark, 2016).

This thesis includes the first qualitative systematic review protocol and thematic synthesis of primary studies to develop a novel ‘model of engagement’ explaining the CR physical activity engagement decisions of adults after a diagnosis of ACS. The systematic literature search was rigorous and used a prior tested strategy to retrieve a broad range of qualitative study designs. All studies included the experiences and perceptions of adults believing themselves to be previously active. Despite the thematic synthesis offering a transparent process, a limitation of the synthesis was due to the primary studies not directly assessing how beliefs related to previous physical activity impacted engagement in exercise during CR. Although this may have implication for the synthesised findings and the ability to generalise to individuals who have previous experience of physical activity, the gap in the literature demonstrated the importance of the thesis research. Exercise-based CR interventions have been criticised for being ineffective in changing the physical activity of CR patients (Powell et al., 2018; ter Hoeve et al., 2015). Additionally, review evidence confirms exercise after a CHD diagnosis correlates with confidence to exercise during CR (Petter et al., 2009), yet, at an individual level, research has not explored how a prior experience of physical activity influences engagement with physical activity during CR.

The quantitative phase of the mixed-methods study provided invaluable information about the self-reported physical activity levels of adults after a diagnosis of ACS, however, it may be suggested that the use of a self-completed survey may introduce a social desirability bias. For example, the self-reporting of physical activity may influence the respondents to answer in a favourable direction and result in over-reporting of their physical activity levels (Sallis & Saelens, 2000). In relation to the thesis findings, the qualitative study questioned those self-reporting moderate levels of physical activity or higher and provided insight into the quantitative findings. The internal validity of the quantitative findings was strengthened by the data collected from the qualitative methods which supports the physical activity levels reported by a sub sample of the study participants. The integration of the quantitative and qualitative methods and the data triangulation strengthened the trustworthiness of the findings drawn from the mixed-methods study (Plano Clark, 2016).

The major limitations of this study include the use of convenience sampling in the quantitative phase, and the underrepresentation of females in the mixed-methods samples. These limitations have implications for the transferability of the thesis findings. Females are less likely to be represented in cardiac research studies, including randomised control trials (Melloni et al., 2010; Whitelaw et al., 2021), and less commonly referred to CR (Colbert et al., 2015), or enrolled in CR when compared to males (Samayoa et al., 2014). This may reduce the pool from which to recruit female study participants, or it may be that females are less likely to consent to research. It was noted from the quantitative phase of the mixed-methods study that 64% of females consenting to the quantitative phase did not give consent to the qualitative phase. Recruitment to this study was adversely affected by the COVID-19 pandemic, and removed all opportunities to undertake face to face research, creating challenges to recruit and collect data.

7.6 Future research directions

Considering the underrepresentation of females within this research, future research should focus specifically on the previous physical activity experiences of females to understand whether their physical activity perceptions are different to that of males. Whilst contemporary research has compared female and male correlates of exercise (Taherzadeh et al., 2018), and examined female reported barriers to CR participation and adherence (Grace et al., 2016; Resurreccion et al., 2017), and functional capacity (Grace et al., 2016), further mixed-methods research is needed to understand how the perceptions of previous physical activity experience in females influences engagement with CR.

The use of step count to self-monitoring physical activity was identified as being part of previous experience of physical activity behaviour for 50% of the participants in the qualitative phase of the mixed-methods study. Adults self-reporting moderate levels of physical activity after a diagnosis of ACS reported motivation for future physical activity behaviour was based upon self-reflection of the past performance. Contemporary research has focused on interventions assessing the effect of activity trackers to promote future physical activity levels in chronically ill patients (Franssen et al., 2020). Evidence from this study would suggest future research should consider assessing the effect of prior habitual experience of physical activity tracking in moderate and high active adults to understand how this promotes future physical activity levels after a diagnosis of ACS and during CR. Additionally, the self-reported physical activity levels found within the quantitative study did not reflect the intended levels of participant's physical activity levels found within the qualitative study. This is important because the intended levels of physical activity are what moderately active and high active participants are motivated to achieve after a diagnosis of ACS and during CR. Taking into account prior evidence criticising the efficacy of CR to improve physical activity levels (Powell et al., 2018; ter Hoeve et al., 2015), and considering evidence from validity studies (An et al., 2017), historical personal wearable step count data could be used to explore step count physical activity level before, and after, ACS diagnosis to assess the impact of CR to support the return to previous physical activity levels at similar or higher levels.

Finally, self-monitoring was identified as a key source of support to understand the capability of exertion limits. The qualitative phase of the mixed-methods study suggests that CR did not provide support for step count self-monitoring during CR. Therefore, future research should examine how CR staff can use a prior habitual experience of step count monitoring to support moderate and high active adults overcome anxiety about the capability to increase physical activity intensity levels after a diagnosis of ACS.

7.7 Reflections on the research process

Reflexivity offers transparent information about a researcher's position and, personal values and beliefs that could affect the research process (Rettke et al., 2018). The researcher should consider the extent to which their assumptions can potentially introduce bias into the research data (Holloway & Biley, 2011). As a novice researcher, it was important for me to recognise that my interest in physical activity and my experience as a CR exercise specialist may influence the research findings. To reduce this influence, the researcher should maintain methodological rigour and establish transparency by way of engaging in reflexive thinking throughout the research process (Fontana, 2004). Reflecting upon *what* informed the research decisions, the *so what* of research findings and the *now what* of next steps, was integral to maintaining rigour and demonstrating transparency regarding the research within this thesis (Rettke et al., 2018).

The impetus for this thesis originated from my motivation to initiate a research project fulfilling a professional and research interest in ACS patients who reported to being previously active after a diagnosis of ACS and before attendance at supervised exercise-based CR. It began from the findings of an MRes phenomenology study completed before this PhD project. One unexpected finding from a small sample was how participants were gaining emotional control from testing their maximum physical performance during physical activity after receiving PCI treatment. The findings included the voices of participants who had and had not, adhered to attendance at supervised exercise-based CR. The sample included participants attending one community-integrated phase III/IV exercise-based CR programme delivered by the researcher. My previous constructivist stance and interpretative assumptions provided the initial context from which my role as a researcher in this thesis evolved and prompted the desire to understand how previous experience of physical activity had influenced engagement with physical activity during CR.

In recognising my limited research experience, and my influences and potential bias, it was important for me to identify evidence that supported my research interest and ensured a transparent basis from which to support my research questions. From an initial scoping exercise, three critical sources of literature formed the basis for guiding my initial decisions to complete a qualitative systematic review. Data collected from the 2017 National Audit of Cardiac Rehabilitation (British Heart Foundation, 2016) services across England, Wales and Northern Ireland reported 41.6% of patients post-MI, PCI and/or CABG were at least moderately active before the start of CR. Previous qualitative systematic review evidence confirmed a barrier to attendance at CR was patients believing themselves to be active in their daily lives (Neubeck et al., 2012). Further, review evidence of RCTs confirmed CR was not effective in improving physical activity levels after a diagnosis of ACS (ter Hoeve et al., 2015). Drawing on systematic review and thematic synthesis methods this first study of the PhD aimed to explore the literature to bring together what was known about the research question. The review research process was rigorous and is documented in this thesis. From following the methods, I embraced the step by step approach to identifying literature and generating the review findings.

The driving force for the mixed-methods explanatory sequential study was to answer the research questions developed from the systematic review findings. The study objectives were to identify the self-reported physical activity levels of a sample and identify a sub-sample of ACS patients who reported physical activity at moderate levels and above. Additionally, to understand the participants' previous experience of physical activity and how this influenced their physical activity within the context of CR. This resulted in a paradigm shift to adopting a pragmatic approach towards identifying the best study methods suited to addressing the study objectives and answering the research questions. The challenge for me was learning about the mixing of quantitative and qualitative methods and the need for transparency regarding how the data were integrated. I embarked upon months of reading and attending workshops within the School of Health and Social Care at Edinburgh Napier University and Edinburgh Clinical Research Facility Education Programme. Further, my supervisory team were an invaluable source of information for my personal development of mixed-methods research.

The selection of an explanatory sequential design gave priority to the quantitative study and identification of the sub-sample. Using quantitative analysis methods took me out of my comfort zone and I needed a period of practical training to improve my understanding of quantitative analysis. While I would not have claimed to have been an expert in quantitative data analysis, I did recognise my understanding of the analysis methods used in this thesis had developed. Although I did not achieve the ideal sample size, I was able to put into practice what I had learned and was able to complete the planned analysis and generate findings to inform the qualitative phase of the study.

My experience of the quantitative phase and the implication of a small sample size helped me to appreciate the benefit of the philosophical assumptions of mixed-methods research. The mixing of methods within the same inquiry strengthens the understanding of the research problem (Plano Clark, 2016). Within the thesis, the inclusion of the explanatory qualitative phase provided a broader understanding of the quantitative findings and drew on the strengths of both methods to provide the comprehensive findings within this PhD research (Creswell, 2015).

The challenge during the qualitative phase was setting aside any preconceived ideas and remaining open to unexpected results emerging from the study participants. During the telephone interviews, I referred to the semi-structured interview plan but remained open to whatever emerged naturally. During data analysis I referred to the process of thematic analysis to explore the meanings within the data, but recognised my own influence on the themes generated. Although, I stayed close to the original data when naming themes and sub-themes, I recognised the terminology used may have been different to how another researcher may conceptualise the data. I invited two supervisors to review and independently code three transcripts. This process not only validated my coding but helped me to appreciate the subjective nature of qualitative research. From applying the process of data triangulation, it was possible to identify where the qualitative and quantitative findings converged or contrasted with each other (O'cathain et al., 2008). Data triangulation offered a transparent and practical approach towards understanding the knowledge gained from answering the research questions using a mixed-methods explanatory design.

Finally, it may have been possible that the research questions could have been answered from separate quantitative and qualitative studies, however, to identify a sample representing those reporting to being active at moderate levels or above may have introduced researcher bias. Recognising this risk informed the decision for a sequential design. This was an important decision to the research within this thesis and helped to gain a better understanding of those describing themselves as active at moderate levels and above after a diagnosis of ACS.

7.8. Conclusions

The body of work presented in this thesis suggests that perceptions related to physical activity levels influenced decisions of engagement with exercise-based CR after a diagnosis of ACS. In light of evidence conforming that over 40% of individuals post-MI report being at least moderately active before the start of CR, and previous review evidence confirming that believing oneself to be active post-MI is a barrier to attendance at CR (Neubeck et al., 2012), this research confirms moderately and high active participants' desire specific CR support to return to previous physical activities perceived to be at higher levels. Those self-reporting to being active at moderate physical activity levels or higher, understand being active from reflections of previous physical activity which included self-monitoring activities. To return to previous physical activity levels, active adults require CR support to overcome anxiety about their capability to increase physical activity intensity levels after a diagnosis of ACS. Performing increased levels of physical activity was possible from understanding safe upper exertion limits and being able to self-monitor physical activity exertion. Additionally, CR communication is a source for self-appraisal and when personalised can motivate secondary prevention goal setting for increased fitness and health. Further, where individuals evaluated themselves differently to their CR peers, some desire an alternative model to the current group-based rehabilitation sessions. However, these findings may not be representative of women after a diagnosis of ACS. The mixed-methods study introduced in chapter three requires to be repeated with a female sample after a diagnosis of ACS to understand if their perceptions of physical activity levels are different to that of males.

This research includes individuals reporting previous experience of self-monitoring of physical activity prior to a diagnosis of ACS. CR health care professionals should recognise this prior experience may be part of previous physical activity behaviour in adults self-reporting to be active at moderate levels or above. For those previously monitoring heart rate, CR health care professionals should support individuals to understand their specific heart rate parameters to encourage strategies to self-regulate physical activity exertion at CR recommended levels independently of CR staff. For those monitoring daily step-count, CR staff should engage with this behaviour to encourage internal appraisal of performance and maintenance of step-count monitoring during exercise-based CR.

Finally, the objective of this thesis was to explore how previous experience of physical activity influenced engagement with physical activity after a diagnosis of ACS and in the context of CR. The qualitative systematic review synthesis indicated that perceptions of physical ability, exercise self-reliance, severity of cardiac condition and fitness identity influenced perceived CR need. In the mixed-methods study, perceptions of previous physical activity levels influenced physical activity engagement decisions after an ACS diagnosis and during CR. Most participants (n=50, 74.6%) self-reported being at least moderately active and self-concept for being active predicted self-reported physical activity prior to the start of exercise-based CR. Participants understood the concept of “being active” through the lens of previous physical activity and self-evaluation of health. CR communication and peer comparisons influenced engagement decisions and motivation for fitness goals. Individuals who self-reported being at least moderately active required CR support to increase PA intensity levels after a diagnosis of ACS.

References

Aamot, I.-L., Forbord, S. H., Gustad, K., Løckra, V., Stensen, A., Berg, A. T., Dalen, H., Karlsen, T., & Støylen, A. (2014). Home-based versus hospital-based high-intensity interval training in cardiac rehabilitation: a randomized study. *European journal of preventive cardiology*, *21*(9), 1070-1078. https://doi.org/10.1177/2047487313488299

Abraham, C., Sheeran, P., & Johnston, M. (1998). From health beliefs to self-regulation: Theoretical advances in the psychology of action control. *Psychology and Health*, *13*(4), 569-591.

Adsett, J. A., Morris, N. R., Kuys, S. S., Paratz, J. D., & Mudge, A. M. (2019). Motivators and barriers for participation in aquatic and land-based exercise training programs for people with stable heart failure: A mixed methods approach. *Heart & Lung*, *48*(4), 287-293.

Albert, N. M., Forney, J., Slifcak, E., & Sorrell, J. (2015). Understanding physical activity and exercise behaviors in patients with heart failure. *Heart & Lung*, *44*(1), 2-8.

Alharbi, M., Bauman, A., Neubeck, L., & Gallagher, R. (2016). Validation of Fitbit-Flex as a measure of free-living physical activity in a community-based phase III cardiac rehabilitation population. *European journal of preventive cardiology*, *23*(14), 1476-1485.

Alharbi, M., Bauman, A., Neubeck, L., & Gallagher, R. (2017). Measuring Overall Physical Activity for Cardiac Rehabilitation Participants: A Review of the Literature. *Heart, Lung & Circulation*, *26*(10), 1008-1025. https://doi.org/10.1016/j.hlc.2017.01.005

Alharbi, M., Gallagher, R., Neubeck, L., Bauman, A., Prebill, G., Kirkness, A., & Randall, S. (2017). Exercise barriers and the relationship to self-efficacy for exercise over 12 months of a lifestyle-change program for people with heart disease and/or diabetes. *European Journal of Cardiovascular Nursing*, *16*(4), 309-317. https://doi.org/10.1177/1474515116666475

Ambridge, J., Fleming, P., & Henshall, L. (2020). The influence of self-compassion on perceived responsibility and shame following acquired brain injury. *Brain Injury*, 1-13.

American Association of Cardiovascular and Pulmonary Rehabilitation. (2021). *Guidelines for Cardiac Rehabilitation Programs, Sixth Edition*. Human Kinetics.

Amesberger, G., Finkenzeller, T., Würth, S., & Müller, E. (2011). Physical self-concept and physical fitness in elderly individuals. *Scandinavian journal of medicine & science in sports*, *21*, 83-90.

An, H.-S., Jones, G. C., Kang, S.-K., Welk, G. J., & Lee, J.-M. (2017). How valid are wearable physical activity trackers for measuring steps? *European journal of sport science*, *17*(3), 360-368.

Anderson, L., Oldridge, N., Thompson, D. R., Zwisler, A.-D., Rees, K., Martin, N., & Taylor, R. S. (2016). Exercise-Based Cardiac Rehabilitation for Coronary Heart Disease: Cochrane Systematic Review and Meta-Analysis. *Journal of the American College of Cardiology (JACC)*, *67*(1), 1-12. https://doi.org/10.1016/j.jacc.2015.10.044

Anderson, L., & Taylor, R. S. (2014). Cardiac rehabilitation for people with heart disease: an overview of Cochrane systematic reviews. *The Cochrane Database Of Systematic Reviews*(12), CD011273. https://doi.org/10.1002/14651858.CD011273.pub2

Aromataris, E., & Riitano, D. (2014). Systematic reviews: constructing a search strategy and searching for evidence. *AJN The American Journal of Nursing*, *114*(5), 49-56.

Artinian, N. T., Fletcher, G. F., Mozaffarian, D., Kris-Etherton, P., Van Horn, L., Lichtenstein, A. H., Kumanyika, S., Kraus, W. E., Fleg, J. L., & Redeker, N. S. (2010). Interventions to promote physical activity and dietary lifestyle changes for cardiovascular risk factor reduction in adults: a scientific statement from the American Heart Association. *Circulation*, *122*(4), 406-441.

Association of Chartered Physiotherapists in Cardiac Rehabilitation. (2015). ACPICR Standards for Physical Activity and Exercise in the Cardiac Population.

Avila, A., Claes, J., Goetschalckx, K., Buys, R., Azzawi, M., Vanhees, L., & Cornelissen, V. (2018). Home-based rehabilitation with telemonitoring guidance for patients with coronary artery disease (short-term results of the TRiCH study): randomized controlled trial. *Journal of Medical Internet Research*, *20*(6), e225.

Bäck, M., Öberg, B., & Krevers, B. (2017). Important aspects in relation to patients' attendance at exercise-based cardiac rehabilitation - facilitators, barriers and physiotherapist's role: a qualitative study. *BMC Cardiovascular Disorders*, *17*, 1-10. https://doi.org/10.1186/s12872-017-0512-7

BACPR Elected Council Members. (2012). RAMIT presents an outdated version of cardiac rehabilitation. *Heart*, *98*(8), 672-672.

Bajekal, M., Scholes, S., Love, H., Hawkins, N., O'Flaherty, M., Raine, R., Capewell, S., Bajekal, M., Scholes, S., Love, H., Hawkins, N., O'Flaherty, M., Raine, R., & Capewell, S. (2012). Analysing recent socioeconomic trends in coronary heart disease mortality in England, 2000-2007: a population modelling study. *PLoS Medicine*, *9*(6), e1001237-e1001237. https://doi.org/10.1371/journal.pmed.1001237

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ, US: Prentice-Hall, Inc.

Bandura, A. (1997). *Self-efficacy: The exercise of control*.

Bandura, A. (1999). Self-efficacy: Toward a unifying theory of behavioral change. In R. F. Baumeister & R. F. Baumeister (Eds.), *The self in social psychology.* (pp. 285-298). Psychology Press.

Bandura, A. (2004). Health promotion by social cognitive means. *Health Education & Behavior*, *31*(2), 143-164.

Banning, A. P., Baumbach, A., Blackman, D., Curzen, N., Devadathan, S., Fraser, D., Ludman, P., Norell, M., Muir, D., Nolan, J., & Redwood, S. (2015). Percutaneous coronary intervention in the UK: recommendations for good practice 2015. *Heart*, *101*, 1-13. https://doi.org/10.1136/heartjnl-2015-307821

Barbour, R. S. (1999). The case for combining qualitative and quantitative approaches in health services research. *Journal of health services research & policy*, *4*(1), 39-43.

Barrabes, J. (2015). Comments on the 2015 ESC Guidelines for the Management of Acute Coronary Syndromes in Patients Presenting Without Persistent ST-segment Elevation. *Revista Espanola De Cardiologia (English Ed.)*, *68*(12), 1061-1067. https://doi.org/10.1016/j.rec.2015.11.001

Bauman, A. E., Reis, R. S., Sallis, J. F., Wells, J. C., Loos, R. J., Martin, B. W., & Group, L. P. A. S. W. (2012). Correlates of physical activity: why are some people physically active and others not? *The Lancet*, *380*(9838), 258-271.

Bay, A., Lämås, K., Berghammer, M., Sandberg, C., & Johansson, B. (2018). It's like balancing on a slackline—A description of how adults with congenital heart disease describe themselves in relation to physical activity. *Journal of Clinical Nursing*, *27*(15-16), 3131-3138.

Beauchamp, M. R., Crawford, K. L., & Jackson, B. (2019). Social cognitive theory and physical activity: Mechanisms of behavior change, critique, and legacy. *Psychology of Sport and Exercise*, *42*, 110-117.

Bem, D. J. (1972). Self-perception theory. In *Advances in experimental social psychology* (Vol. 6, pp. 1-62). Elsevier.

Bennett, P., Mayfield, T., Norman, P., Lowe, R., & Morgan, M. (1999). Affective and social-cognitive predictors of behavioural change following first myocardial infarction. *British Journal of Health Psychology*, *4*(3), 247-256.

Benzer, W., Rauch, B., Schmid, J.-P., Zwisler, A. D., Dendale, P., Davos, C. H., Koudi, E., Simon, A., Abreu, A., & Pogosova, N. (2017). Exercise-based cardiac rehabilitation in twelve European countries results of the European cardiac rehabilitation registry. *International journal of cardiology*, *228*, 58-67.

Bettany-Saltikov, J. (2016). *How to do a systematic literature review in nursing : a step-by-step guide* (Second edition / Josette Bettany-Saltikov and Robert McSherry. ed.). Open University Press/McGraw Hill Education.

Biddle, S. J., Mutrie, N., & Gorely, T. (2015). Psychology of Physical Activity: Determinants, Well-Being and Interventions.

Bjarnason-Wehrens, B., McGee, H., Zwisler, A.-D., Piepoli, M. F., Benzer, W., Schmid, J.-P., Dendale, P., Pogosova, N.-G. V., Zdrenghea, D., & Niebauer, J. (2010). Cardiac rehabilitation in Europe: results from the European cardiac rehabilitation inventory survey. *European journal of preventive cardiology*, *17*(4), 410-418.

Blanchard, C., Arthur, H. M., & Gunn, E. (2015). Self-Efficacy and Outcome Expectations in Cardiac Rehabilitation: Associations With Women's Physical Activity. *Rehabilitation Psychology*, *60*(1), 59-66. https://doi.org/10.1037/rep0000024

Blanchard, C. M., McSweeney, J., Giacomantonio, N., Reid, R. D., Rhodes, R. E., Spence, J. C., Murnaghan, D., & McGannon, K. (2014). Distinct trajectories of light and moderate to vigorous physical activity in heart disease patients: results from the Activity Correlates afTer cardIac hospitalizatiON (ACTION) trial. *Journal of Science & Medicine in Sport*, *17*(1), 72-77. https://doi.org/10.1016/j.jsams.2013.03.002

Blanchard, C. M., Reid, R. D., Morrin, L. I., McDonnell, L., McGannon, K., Rhodes, R. E., Spence, J. C., & Edwards, N. (2010). Demographic and clinical determinants of moderate to vigorous physical activity during home-based cardiac rehabilitation: the home-based determinants of exercise (HOME) study. *Journal of Cardiopulmonary Rehabilitation and Prevention*, *30*(4), 240-245.

Blanchard, C. M., Rodgers, W. M., Courneya, K. S., Daub, B., & Knapik, G. (2002). Does barrier efficacy mediate the gender-exercise adherence relationship during phase II cardiac rehabilitation? *Rehabilitation Psychology*, *47*(1), 106.

Boland, A., Cherry, M. G., & Dickson, R. (2014). *Doing a systematic review : a student's guide*. SAGE.

Braun, V. (2013). *Successful qualitative research : a practical guide for beginners*. London : SAGE.

Brawley, L., Rejeski, W. J., Gaukstern, J. E., & Ambrosius, W. T. (2012). Social cognitive changes following weight loss and physical activity interventions in obese, older adults in poor cardiovascular health. *Annals of behavioral medicine*, *44*(3), 353-364.

Brieger, D. B., Chew, D. P. B., Redfern, J., Ellis, C., Briffa, T. G., Howell, T. E., Aliprandi-Costa, B., Astley, C. M., Gamble, G., Carr, B., Hammett, C. J. K., Board, N., & French, J. K. (2015). Survival after an acute coronary syndrome: 18-month outcomes from the Australian and New Zealand SNAPSHOT ACS study. *Medical Journal of Australia*, *203*(9), 368-368. https://doi.org/10.5694/mja15.00504

British Association of Cardiovascular Prevention and Rehabilitation. (2017). *BACPR Standards and Core Components for Cardiovascular Disease Prevention and Rehabilitation,*. http://www.bacpr.com/pages/page_box_contents.asp?pageid=791

British Heart Foundation. (2016). *National Audit for Cardiac Rehabilitation Annual Statistical Report, British Heart Foundation*. Retrieved 20/04/2017 from https://www.bhf.org.uk/NACR2016

British Heart Foundation. (2018). *The National Audit of Cardiac Rehabilitation*. British Heart Founation. https://www.bhf.org.uk/informationsupport/publications/statistics/national-audit-of-cardiac-rehabilitation-quality-and-outcomes-report-2018

British Heart Foundation. (2019). *The National Audit of Cardiac Rehabilitation*. British Heart Foundation. https://www.bhf.org.uk/informationsupport/publications/statistics/national-audit-of-cardiac-rehabilitation-quality-and-outcomes-report-2019

Broadbent, E., Petrie, K. J., Main, J., & Weinman, J. (2006). The Brief Illness Perception Questionnaire. *Journal of psychosomatic research*, *60*(6), 631-637. https://doi.org/10.1016/j.jpsychores.2005.10.020

Broadbent, E., Wilkes, C., Koschwanez, H., Weinman, J., Norton, S., & Petrie, K. J. (2015). A systematic review and meta-analysis of the Brief Illness Perception Questionnaire. *Psychology & Health*, *30*(11), 1361-1385. https://doi.org/10.1080/08870446.2015.1070851

Brown, J. (1999). Clinical. Barriers to physical activity in people at risk of coronary heart disease. *British Journal of Nursing*, *8*(8), 517-523.

Bruthans, J., Mayer Jr, O., De Bacquer, D., De Smedt, D., Reiner, Z., Kotseva, K., Cífková, R., & investigators, E. I. (2016). Educational level and risk profile and risk control in patients with coronary heart disease. *European journal of preventive cardiology*, *23*(8), 881-890.

Bull, F. C., Al-Ansari, S. S., Biddle, S., Borodulin, K., Buman, M. P., Cardon, G., Carty, C., Chaput, J.-P., Chastin, S., & Chou, R. (2020). World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *British journal of sports medicine*, *54*(24), 1451-1462.

Burke, P. J. (2009). *Identity theory*. Oxford University Press.

Burke, P. J., & Stryker, S. (2016). Identity theory: Progress in relating the two strands. In J. E. Stets, R. T. Serpe, J. E. Stets, & R. T. Serpe (Eds.), *New directions in identity theory and research.* (pp. 657-681). Oxford University Press. https://doi.org/10.1093/acprof:oso/9780190457532.003.0023

Caruana, E. J., Roman, M., Hernández-Sánchez, J., & Solli, P. (2015). Longitudinal studies. *Journal of thoracic disease*, *7*(11), E537.

Chen, C.-W., Su, W.-J., Wang, J.-K., Yang, H.-L., Chiang, Y.-T., & Moons, P. (2015). Physical self-concept and its link to cardiopulmonary exercise tolerance among adolescents with mild congenital heart disease. *European Journal of Cardiovascular Nursing*, *14*(3), 206-213.

Chen, Y.-C., Tsai, J.-C., Liou, Y.-M., & Chan, P. (2017). Effectiveness of endurance exercise training in patients with coronary artery disease: a meta-analysis of randomised controlled trials. *European Journal of Cardiovascular Nursing*, *16*(5), 397-408.

Choi, K. W., Chen, C.-Y., Stein, M. B., Klimentidis, Y. C., Wang, M.-J., Koenen, K. C., & Smoller, J. W. (2019). Assessment of bidirectional relationships between physical activity and depression among adults: a 2-sample mendelian randomization study. *JAMA psychiatry*, *76*(4), 399-408.

Chu, I. H., Nigg, C., Wu, W.-L., & Guo, L.-Y. (2016). *Self-determined Motivation Predicts Different Physical Activity Behaviors in Patients with Coronary Heart Disease* (Vol. 47). https://doi.org/10.7352/IJSP2016.47.545

Church, T. S., Earnest, C. P., Skinner, J. S., & Blair, S. N. (2007). Effects of different doses of physical activity on cardiorespiratory fitness among sedentary, overweight or obese postmenopausal women with elevated blood pressure: a randomized controlled trial. *Jama*, *297*(19), 2081-2091.

Clark, A. M. (1998). The qualitative-quantitative debate: moving from positivism and confrontation to post-positivism and reconciliation. *Journal Of Advanced Nursing*, *27*(6), 1242-1249.

Clark, A. M., Barbour, R. S., White, M., & MacIntyre, P. D. (2004). Promoting participation in cardiac rehabilitation: patient choices and experiences. *Journal Of Advanced Nursing*, *47*(1), 5-14.

Clark, A. M., Hartling, L., Vandermeer, B., & McAlister, F. A. (2005). Meta-analysis: secondary prevention programs for patients with coronary artery disease. *Annals of Internal Medicine*, *143*(9), 659-I687.

Clark, A. M., King-Shier, K. M., Spaling, M. A., Duncan, A. S., Stone, J. A., Jaglal, S. B., Thompson, D. R., & Angus, J. E. (2013). Factors influencing participation in cardiac rehabilitation programmes after referral and initial attendance: qualitative systematic review and meta-synthesis. *Clinical Rehabilitation*, *27*(10), 948-959. https://doi.org/10.1177/0269215513481046

Clark, A. M., Munday, C., McLaughlin, D., Catto, S., McLaren, A., & MacIntyre, P. D. (2012). Peer support to promote physical activity after completion of centre-based cardiac rehabilitation: evaluation of access and effects. *European Journal of Cardiovascular Nursing*, *11*(4), 388-395.

Cleary, K., LaPier, T., & Rippee, A. (2015). Perceptions of exercise and quality of life in older patients in the United States during the first year following coronary artery bypass surgery. *Physiotherapy Theory & Practice*, *31*(5), 337-346. https://doi.org/10.3109/09593985.2015.1004770

Cohen, J. (2013). *Statistical power analysis for the behavioral sciences*. Academic press.

Colbert, J. D., Martin, B.-J., Haykowsky, M. J., Hauer, T. L., Austford, L. D., Arena, R. A., Knudtson, M. L., Meldrum, D. A., Aggarwal, S. G., & Stone, J. A. (2015). Cardiac rehabilitation referral, attendance and mortality in women. *European journal of preventive cardiology*, *22*(8), 979-986.

Collet, J.-P., Thiele, H., Barbato, E., Barthélémy, O., Bauersachs, J., Bhatt, D. L., Dendale, P., Dorobantu, M., Edvardsen, T., & Folliguet, T. (2020).

2020 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevationThe Task Force for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation of the European Society of Cardiology (ESC). *European heart journal*.

Collet, J.-P., Thiele, H., Barbato, E., Barthélémy, O., Bauersachs, J., Bhatt, D. L., Dendale, P., Dorobantu, M., Edvardsen, T., & Folliguet, T. (2021). 2020 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation: the Task Force for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation of the European Society of Cardiology (ESC). *European heart journal*, *42*(14), 1289-1367.

Conn, V., Taylor, S. G., & Abele, P. B. (1991). Myocardial infarction survivors: age and gender differences in physical health, psychosocial state and regimen adherence. *Journal Of Advanced Nursing*, *16*(9), 1026-1034.

Cooper, A. F., Jackson, G., Weinman, J., & Horne, R. (2005). A qualitative study investigating patients' beliefs about cardiac rehabilitation. *Clinical Rehabilitation*, *19*(1), 87-96.

Cosoli, G., Spinsante, S., & Scalise, L. (2020). Wrist-worn and chest-strap wearable devices: Systematic review on accuracy and metrological characteristics. *Measurement*, *159*, 107789.

Craig, C. L., Marshall, A. L., Sjöström, M., Bauman, A. E., Booth, M. L., Ainsworth, B. E., Pratt, M., Ekelund, U., Yngve, A., Sallis, J. F., & Oja, P. (2003). International Physical Activity Questionnaire: 12-country reliability and validity...including commentary by Bassett DR Jr. *Medicine & Science in Sports & Exercise*, *35*(8), 1381-1396.

Craig, P., Dieppe, P., Macintyre, S., Michie, S., Nazareth, I., & Petticrew, M. (2008). Developing and evaluating complex interventions: the new Medical Research Council guidance. *BMJ*, *337*. http://www.bmj.com/content/337/bmj.a1655.short

Creswell, J. W. (2015). *A concise introduction to mixed methods research*. SAGE Publications, Inc.

Creswell, J. W., & Plano Clark, V. L. (2011). *Designing and conducting mixed methods research* (2nd ed. ed.). SAGE.

Critchley, J. A., Capewell, S., Critchley, J. A., & Capewell, S. (2003). Mortality risk reduction associated with smoking cessation in patients with coronary heart disease: a systematic review. *JAMA: Journal of the American Medical Association*, *290*(1), 86-97.

Crossan, F. (2003). Research philosophy: towards an understanding. *Nurse Researcher*, *11*(1), 46-55.

Crotty, M. (1998). *The foundations of social research : meaning and perspective in the research process*. London : Sage.

Dalal, H. M., Doherty, P., & Taylor, R. S. (2015). Cardiac rehabilitation. *BMJ*, *351*, h5000.

Dale, C. M., Angus, J. E., Seto Nielsen, L., Kramer-Kile, M., Pritlove, C., Lapum, J., Price, J., Marzolini, S., Abramson, B., Oh, P., & Clark, A. (2015). "I'm No Superman": Understanding Diabetic Men, Masculinity, and Cardiac Rehabilitation. *Qualitative Health Research*, *25*(12), 1648-1661. https://doi.org/10.1177/1049732314566323

Darlow, S. D., & Xu, X. (2011). The influence of close others' exercise habits and perceived social support on exercise. *Psychology of Sport and Exercise*, *12*(5), 575-578.

De Chesnay, M. (2015a). *Nursing research using ethnography : qualitative designs and methods in nursing*. New York : Springer Publishing Company.

De Chesnay, M. (2015b). *Nursing research using grounded theory : qualitative designs and methods in nursing*.

De Chesnay, M. (2015c). *Nursing research using phenomenology : qualitative designs and methods in nursing*.

Department of Health & Social Care. (2019). *UK Chief Medical Officers' Physical Activity Guidelines* Retrieved 20 March from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/832868/uk-chief-medical-officers-physical-activity-guidelines.pdf

Díaz-Buschmann, I., Jaureguizar, K. V., Calero, M. J., & Aquino, R. S. (2014). Programming exercise intensity in patients on beta-blocker treatment: the importance of choosing an appropriate method. *European journal of preventive cardiology*, *21*(12), 1474-1480.

Dinas, P., Koutedakis, Y., & Flouris, A. (2011). Effects of exercise and physical activity on depression. *Irish journal of medical science*, *180*(2), 319-325.

Divers, F. (2015). Scoping of cardiac rehabilitation services in Scotland 2015. *Edinburgh: Scottish Government*.

Dixon-Woods, M., Bonas, S., Booth, A., Jones, D. R., Miller, T., Sutton, A. J., Shaw, R. L., Smith, J. A., & Young, B. (2006). How can systematic reviews incorporate qualitative research? A critical perspective. *Qualitative research*, *6*(1), 27-44.

Dodson, J. A., Arnold, S. V., Reid, K. J., Gill, T. M., Rich, M. W., Masoudi, F. A., Spertus, J. A., Krumholz, H. M., & Alexander, K. P. (2012). Physical function and independence 1 year after myocardial infarction: observations from the Translational Research Investigating Underlying disparities in recovery from acute Myocardial infarction: Patients' Health status registry. *American heart journal*, *163*(5), 790-796.

Dohnke, B., Nowossadeck, E., & Muller-Fahrnow, W. (2010). Motivation and Participation in a Phase III Cardiac Rehabilitation Programme: An Application of the Health Action Process Approach. *Research in Sports Medicine*, *18*(4), 219-235. https://doi.org/10.1080/15438627.2010.510032

Doody, O., & Noonan, M. (2016). Nursing research ethics, guidance and application in practice. *British journal of nursing (Mark Allen Publishing)*, *25*(14), 803. https://doi.org/10.12968/bjon.2016.25.14.803

Doyle, L., Brady, A.-M., & Byrne, G. (2016). An overview of mixed methods research–revisited. *Journal of research in nursing*, *21*(8), 623-635.

Du, H., Everett, B., Newton, P. J., Salamonson, Y., & Davidson, P. M. (2012). Self-efficacy: a useful construct to promote physical activity in people with stable chronic heart failure. *Journal of Clinical Nursing*, *21*(3-4), 301-310.

Duff, O. M., Walsh, D. M. J., Furlong, B. A., O'Connor, N. E., Moran, K. A., & Woods, C. B. (2017). Behavior Change Techniques in Physical Activity eHealth Interventions for People With Cardiovascular Disease: Systematic Review. *Journal of Medical Internet Research*, *19*(8), 1-1. https://doi.org/10.2196/jmir.7782

Duscha, B. D., Piner, L. W., Patel, M. P., Craig, K. P., Brady, M., McGarrah III, R. W., Chen, C., & Kraus, W. E. (2018). Effects of a 12-week mHealth program on peak VO2 and physical activity patterns after completing cardiac rehabilitation: a randomized controlled trial. *American heart journal*, *199*, 105-114.

Ekkekakis, P., Lind, E., & Vazou, S. (2010). Affective responses to increasing levels of exercise intensity in normal-weight, overweight, and obese middle-aged women. *Obesity (19307381)*, *18*(1), 79-85. https://doi.org/10.1038/oby.2009.204

Ellis, P. (2010). *Understanding research for nursing students*. Learning Matters.

Elrod, C. S. (2007). Patient Adherence to Self-Monitoring Recommendations Taught in Extended Phase I Cardiac Rehabilitation. *Cardiopulmonary Physical Therapy Journal (American Physical Therapy Association, Cardiopulmonary Section)*, *18*(1).

Etiwy, M., Akhrass, Z., Gillinov, L., Alashi, A., Wang, R., Blackburn, G., Gillinov, S. M., Phelan, D., Gillinov, A. M., & Houghtaling, P. L. (2019). Accuracy of wearable heart rate monitors in cardiac rehabilitation. *Cardiovascular diagnosis and therapy*, *9*(3), 262.

Faden, R. R., & Beauchamp, T. L. (1986). *A history and theory of informed consent*. Oxford University Press.

Fanning, J. P., Nyong, J., Scott, I. A., Aroney, C. N., & Walters, D. L. (2016). Routine invasive strategies versus selective invasive strategies for unstable angina and non-ST elevation myocardial infarction in the stent era. *The Cochrane Database Of Systematic Reviews*(5), CD004815. https://doi.org/10.1002/14651858.CD004815.pub4

Farris, S. G., Bond, D. S., Wu, W.-C., Stabile, L. M., & Abrantes, A. M. (2018). Anxiety sensitivity and fear of exercise in patients attending cardiac rehabilitation. *Mental Health and Physical Activity*, *15*, 22-26.

Fletcher, G. F., Ades, P. A., Kligfield, P., Arena, R., Balady, G. J., Bittner, V. A., Coke, L. A., Fleg, J. L., Forman, D. E., & Gerber, T. C. (2013). Exercise standards for testing and training: a scientific statement from the American Heart Association. *Circulation*, *128*(8), 873-934.

Flora, P. K., Anderson, T. J., & Brawley, L. R. (2015). Illness Perceptions and Adherence to Exercise Therapy in Cardiac Rehabilitation Participants. *Rehabilitation Psychology*, *60*(2), 179-186. https://doi.org/10.1037/a0039123

Floyd, J., & Fowler, J. (2013). *Survey research methods*. Sage publications.

Fontana, J. S. (2004). A methodology for critical science in nursing. *Advances in Nursing Science*, *27*(2), 93-101.

Fox, K. R. (2000). Self-esteem, self-perceptions and exercise. *International journal of sport psychology*.

Fox, K. R., & Wilson, P. M. (2008). Self-perceptual systems and physical activity. In T. S. Horn & T. S. Horn (Eds.), *Advances in sport psychology.* (pp. 49-64). Human Kinetics.

Franklin, B. A., Thompson, P. D., Al-Zaiti, S. S., Albert, C. M., Hivert, M.-F., Levine, B. D., Lobelo, F., Madan, K., Sharrief, A. Z., & Eijsvogels, T. M. (2020). Exercise-related acute cardiovascular events and potential deleterious adaptations following long-term exercise training: placing the risks into perspective–an update: a scientific statement from the American Heart Association. *Circulation*, *141*(13), e705-e736.

Franssen, W. M., Franssen, G. H., Spaas, J., Solmi, F., & Eijnde, B. O. (2020). Can consumer wearable activity tracker-based interventions improve physical activity and cardiometabolic health in patients with chronic diseases? A systematic review and meta-analysis of randomised controlled trials. *International Journal of Behavioral Nutrition and Physical Activity*, *17*, 1-20.

Frederix, I., Driessche, N. V., Hansen, D., Berger, J., Bonne, K., Alders, T., & Dendale, P. (2015). Increasing the medium-term clinical benefits of hospital-based cardiac rehabilitation by physical activity telemonitoring in coronary artery disease patients. *European journal of preventive cardiology*, *22*(2), 150-158.

French, D. P., Cooper, A., & Weinman, J. (2006). Illness perceptions predict attendance at cardiac rehabilitation following acute myocardial infarction: a systematic review with meta-analysis. *Journal of psychosomatic research*, *61*(6), 757-767.

French, D. P., Olander, E. K., Chisholm, A., & Mc Sharry, J. (2014). Which behaviour change techniques are most effective at increasing older adults’ self-efficacy and physical activity behaviour? A systematic review. *Annals of behavioral medicine*, *48*(2), 225-234.

French, S. D., Green, S. E., O’Connor, D. A., McKenzie, J. E., Francis, J. J., Michie, S., Buchbinder, R., Schattner, P., Spike, N., & Grimshaw, J. M. (2012). Developing theory-informed behaviour change interventions to implement evidence into practice: a systematic approach using the Theoretical Domains Framework. *Implementation Science*, *7*(1), 1-8.

Gaalema, D. E., Savage, P. D., Rengo, J. L., Cutler, A. Y., Elliott, R. J., Priest, J. S., Higgins, S. T., & Ades, P. A. (2017). Patient characteristics predictive of cardiac rehabilitation adherence. *Journal of Cardiopulmonary Rehabilitation and Prevention*, *37*(2), 103.

Gajda, R., Biernacka, E., & Drygas, W. (2018). Are heart rate monitors valuable tools for diagnosing arrhythmias in endurance athletes? *Scandinavian journal of medicine & science in sports*, *28*(2), 496-516.

Galdas, P. M., Oliffe, J. L., Kang, H. B. K., & Kelly, M. T. (2012). Punjabi Sikh patients' perceived barriers to engaging in physical exercise following myocardial infarction. *Public Health Nursing (Boston, Mass.)*, *29*(6), 534-541. https://doi.org/10.1111/j.1525-1446.2012.01009.x

Gallagher, R., Parker, H., Zhang, L., Kirkness, A., Roach, K., Belshaw, J., Glinatsis, H., Gallagher, P., & Neubeck, L. (2020). Target audience and preferences related to an Australian coronary heart disease specific mobile app: a mixed methods study. *Heart, Lung and Circulation*, *29*(5), 696-702.

Gardiner, F. W., Nwose, E. U., Regan, E., Park, B. K., Bwititi, P. T., Crockett, J., & Wang, L. (2018). Outpatient cardiac rehabilitation: Patient perceived benefits and reasons for non-attendance. *Collegian*, *25*(5), 479-485. https://doi.org/10.1016/j.colegn.2018.01.001

Gardner, B., & Rebar, A. L. (2019). Habit formation and behavior change. In *Oxford research encyclopedia of psychology*.

Ghisi, G. L. d. M., Grace, S. L., Thomas, S., & Oh, P. (2015). Behavior determinants among cardiac rehabilitation patients receiving educational interventions: an application of the health action process approach. *Patient Education & Counseling*, *98*(5), 612-621. https://doi.org/10.1016/j.pec.2015.01.006

Gilchrist, I. C. (2014). Same day discharge after elective percutaneous coronary intervention. *Current Cardiology Reports*, *16*(4), 470-470. https://doi.org/10.1007/s11886-014-0470-y

Gomes-Neto, M., Duraes, A. R., Reis, H. F. C. d., Neves, V. R., Martinez, B. P., & Carvalho, V. O. (2017). High-intensity interval training versus moderate-intensity continuous training on exercise capacity and quality of life in patients with coronary artery disease: A systematic review and meta-analysis. *European journal of preventive cardiology*, *24*(16), 1696-1707.

Gonçalves, C., Raimundo, A., Abreu, A., & Bravo, J. (2021). Exercise Intensity in Patients with Cardiovascular Diseases: Systematic Review with Meta-Analysis. *International journal of environmental research and public health*, *18*(7), 3574.

Goodwin, A. M., Duran, A. T., Kronish, I. M., Moise, N., Sanchez, G. J., Garber, C. E., Schwartz, J. E., & Diaz, K. M. (2019). Factors associated with objectively measured exercise participation after hospitalization for acute coronary syndrome. *International journal of cardiology*, *275*, 1-5.

Goodwin, L., Ostuzzi, G., Khan, N., Hotopf, M. H., & Moss-Morris, R. (2016). Can we identify the active ingredients of behaviour change interventions for coronary heart disease patients? A systematic review and meta-analysis. *PloS one*, *11*(4), e0153271.

Grace, S. L., Midence, L., Oh, P., Brister, S., Chessex, C., Stewart, D. E., & Arthur, H. M. (2016). Cardiac rehabilitation program adherence and functional capacity among women: a randomized controlled trial. Mayo Clinic Proceedings,

Grant, M. J., & Booth, A. (2009). A typology of reviews: an analysis of 14 review types and associated methodologies. *Health Information & Libraries Journal*, *26*(2), 91-108. https://doi.org/10.1111/j.1471-1842.2009.00848.x

Greenberg, J., Solomon, S., & Pyszczynski, T. (1997). Terror management theory of self-esteem and cultural worldviews: Empirical assessments and conceptual refinements. In *Advances in experimental social psychology* (Vol. 29, pp. 61-139). Elsevier.

Hagger, M. S. (2019). Habit and physical activity: Theoretical advances, practical implications, and agenda for future research. *Psychology of Sport and Exercise*, *42*, 118-129.

Hagger, M. S., & Orbell, S. (2003). A meta-analytic review of the common-sense model of illness representations. *Psychology and Health*, *18*(2), 141-184.

Hankinson, A. L., Daviglus, M. L., Bouchard, C., Carnethon, M., Lewis, C. E., Schreiner, P. J., Liu, K., & Sidney, S. (2010). Maintaining a high physical activity level over 20 years and weight gain. *Jama*, *304*(23), 2603-2610.

Hannan, A. L., Harders, M. P., Hing, W., Climstein, M., Coombes, J. S., & Furness, J. (2019). Impact of wearable physical activity monitoring devices with exercise prescription or advice in the maintenance phase of cardiac rehabilitation: systematic review and meta-analysis. *BMC Sports Science, Medicine and Rehabilitation*, *11*(1), 1-21.

Hartung, D. M., & Touchette, D. (2009). Overview of clinical research design. *American Journal of Health-System Pharmacy*, *66*(4), 398-408. https://doi.org/10.2146/ajhp080300

Herber, O. R., Smith, K., White, M., & Jones, M. C. (2017). 'Just not for me' - contributing factors to nonattendance/noncompletion at phase III cardiac rehabilitation in acute coronary syndrome patients: a qualitative enquiry. *Journal of Clinical Nursing*, *26*(21/22), 3529-3542. https://doi.org/10.1111/jocn.13722

Heron, N., Kee, F., Donnelly, M., Cardwell, C., Tully, M. A., & Cupples, M. E. (2016). Behaviour change techniques in home-based cardiac rehabilitation: a systematic review. *British Journal of General Practice*, *66*(651), e747-e757. https://doi.org/10.3399/bjgp16X686617

Hess, C. N., Wang, T. Y., McCoy, L. A., Messenger, J. C., Effron, M. B., Zettler, M. E., Henry, T. D., Peterson, E. D., & Fonarow, G. C. (2016). Unplanned Inpatient and Observation Rehospitalizations After Acute Myocardial Infarction: Insights From the Treatment With Adenosine Diphosphate Receptor Inhibitors: Longitudinal Assessment of Treatment Patterns and Events After Acute Coronary Syndrome (TRANSLATE-ACS) Study. *Circulation*, *133*(5), 493-501. https://doi.org/10.1161/CIRCULATIONAHA.115.017001

Hillsdon, M., Lawlor, D., Ebrahim, S., & Morris, J. (2008). Physical activity in older women: associations with area deprivation and with socioeconomic position over the life course: observations in the British Women's Heart and Health Study. *Journal of Epidemiology & Community Health*, *62*(4), 344-350.

Hird, C., Upton, C., & Chesson, R. A. (2004). 'Getting back to normal': Patients' expectations of cardiac rehabilitation. *Physiotherapy*, *90*, 125-131. https://doi.org/http://dx.doi.org/10.1016/j.physio.2004.03.006

Holloway, I., & Biley, F. C. (2011). Being a qualitative researcher. *Qualitative Health Research*, *21*(7), 968-975.

Holmes, M. G. (2016). *Increasing walking in individuals with intermittent claudication: the roles of walking treatment and illness cognitions* King's College London London].

Hotchkiss, J. W., Davies, C. A., Dundas, R., Hawkins, N., Jhund, P. S., Scholes, S., Bajekal, M., O'Flaherty, M., Critchley, J., Leyland, A. H., & Capewell, S. (2014). Explaining trends in Scottish coronary heart disease mortality between 2000 and 2010 using IMPACT SEC model: retrospective analysis using routine data. *BMJ: British Medical Journal*, *348*(7946), 14-14. https://doi.org/10.1136/bmj.g1088

Houghton, C., Hunter, A., & Meskell, P. (2012). Linking aims, paradigm and method in nursing research. *Nurse Researcher*, *20*(2), 34-39.

Houle, J., Doyon, O., Vadeboncoeur, N., Turbide, G., Diaz, A., & Poirier, P. (2012). Effectiveness of a pedometer-based program using a socio-cognitive intervention on physical activity and quality of life in a setting of cardiac rehabilitation. *Canadian Journal of Cardiology*, *28*(1), 27-32.

Huffman, J. C., Moore, S. V., DuBois, C. M., Mastromauro, C. A., Suarez, L., & Park, E. R. (2015). An exploratory mixed methods analysis of adherence predictors following acute coronary syndrome. *Psychology, health & medicine*, *20*(5), 541-550.

Hwang, R., Mandrusiak, A., Morris, N. R., Peters, R., Korczyk, D., Bruning, J., & Russell, T. (2017). Exploring patient experiences and perspectives of a heart failure telerehabilitation program: A mixed methods approach. *Heart & Lung: The Journal Of Critical Care*, *46*(4), 320-327. https://doi.org/10.1016/j.hrtlng.2017.03.004

Ibanez, B., James, S., Agewall, S., Antunes, M. J., Bucciarelli-Ducci, C., Bueno, H., Caforio, A. L., Crea, F., Goudevenos, J. A., & Halvorsen, S. (2018). 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation: The Task Force for the management of acute myocardial infarction in patients presenting with ST-segment elevation of the European Society of Cardiology (ESC). *European heart journal*, *39*(2), 119-177.

Information Services Division. (2020). *Scottish Heart Disease Statistics, Year ending 31 March 2019*. NHS, National Services Scotland. file:///C:/Users/40189990/AppData/Local/Packages/Microsoft.MicrosoftEdge_8wekyb3d8bbwe/TempState/Downloads/2020-01-28-heart-disease-report.pdf

Jason, T., McGannon, K. R., Blanchard, C. M., Rainham, D., & Dechman, G. (2015). A systematic gender-based review of physical activity correlates in coronary heart disease patients. *International Review of Sport & Exercise Psychology*, *8*(1), 1-23. https://doi.org/10.1080/1750984X.2014.932425

Jernberg, T., Hasvold, P., Henriksson, M., Hjelm, H., Thuresson, M., & Janzon, M. (2015). Cardiovascular risk in post-myocardial infarction patients: nationwide real world data demonstrate the importance of a long-term perspective. *European heart journal*, *36*(19), 1163-1170.

Ji, H., Fang, L., Yuan, L., & Zhang, Q. (2019). Effects of exercise-based cardiac rehabilitation in patients with acute coronary syndrome: a meta-analysis. *Medical science monitor: international medical journal of experimental and clinical research*, *25*, 5015.

Jiwani, R. B., Cleveland, L. M., Patel, D. I., Virani, S. S., & Gill, S. L. (2017). Understanding self-regulation behaviors in South Asians with coronary artery disease: A mixed-methods study. *Journal of Cardiovascular Nursing*, *32*(3), 281-287.

Jones, J., Buckley, J., Furze, G., & Sheppard, G. (2020). *Cardiovascular Prevention and Rehabilitation in Practice* (Second Edition ed.). Wiley Online Library.

Jones, M., Jolly, K., Raftery, J., Lip, G. Y. H., & Greenfield, S. (2007). 'DNA' may not mean 'did not participate': a qualitative study of reasons for non-adherence at home- and centre-based cardiac rehabilitation. *Family Practice*, *24*(4), 343-357.

Jones, M. C., Smith, K., Herber, O., White, M., Steele, F., & Johnston, D. W. (2018). Intention, beliefs and mood assessed using electronic diaries predicts attendance at cardiac rehabilitation: an observational study. *International Journal of Nursing Studies*, *88*, 143-152.

Karapanos, E., Gouveia, R., Hassenzahl, M., & Forlizzi, J. (2016). Wellbeing in the making: peoples' experiences with wearable activity trackers. *Psychology of well-being*, *6*(1), 1-17.

Kelley, K., Clark, B., Brown, V., & Sitzia, J. (2003). Good practice in the conduct and reporting of survey research. *International Journal for Quality in Health Care*, *15*(3), 261-266.

Kendzierski, D., & Morganstein, M. S. (2009). Test, revision, and cross-validation of the physical activity self-definition model. *Journal of Sport and Exercise Psychology*, *31*(4), 484-504.

Khoramdad, M., Vahedian-azimi, A., Karimi, L., Rahimi-Bashar, F., Amini, H., & Sahebkar, A. (2020). Association between passive smoking and cardiovascular disease: A systematic review and meta-analysis. *IUBMB life*, *72*(4), 677-686.

Knittle, K., Nurmi, J., Crutzen, R., Hankonen, N., Beattie, M., & Dombrowski, S. U. (2018). How can interventions increase motivation for physical activity? A systematic review and meta-analysis. *Health Psychology Review*, *12*(3), 211-230.

Kotseva, K., Jennings, C. S., Turner, E. L., Mead, A., Connolly, S., Jones, J., Bowker, T. J., Wood, D. A., Kotseva, K., Jennings, C. S., Turner, E. L., Mead, A., Connolly, S., Jones, J., Bowker, T. J., & Wood, D. A. (2012). ASPIRE-2-PREVENT: a survey of lifestyle, risk factor management and cardioprotective medication in patients with coronary heart disease and people at high risk of developing cardiovascular disease in the UK. *Heart*, *98*(11), 865-871. https://doi.org/10.1136/heartjnl-2011-301603

Kotseva, K., Wood, D., & De Bacquer, D. (2018). Determinants of participation and risk factor control according to attendance in cardiac rehabilitation programmes in coronary patients in Europe: EUROASPIRE IV survey. *European journal of preventive cardiology*, *25*(12), 1242-1251.

Kwasnicka, D., Dombrowski, S. U., White, M., & Sniehotta, F. (2016). Theoretical explanations for maintenance of behaviour change: a systematic review of behaviour theories. *Health Psychology Review*, *10*(3), 277-296.

Lakshman, R., McConville, A., How, S., Flowers, J., Wareham, N., & Cosford, P. (2010). Association between area-level socioeconomic deprivation and a cluster of behavioural risk factors: cross-sectional, population-based study. *Journal of Public Health*, *33*(2), 234-245.

Lee, P. H., Macfarlane, D. J., Lam, T., & Stewart, S. M. (2011). Validity of the international physical activity questionnaire short form (IPAQ-SF): A systematic review. *International Journal of Behavioral Nutrition and Physical Activity*, *8*(1), 115.

Leventhal, H. (1970). Findings and theory in the study of fear communications. In *Advances in experimental social psychology* (Vol. 5, pp. 119-186). Elsevier.

Leventhal, H., Diefenbach, M., & Leventhal, E. A. (1992). Illness cognition: Using common sense to understand treatment adherence and affect cognition interactions. *Cognitive Therapy and Research*, *16*(2), 143-163. https://doi.org/10.1007/BF01173486

Levine, D. A., Davydow, D. S., Hough, C. L., Langa, K. M., Rogers, M. A., & Iwashyna, T. J. (2014). Functional disability and cognitive impairment after hospitalization for myocardial infarction and stroke. *Circulation: Cardiovascular Quality and Outcomes*, *7*(6), 863-871.

Lima de Melo Ghisi, G., Pesah, E., Turk-Adawi, K., Supervia, M., Lopez Jimenez, F., & Grace, S. (2018). Cardiac rehabilitation models around the globe. *Journal of clinical medicine*, *7*(9), 260.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Sage Publications.

Liou, K., Ho, S., Fildes, J., & Ooi, S.-Y. (2016). High intensity interval versus moderate intensity continuous training in patients with coronary artery disease: a meta-analysis of physiological and clinical parameters. *Heart, Lung and Circulation*, *25*(2), 166-174.

Locke, S. R., McMahon, C. J., & Brawley, L. R. (2020). Self-regulatory efficacy for exercise in cardiac rehabilitation: Review and recommendations for measurement. *Rehabilitation Psychology*, *65*(3), 239.

Macintyre, S., & Mutrie, N. (2004). Socio-economic differences in cardiovascular disease and physical activity: stereotypes and reality. *The journal of the Royal Society for the Promotion of Health*, *124*(2), 66-69.

MacLure, K., Paudyal, V., & Stewart, D. (2016). Reviewing the literature, how systematic is systematic? *International journal of clinical pharmacy*, *38*(3), 685-694.

Manen, M. v. (1990). *Researching lived experience : human science for an action sensitive pedagogy*. State University of New York Press.

Marsh, H. W., Martin, A. J., & Jackson, S. (2010). Introducing a short version of the Physical Self Description Questionnaire: New strategies, short-form evaluative criteria, and applications of factor analyses. *Journal of Sport & Exercise Psychology*, *32*(4), 438-482. https://doi.org/10.1123/jsep.32.4.438

Marsh, H. W., Papaioannou, A., & Theodorakis, Y. (2006). Causal ordering of physical self-concept and exercise behavior: Reciprocal effects model and the influence of physical education teachers. *Health Psychology*, *25*(3), 316-328. https://doi.org/10.1037/0278-6133.25.3.316

Marsh, H. W., & Shavelson, R. (1985). Self-concept: Its multifaceted, hierarchical structure. *Educational Psychologist*, *20*(3), 107-123. https://doi.org/10.1207/s15326985ep2003_1

Martin, J. (2007). PHYSICAL, ACTIVITY AND PHYSICAL SELF-CONCEPT OF INDIVIDUALS VVITH DISABILITIES: AN EXPLORATORY STUDY. *Journal of human movement studies*, *52*, 037-048.

McAloon, C. J., Boylan, L. M., Hamborg, T., Stallard, N., Osman, F., Lim, P. B., & Hayat, S. A. (2016). The changing face of cardiovascular disease 2000–2012: An analysis of the world health organisation global health estimates data. *International journal of cardiology*, *224*, 256-264.

McCorry, N. K., Corrigan, M., Tully, M. A., Dempster, M., Downey, B., & Cupples, M. E. (2009). Perceptions of exercise among people who have not attended cardiac rehabilitation following myocardial infarction. *Journal Of Health Psychology*, *14*(7), 924-932. https://doi.org/10.1177/1359105309341144

McHale, S., Astin, F., Neubeck, L., Dawkes, S., & Hanson, C. L. (2020). A systematic review and thematic synthesis exploring how a previous experience of physical activity influences engagement with cardiac rehabilitation. *European Journal of Cardiovascular Nursing*, *19*(1), 31-43.

McIntosh, M. J., & Morse, J. M. (2015). Situating and constructing diversity in semi-structured interviews. *Global qualitative nursing research*, *2*, 2333393615597674.

McKee, G., Mooney, M., O'Donnell, S., O'Brien, F., Biddle, M. J., & Moser, D. K. (2019). A cohort study examining the factors influencing changes in physical activity levels following an acute coronary syndrome event. *European Journal of Cardiovascular Nursing*, *18*(1), 57-66.

Meinhart, F., Stütz, T., Sareban, M., Kulnik, S. T., & Niebauer, J. (2021). Mobile technologies to promote physical activity during cardiac rehabilitation: a scoping review. *Sensors*, *21*(1), 65.

Melloni, C., Berger, J. S., Wang, T. Y., Gunes, F., Stebbins, A., Pieper, K. S., Dolor, R. J., Douglas, P. S., Mark, D. B., & Newby, L. K. (2010). Representation of women in randomized clinical trials of cardiovascular disease prevention. *Circulation: Cardiovascular Quality and Outcomes*, *3*(2), 135-142.

Mercer, K., Giangregorio, L., Schneider, E., Chilana, P., Li, M., & Grindrod, K. (2016). Acceptance of commercially available wearable activity trackers among adults aged over 50 and with chronic illness: a mixed-methods evaluation. *JMIR mHealth and uHealth*, *4*(1), e7.

Michie, S., Ashford, S., Sniehotta, F. F., Dombrowski, S. U., Bishop, A., & French, D. P. (2011). A refined taxonomy of behaviour change techniques to help people change their physical activity and healthy eating behaviours: The CALO-RE taxonomy. *Psychology & Health*, *26*(11), 1479-1498. https://doi.org/10.1080/08870446.2010.540664

Milligan, F. (2013). Using exercise to improve quality of life for people with heart failure. *British Journal of Nursing*, *22*(21), 1242-1246.

Moore, J. B., Mitchell, N. G., Beets, M. W., & Bartholomew, J. B. (2012). Physical self-esteem in older adults: A test of the indirect effect of physical activity. *Sport, Exercise, and Performance Psychology*, *1*(4), 231.

Moran-Ellis, J., Alexander, V. D., Cronin, A., Dickinson, M., Fielding, J., Sleney, J., & Thomas, H. (2006). Triangulation and integration: processes, claims and implications. *Qualitative research*, *6*(1), 45-59.

Morgan, D. L. (2014). Pragmatism as a paradigm for social research. *Qualitative inquiry*, *20*(8), 1045-1053.

Mosleh, S. M., & Almalik, M. M. (2016). Illness perception and adherence to healthy behaviour in Jordanian coronary heart disease patients. *European Journal of Cardiovascular Nursing*, *15*(4), 223-230.

Moule, P., & Goodman, M. D. (2009). *Nursing research : an introduction*. SAGE.

Moulson, N., Bewick, D., Selway, T., Harris, J., Suskin, N., Oh, P., Coutinho, T., Singh, G., Chow, C.-M., & Clarke, B. (2020). Cardiac rehabilitation during the COVID-19 era: guidance on implementing virtual care. *Canadian Journal of Cardiology*, *36*(8), 1317-1321.

Mühlen, J. M., Stang, J., Skovgaard, E. L., Judice, P. B., Molina-Garcia, P., Johnston, W., Sardinha, L. B., Ortega, F. B., Caulfield, B., & Bloch, W. (2021). Recommendations for determining the validity of consumer wearable heart rate devices: expert statement and checklist of the INTERLIVE Network. *British journal of sports medicine*.

Munn, Z., Stern, C., Aromataris, E., Lockwood, C., & Jordan, Z. (2018). What kind of systematic review should I conduct? A proposed typology and guidance for systematic reviewers in the medical and health sciences. *BMC medical research methodology*, *18*(1), 5.

Murphy, A., Palafox, B., Walli-Attaei, M., Powell-Jackson, T., Rangarajan, S., Alhabib, K. F., Calik, K. B. T., Chifamba, J., Choudhury, T., & Dagenais, G. (2020). The household economic burden of non-communicable diseases in 18 countries. *BMJ global health*, *5*(2).

Musselwhite, K., Cuff, L., McGregor, L., & King, K. M. (2007). The telephone interview is an effective method of data collection in clinical nursing research: A discussion paper. *International Journal of Nursing Studies*, *44*(6), 1064-1070.

Neubeck, L., Freedman, S. B., Clark, A. M., Briffa, T., Bauman, A., & Redfern, J. (2012). Participating in cardiac rehabilitation: a systematic review and meta-synthesis of qualitative data. *European journal of preventive cardiology*, *19*(3), 494-503.

Nguyen, N. H., Hadgraft, N. T., Moore, M. M., Rosenberg, D. E., Lynch, C., Reeves, M. M., & Lynch, B. M. (2017). A qualitative evaluation of breast cancer survivors' acceptance of and preferences for consumer wearable technology activity trackers. *Supportive Care in Cancer*, *25*(11), 3375-3384.

NHS UK. (2015). *National Health Service UK,*

Rights and Choices,.

Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic analysis: Striving to meet the trustworthiness criteria. *International journal of qualitative methods*, *16*(1), 1609406917733847.

Noyes, J., Booth, A., Cargo, M., Flemming, K., Garside, R., Hannes, K., Harden, A., Harris, J., Lewin, S., & Pantoja, T. (2018). Cochrane Qualitative and Implementation Methods Group guidance series—paper 1: introduction. *Journal of clinical epidemiology*, *97*, 35-38.

Noyes, J., Popay, J., Pearson, A., & Hannes, K. (2008). 20 Qualitative research and Cochrane reviews. *Cochrane handbook for systematic reviews of interventions*, 571.

Nymark, C., Mattiasson, A. C., Henriksson, P., & Kiessling, A. (2014). Emotions delay care-seeking in patients with an acute myocardial infarction. *Eur J Cardiovasc Nurs*, *13*(1), 41-47. https://doi.org/10.1177/1474515113475953

O'brien, T., Troutman-Jordan, M., Hathaway, D., Armstrong, S., & Moore, M. (2015). Acceptability of wristband activity trackers among community dwelling older adults. *Geriatric Nursing*, *36*(2), S21-S25.

O'cathain, A., Murphy, E., & Nicholl, J. (2008). The quality of mixed methods studies in health services research. *Journal of health services research & policy*, *13*(2), 92-98.

O'Donovan, G., Lee, I.-M., Hamer, M., & Stamatakis, E. (2017). Association of "weekend warrior" and other leisure time physical activity patterns with risks for all-cause, cardiovascular disease, and cancer mortality. *JAMA internal medicine*, *177*(3), 335-342.

O'Neill, D., Nicholas, O., Gale, C. P., Ludman, P., de Belder, M. A., Timmis, A., Fox, K. A., Simpson, I. A., Redwood, S., & Ray, S. G. (2017). Total center percutaneous coronary intervention volume and 30-day mortality: a contemporary national cohort study of 427 467 elective, urgent, and emergency cases. *Circulation: Cardiovascular Quality and Outcomes*, *10*(3), e003186.

Pandey, A., Salahuddin, U., Garg, S., Ayers, C., Kulinski, J., Anand, V., Mayo, H., Kumbhani, D. J., de Lemos, J., & Berry, J. D. (2016). Continuous Dose-Response Association Between Sedentary Time and Risk for Cardiovascular Disease: A Meta-analysis. *JAMA Cardiology*, *1*(5), 575-583. https://doi.org/10.1001/jamacardio.2016.1567

Pelliccia, A., Sharma, S., Gati, S., Bäck, M., Börjesson, M., Caselli, S., Collet, J.-P., Corrado, D., Drezner, J. A., & Halle, M. (2021). 2020 ESC Guidelines on sports cardiology and exercise in patients with cardiovascular disease: The Task Force on sports cardiology and exercise in patients with cardiovascular disease of the European Society of Cardiology (ESC). *European heart journal*, *42*(1), 17-96.

Pentecost, C., & Taket, A. (2011). Understanding exercise uptake and adherence for people with chronic conditions: a new model demonstrating the importance of exercise identity, benefits of attending and support. *Health Education Research*, *26*(5), 908-922. https://doi.org/10.1093/her/cyr052

Petter, M., Blanchard, C., Kemp, K. A., Mazoff, A. S., & Ferrier, S. N. (2009). Correlates of exercise among coronary heart disease patients: review, implications and future directions. *European Journal of Cardiovascular Prevention & Rehabilitation*, *16*(5), 515-526.

Phillips, A. C., Der, G., & Carroll, D. (2010). Self-reported health, self-reported fitness, and all-cause mortality: prospective cohort study. *British Journal of Health Psychology*, *15*(2), 337-346.

Piepoli, M. F., Corrà, U., Abreu, A., Cupples, M., Davos, C., Doherty, P., Höfer, S., Garcia-Porrero, E., Rauch, B., & Vigorito, C. (2015). Challenges in secondary prevention of cardiovascular diseases: a review of the current practice. *International journal of cardiology*, *180*, 114-119.

Piepoli, M. F., Corrà, U., Adamopoulos, S., Benzer, W., Bjarnason-Wehrens, B., Cupples, M., Dendale, P., Doherty, P., Gaita, D., & Höfer, S. (2014). Secondary prevention in the clinical management of patients with cardiovascular diseases. Core components, standards and outcome measures for referral and delivery: a policy statement from the cardiac rehabilitation section of the European Association for Cardiovascular Prevention & Rehabilitation. Endorsed by the Committee for Practice Guidelines of the European Society of Cardiology. *European journal of preventive cardiology*, *21*(6), 664-681.

Piepoli, M. F., Hoes, A. W., Agewall, S., Albus, C., Brotons, C., Catapano, A. L., Cooney, M.-T., Corrà, U., & Cosyns, B. (2016). 2016 European Guidelines on cardiovascular disease prevention in clinical practice: The Sixth Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular Disease Prevention in Clinical Practice (constituted by representatives of 10 societies and by invited experts) Developed with the special contribution of the European Association for Cardiovascular Prevention & Rehabilitation (EACPR). *European journal of preventive cardiology*, *23*(11), NP1-NP96.

Plano Clark, V. L. (2016). *Mixed methods research : a guide to the field*. SAGE Publications Inc.

Powell, R., McGregor, G., Ennis, S., Kimani, P. K., & Underwood, M. (2018). Is exercise-based cardiac rehabilitation effective? A systematic review and meta-analysis to re-examine the evidence. *BMJ open*, *8*(3), e019656.

Price, K. J., Gordon, B. A., Bird, S. R., & Benson, A. C. (2020). Acute cardiovascular responses to interval exercise: A systematic review and meta-analysis. *Journal of Sports Sciences*, *38*(9), 970-984.

Puymirat, E., Simon, T., Cayla, G., Cottin, Y., Elbaz, M., Coste, P., Lemesle, G., Motreff, P., Popovic, B., & Khalife, K. (2017). Acute myocardial infarction: changes in patient characteristics, management, and 6-month outcomes over a period of 20 years in the FAST-MI Program (French Registry of Acute ST-Elevation or Non-ST-Elevation Myocardial Infarction) 1995 to 2015. *Circulation*, *136*(20), 1908-1919.

Rattray, J., & Jones, M. C. (2007). Essential elements of questionnaire design and development. *Journal of Clinical Nursing*, *16*(2), 234-243.

Raungratanaamporn, S., Yunibhand, J., & Jitpanya, C. (2015). Factors predicting physical activity after hospitalization among new coronary artery disease patients. *Journal of Health Research*, *29*(2), 127-133.

Reges, O., Vilchinsky, N., Leibowitz, M., Khaskia, A., Mosseri, M., & Kark, J. D. (2013). Illness cognition as a predictor of exercise habits and participation in cardiac prevention and rehabilitation programs after acute coronary syndrome. *BMC public health*, *13*(1), 956.

Reid, R. D., Morrin, L. I., Higginson, L. A. J., Wielgosz, A., Blanchard, C., Beaton, L. J., Nelson, C., McDonnell, L., Oldridge, N., Wells, G. A., & Pipe, A. L. (2012). Motivational counselling for physical activity in patients with coronary artery disease not participating in cardiac rehabilitation. *European journal of preventive cardiology*, *19*(2), 161-166. https://doi.org/10.1177/1741826711400519

Reid, R. D., Morrin, L. I., Pipe, A. L., Dafoe, W. A., Higginson, L. A., Wielgosz, A. T., McDonald, P. W., Plotnikoff, R. C., Courneya, K. S., & Oldridge, N. B. (2006). Determinants of physical activity after hospitalization for coronary artery disease: the Tracking Exercise After Cardiac Hospitalization (TEACH) Study. *European Journal of Cardiovascular Prevention & Rehabilitation*, *13*(4), 529-537.

Renner, B., Knoll, N., & Schwarzer, R. (2000). Age and body make a difference in optimistic health beliefs and nutrition behaviors. *International Journal of Behavioral Medicine*, *7*(2), 143-159.

Resurreccion, D. M., Motrico, E., Rigabert, A., Rubio-Valera, M., Conejo-Ceron, S., Pastor, L., & Moreno-Peral, P. (2017). Barriers for nonparticipation and dropout of women in cardiac rehabilitation programs: a systematic review. *Journal of women's health*, *26*(8), 849-859.

Rettke, H., Pretto, M., Spichiger, E., Frei, I. A., & Spirig, R. (2018). Using reflexive thinking to establish rigor in qualitative research. *Nursing Research*, *67*(6), 490-497.

Rise, J., Sheeran, P., & Hukkelberg, S. (2010). The role of self-identity in the theory of planned behavior: A meta-analysis. *Journal of Applied Social Psychology*, *40*(5), 1085-1105.

Robertson, S., Sheikh, K., & Moore, A. (2010). Embodied masculinities in the context of cardiac rehabilitation. *Sociology of Health & Illness*, *32*, 695-710. https://doi.org/10.1111/j.1467-9566.2010.01249.x

Roffi, M., Patrono, C., Collet, J.-P., Mueller, C., Valgimigli, M., Andreotti, F., Bax, J. J., Borger, M. A., Brotons, C., & Chew, D. P. (2016). 2015 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation: Task Force for the Management of Acute Coronary Syndromes in Patients Presenting without Persistent ST-Segment Elevation of the European Society of Cardiology (ESC). *European heart journal*, *37*(3), 267-315.

Rogerson, M. C., Murphy, B. M., Bird, S., & Morris, T. (2012). “I don’t have the heart”: a qualitative study of barriers to and facilitators of physical activity for people with coronary heart disease and depressive symptoms. *International Journal of Behavioral Nutrition and Physical Activity*, *9*(1), 1-9.

Rognmo, Ø., Moholdt, T., Bakken, H., Hole, T., Mølstad, P., Myhr, N. E., Grimsmo, J., & Wisløff, U. (2012). Cardiovascular risk of high-versus moderate-intensity aerobic exercise in coronary heart disease patients. *Circulation*, *126*(12), 1436-1440.

Rowley, J. (2014). Designing and using research questionnaires. *Management Research Review*, *37*(3), 308-330.

Sales, M., Levinger, P., & Polman, R. (2017). Relationships between self perceptions and physical activity behaviour, fear of falling, and physical function among older adults. *European review of aging and physical activity*, *14*(1), 17.

Sallis, J. F., & Saelens, B. E. (2000). Assessment of physical activity by self-report: status, limitations, and future directions. *Research quarterly for exercise and sport*, *71*(sup2), 1-14.

Samayoa, L., Grace, S. L., Gravely, S., Scott, L. B., Marzolini, S., & Colella, T. J. (2014). Sex differences in cardiac rehabilitation enrollment: a meta-analysis. *Canadian Journal of Cardiology*, *30*(7), 793-800.

Sattelmair, J., Pertman, J., Ding, E. L., Kohl III, H. W., Haskell, W., & Lee, I.-M. (2011). Dose response between physical activity and risk of coronary heart disease: a meta-analysis. *Circulation*, *124*(7), 789-795.

Sawyer, A., Ucci, M., Jones, R., Smith, L., & Fisher, A. (2017). Simultaneous evaluation of physical and social environmental correlates of physical activity in adults: A systematic review. *SSM-population health*, *3*, 506-515.

Schunk, D. H., & DiBenedetto, M. K. (2020). Motivation and social cognitive theory. *Contemporary Educational Psychology*, *60*, 101832.

Schwarzer, R. (2008). Modeling health behavior change: how to predict and modify the adoption and maintenance of health behaviors. *Applied Psychology: An International Review*, *57*(1), 1-29.

Schwarzer, R., Ziegelmann, J. P., Luszczynska, A., Scholz, U., & Lippke, S. (2008). Social-cognitive predictors of physical exercise adherence: three longitudinal studies in rehabilitation. *Health Psychology*, *27*, S54-63.

Scottish Government. (2018). *Scottish Household Survey, Scotland's People Annual Report 2017*. Retrieved from file:///C:/Users/40189990/AppData/Local/Packages/Microsoft.MicrosoftEdge_8wekyb3d8bbwe/TempState/Downloads/00539979.pdf

Scottish Intercollegiate Guidelines Network 148. (2016). *Acute coronary syndrome, SIGN* (978 1 909103 44 3) http://www.sign.ac.uk

Scottish Intercollegiate Guidelines Network. (2017). *SIGN 150, Cardiac Rehabilitation, A national clinical guideline*. http://www.sign.ac.uk/sign-150-cardiac-rehabilitation.html

Selzler, A.-M., Rodgers, W. M., Berry, T. R., & Stickland, M. K. (2016). The importance of exercise self-efficacy for clinical outcomes in pulmonary rehabilitation. *Rehabilitation Psychology*, *61*(4), 380-388. https://doi.org/10.1037/rep0000106

Setia, M. S. (2016a). Methodology series module 2: case-control studies. *Indian journal of dermatology*, *61*(2), 146.

Setia, M. S. (2016b). Methodology series module 3: Cross-sectional studies. *Indian journal of dermatology*, *61*(3), 261.

Shan, L., Saxena, A., & McMahon, R. (2014). A systematic review on the quality of life benefits after percutaneous coronary intervention in the elderly. *Cardiology*, *129*(1), 46-54. https://doi.org/10.1159/000360603

Shavelson, R. J., Hubner, J. J., & Stanton, G. C. (1976). Self-concept: Validation of construct interpretations. *Review of Educational Research*, *46*(3), 407-441. https://doi.org/10.2307/1170010

Shaw, R., Gillies, M., Barber, J., MacIntyre, K., Harkins, C., Findlay, I. N., McCloy, K., Gillie, A., Scoular, A., & MacIntyre, P. D. (2012). Pre-exercise screening and health coaching in CHD secondary prevention: a qualitative study of the patient experience. *Health Education Research*, *27*(3), 424-436. https://doi.org/10.1093/her/cys005

Smith, B., & McGannon, K. R. (2018). Developing rigor in qualitative research: Problems and opportunities within sport and exercise psychology. *International review of sport and exercise psychology*, *11*(1), 101-121.

Smith, R., Frazer, K., Hall, P., Hyde, A., & O'Connor, L. (2017). 'Betwixt and between health and illness'–women's narratives following acute coronary syndrome. *Journal of Clinical Nursing*, *26*(21-22), 3457-3470.

Sniehotta, F. F., Gorski, C., & Araujo-Soares, V. (2010). Adoption of community-based cardiac rehabilitation programs and physical activity following phase III cardiac rehabilitation in Scotland: A prospective and predictive study. *Psychology & Health*, *25*(7), 839-854. https://doi.org/10.1080/08870440902915915

Sniehotta, F. F., Scholz, U., & Schwarzer, R. (2005). Bridging the intention-behaviour gap: planning, self-efficacy, and action control in the adoption and maintenance of physical exercise. *Psychology & Health*, *20*(2), 143-160.

Southern, D. A., Ngo, J., Martin, B.-J., Galbraith, P. D., Knudtson, M. L., Ghali, W. A., James, M. T., & Wilton, S. B. (2014). Characterizing types of readmission after acute coronary syndrome hospitalization: implications for quality reporting. *Journal Of The American Heart Association*, *3*(5), e001046-e001046. https://doi.org/10.1161/JAHA.114.001046

Stamm-Balderjahn, S., Brünger, M., Michel, A., Bongarth, C., & Spyra, K. (2016). The efficacy of goal setting in cardiac rehabilitation—A gender-specific randomized controlled trial. *Deutsches Ärzteblatt International*, *113*, 525-531.

Steca, P., Pancani, L., Cesana, F., Fattirolli, F., Giannattasio, C., Greco, A., D'Addario, M., Monzani, D., Cappelletti, E. R., Magrin, M. E., Miglioretti, M., Sarini, M., Scrignaro, M., Vecchio, L., & Franzelli, C. (2017). Changes in physical activity among coronary and hypertensive patients: A longitudinal study using the Health Action Process Approach. *Psychology & Health*, *32*(3), 361-380. https://doi.org/10.1080/08870446.2016.1273353

Stewart, L., Moher, D., & Shekelle, P. (2012). Why prospective registration of systematic reviews makes sense [journal article]. *Systematic Reviews*, *1*(1), 7. https://doi.org/10.1186/2046-4053-1-7

Stewart, R., Held, C., Brown, R., Vedin, O., Hagstrom, E., Lonn, E., Armstrong, P., Granger, C. B., Hochman, J., & Davies, R. (2013). Physical activity in patients with stable coronary heart disease: an international perspective. *European heart journal*, *34*(42), 3286-3293.

Stewart, R. A., Held, C., Hadziosmanovic, N., Armstrong, P. W., Cannon, C. P., Granger, C. B., Hagström, E., Hochman, J. S., Koenig, W., & Lonn, E. (2017). Physical activity and mortality in patients with stable coronary heart disease. *Journal of the American College of Cardiology*, *70*(14), 1689-1700.

Stolker, J. M., Cohen, D. J., Kennedy, K. F., Pencina, M. J., Lindsey, J. B., Mauri, L., Cutlip, D. E., & Kleiman, N. S. (2012). Repeat revascularization after contemporary percutaneous coronary intervention: an evaluation of staged, target lesion, and other unplanned revascularization procedures during the first year. *Circulation. Cardiovascular Interventions*, *5*(6), 772-782. https://doi.org/10.1161/CIRCINTERVENTIONS.111.967802

Strauss, A. L. (1998). *Basics of qualitative research : techniques and procedures for developing grounded theory* (2nd ed. ed.). Thousand Oaks, Calif.

London : Sage.

Sumner, J., Grace, S. L., & Doherty, P. (2016). Predictors of cardiac rehabilitation utilization in England: results from the national audit. *Journal Of The American Heart Association*, *5*(10), e003903.

Supervía, M., Medina-Inojosa, J. R., Yeung, C., Lopez-Jimenez, F., Squires, R. W., Pérez-Terzic, C. M., Brewer, L. C., Leth, S. E., & Thomas, R. J. (2017). Cardiac rehabilitation for women: a systematic review of barriers and solutions. Mayo Clinic Proceedings,

Taherzadeh, G., Reid, R. D., Prince, S. A., Blanchard, C. M., Chessex, C., Harris, J., Pipe, A. L., & Grace, S. L. (2018). Amount and socio-ecological correlates of exercise in men and women at cardiac rehabilitation completion. *American journal of physical medicine & rehabilitation*, *97*(11), 816-824.

Tang, L. H., Zwisler, A.-D., Berg, S. K., Doherty, P., Taylor, R. S., & Langberg, H. (2017). Is the cardiovascular response equivalent between a supervised center-based setting and a self-care home-based setting when rating of perceived exertion is used to guide aerobic exercise intensity during a cardiac rehabilitation program? *American journal of physical medicine & rehabilitation*, *96*(6), 381-387.

Tashakkori, A., & Teddlie, C. (2010). *Sage handbook of mixed methods in social & behavioral research*. Sage.

Taylor, R. S. (2012). The RAMIT trial: its results in the context of 2012 Cochrane review. *Heart*, *98*(8), 672-673.

ter Hoeve, N., Huisstede, B. M. A., Stan, H. J., van Domburg, R. T., Sunamura, M., & van den Berg-Emons, R. J. G. (2015). Does Cardiac Rehabilitation After an Acute Cardiac Syndrome Lead to Changes in Physical Activity Habits? Systematic Review. *Physical Therapy*, *95*(2), 167-179. https://doi.org/10.2522/ptj.20130509

Thomas, J., & Harden, A. (2008). Methods for the thematic synthesis of qualitative research in systematic reviews. *BMC medical research methodology*, *8*, 45-45. https://doi.org/10.1186/1471-2288-8-45

Thompson, P. D., Franklin, B. A., Balady, G. J., Blair, S. N., Corrado, D., Estes, N. A., 3rd, Fulton, J. E., Gordon, N. F., Haskell, W. L., Link, M. S., Maron, B. J., Mittleman, M. A., Pelliccia, A., Wenger, N. K., Willich, S. N., & Costa, F. (2007). Exercise and acute cardiovascular events placing the risks into perspective: a scientific statement from the American Heart Association Council on Nutrition, Physical Activity, and Metabolism and the Council on Clinical Cardiology. *Circulation*, *115*(17), 2358-2368.

Thoolen, B., De Ridder, D., Bensing, J., Gorter, K., & Rutten, G. (2008). No worries, no impact? A systematic review of emotional, cognitive, and behavioural responses to the diagnosis of type 2 diabetes. *Health Psychology Review*, *2*(1), 65-93.

Thorogood, A., Mottillo, S., Shimony, A., Filion, K. B., Joseph, L., Genest, J., Pilote, L., Poirier, P., Schiffrin, E. L., & Eisenberg, M. J. (2011). Isolated aerobic exercise and weight loss: a systematic review and meta-analysis of randomized controlled trials. *The American journal of medicine*, *124*(8), 747-755.

Tonet, E., Pavasini, R., Biscaglia, S., & Campo, G. (2019). Frailty in patients admitted to hospital for acute coronary syndrome: when, how and why? *Journal of geriatric cardiology: JGC*, *16*(2), 129.

Tong, A., Flemming, K., McInnes, E., Oliver, S., & Craig, J. (2012). Enhancing transparency in reporting the synthesis of qualitative research: ENTREQ. *BMC medical research methodology*, *12*(1), 181-181. https://doi.org/10.1186/1471-2288-12-181

Tong, A., Sainsbury, P., & Craig, J. (2007). Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*, *19*(6), 349-357. https://doi.org/10.1093/intqhc/mzm042

Turner, K. M., Winder, R., Campbell, J. L., Richards, D. A., Gandhi, M., Dickens, C. M., & Richards, S. (2017). Patients’ and nurses’ views on providing psychological support within cardiac rehabilitation programmes: a qualitative study. *BMJ open*, *7*(9).

van ‘t Riet, J., & Ruiter, R. A. (2013). Defensive reactions to health-promoting information: An overview and implications for future research. *Health Psychology Review*, *7*(sup1), S104-S136.

van Stralen, M. M., De Vries, H., Mudde, A. N., Bolman, C., & Lechner, L. (2009). Determinants of initiation and maintenance of physical activity among older adults: a literature review. *Health Psychology Review*, *3*(2), 147-207.

Vogel, J., Auinger, A., Riedl, R., Kindermann, H., Helfert, M., & Ocenasek, H. (2017). Digitally enhanced recovery: Investigating the use of digital self-tracking for monitoring leisure time physical activity of cardiovascular disease (CVD) patients undergoing cardiac rehabilitation. *PloS one*, *12*(10), e0186261.

Von Elm, E., Altman, D. G., Egger, M., Pocock, S. J., Gøtzsche, P. C., & Vandenbroucke, J. P. (2007). The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *Bulletin of the World Health Organization*, *85*, 867-872.

Warner, R. M. (2008). *Applied statistics: From bivariate through multivariate techniques*. sage.

West, R. R., Jones, D. A., & Henderson, A. H. (2012). Rehabilitation after myocardial infarction trial (RAMIT): multi-centre randomised controlled trial of comprehensive cardiac rehabilitation in patients following acute myocardial infarction. *Heart*, *98*(8), 637-644.

Whitelaw, S., Sullivan, K., Eliya, Y., Alruwayeh, M., Thabane, L., Yancy, C. W., Mehran, R., Mamas, M. A., & Van Spall, H. G. (2021). Trial characteristics associated with under-enrolment of females in randomized controlled trials of heart failure with reduced ejection fraction: a systematic review. *European journal of heart failure*, *23*(1), 15-24.

Wilkins, E., Wilson, L., Wickramasinghe, K., Bhatnagar, P., Leal, J., Luengo-Fernandez, R., Burns, R., Rayner, M., & Townsend, N. (2017). European cardiovascular disease statistics 2017.

Williams, P. T., & Thompson, P. D. (2014). Increased cardiovascular disease mortality associated with excessive exercise in heart attack survivors. *Mayo Clinic Proceedings*, *89*(9), 1187-1194. https://doi.org/10.1016/j.mayocp.2014.05.006

Wolf, A., Vella, R., & Fors, A. (2019). The impact of person-centred care on patients’ care experiences in relation to educational level after acute coronary syndrome: secondary outcome analysis of a randomised controlled trial. *European Journal of Cardiovascular Nursing*, *18*(4), 299-308.

Woodgate, J., & Brawley, L. R. (2008). Self-efficacy for exercise in cardiac rehabilitation: review and recommendations. *Journal Of Health Psychology*, *13*(3), 366-387.

World Health Organisation. (2016). *World Health Organisation Factsheet,*. http://www.who.int/mediacentre/factsheets/fs317/en/

World Health Organisation. (2020). *Coronavirus disease (COVID-19) pandemic*. Retrieved May 25, 2020 from https://www.who.int/emergencies/diseases/novel-coronavirus-2019?gclid=EAIaIQobChMI3sPFprLR6QIVhe3tCh1rfAG7EAAYASAAEgKR6PD_BwE

World Heart Federation. (2017). *Cardiovascular Diseases (CVD's) Global Facts and Figures*. https://www.world-heart-federation.org/wp-content/uploads/2017/05/WCC2016_CVDs_infographic-1.pdf

Xie, B., Yan, X., Cai, X., & Li, J. (2017). Effects of high-intensity interval training on aerobic capacity in cardiac patients: a systematic review with meta-analysis. *BioMed research international*, *2017*.

Yusuf, S., Hawken, S., Ounpuu, S., Dans, T., Avezum, A., Lanas, F., McQueen, M., Budaj, A., Pais, P., Varigos, J., & Lisheng, L. (2004). Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. *Lancet (London, England)*, *364*(9438), 937-952.

Zheng, X., Zheng, Y., Ma, J., Zhang, M., Zhang, Y., Liu, X., Chen, L., Yang, Q., Sun, Y., & Wu, J. (2019). Effect of exercise-based cardiac rehabilitation on anxiety and depression in patients with myocardial infarction: a systematic review and meta-analysis. *Heart & Lung*, *48*(1), 1-7.

Appendix 2: Search strategy

Medline (EBSCO) Search Strategy 4 Oct 2017

#	Query	Limiters/Expanders	Results
1	(MH "Myocardial Revascularization+")	Search modes - Boolean/Phrase	86,183
2	TI (myocardial revascularization" or "myocardial revascularisation" or "cardi* revascularization" or "cardi* revascularisation) OR AB (myocardial revascularization" or "myocardial revascularisation" or "cardi* revascularization" or "cardi* revascularisation)	Search modes - Boolean/Phrase	1
3	TI coronary N3 angioplast* OR AB coronary N3 angioplast*	Search modes - Boolean/Phrase	14,831
4	TI ("coronary artery bypass" or CABG or "aortocoronary bypass" or "coronary bypass") OR AB ("coronary artery bypass" or CABG or "aortocoronary bypass" or "coronary bypass")	Search modes - Boolean/Phrase	46,744
5	(MH "Percutaneous Coronary Intervention+")	Search modes - Boolean/Phrase	44,923
6	TI (percutaneous coronary intervention*" or PCI or "coronary angioplast*") OR AB (percutaneous coronary intervention*" or PCI or "coronary angioplast*")	Search modes - Boolean/Phrase	111
7	(MH "Heart Diseases+")	Search modes - Boolean/Phrase	1,012,497
8	TI ("cardiac disease*" or "heart disease*") OR AB ("cardiac disease*" or "heart disease*")	Search modes - Boolean/Phrase	159,049
9	TI (("myocardial ischemia" or "myocardial ischaemia" or "ischemic heart disease" or "ischaemic heart disease") OR AB (("myocardial ischemia" or "myocardial ischaemia" or "ischemic heart disease" or "ischaemic heart disease")	Search modes - Boolean/Phrase	57,357
10	TI (("acute coronary syndrome" or ACS) OR AB (("acute coronary syndrome" or ACS)	Search modes - Boolean/Phrase	26,450
11	TI (("myocardial infarct*" or "heart attack*") OR AB (("myocardial infarct*" or "heart attack*")	Search modes - Boolean/Phrase	174,053
12	S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11	Search modes - Boolean/Phrase	1,141,305
13	(MH "Rehabilitation+")	Search modes - Boolean/Phrase	262,968
14	TI rehabilitat* OR AB rehabilitat*	Search modes - Boolean/Phrase	135,942

15	TI habilitation OR AB habilitation	Search modes - Boolean/Phrase	871
16	(MH "Physical and Rehabilitation Medicine")	Search modes - Boolean/Phrase	2,977
17	(MH "Rehabilitation Centers")	Search modes - Boolean/Phrase	7,633
18	(MH "Rehabilitation Nursing")	Search modes - Boolean/Phrase	1,293
19	"secondary prevention"	Search modes - Boolean/Phrase	30,535
20	S13 OR S14 OR S15 OR S16 OR S17 OR S18 OR S19	Search modes - Boolean/Phrase	390,271
21	(MH "Exercise+")	Search modes - Boolean/Phrase	155,076
22	(MH "Exercise Therapy+")	Search modes - Boolean/Phrase	40,055
23	(MH "Sports+")	Search modes - Boolean/Phrase	155,789
24	(MH "Physical Fitness")	Search modes - Boolean/Phrase	24,874
25	(MH "Physical Education and Training")	Search modes - Boolean/Phrase	12,905
26	(MH "Physical Exertion")	Search modes - Boolean/Phrase	54,901
27	TI (exercis* or "physical exercis*") OR AB (exercis* or "physical exercis*")	Search modes - Boolean/Phrase	246,727
28	TI sport* OR AB sport*	Search modes - Boolean/Phrase	58,242
29	TI ((physical* N3 (fit* or fitness or train* or therap* or activit*))) OR AB ((physical* N3 (fit* or fitness or train* or therap* or activit*)))	Search modes - Boolean/Phrase	121,922
30	TI ((train* N4 (strength* or aerobic* or exercis*)).) OR AB ((train* N4 (strength* or aerobic* or exercis*)).)	Search modes - Boolean/Phrase	30,856
31	TI ((fitness or exertion*)) OR AB ((fitness or exertion*))	Search modes - Boolean/Phrase	75,635
32	S21 OR S22 OR S23 OR S24 OR S25 OR S26 OR S27 OR S28 OR S29 OR S30 OR S31	Search modes - Boolean/Phrase	565,153
33	S12 AND S20	Search modes - Boolean/Phrase	26,243
34	S32 AND S33	Search modes - Boolean/Phrase	8,213
35	S32 AND S33	Limiters - Date of Publication: 19900101-20171231; English Language; Age Related: All Adult: 19+ years Search modes - Boolean/Phrase	3,207

36	(MH "Qualitative Research+") or (MH "Grounded Theory")	Limiters - Date of Publication: 19900101-20171231; English Language; Age Related: All Adult: 19+ years Search modes - Boolean/Phrase	19,658
37	(MH "Narration")	Limiters - Date of Publication: 19900101-20171231; English Language; Age Related: All Adult: 19+ years Search modes - Boolean/Phrase	2,650
38	(MH "Focus Groups")	Limiters - Date of Publication: 19900101-20171231; English Language; Age Related: All Adult: 19+ years Search modes - Boolean/Phrase	12,660
39	(MH "Interviews as Topic")	Limiters - Date of Publication: 19900101-20171231; English Language; Age Related: All Adult: 19+ years Search modes - Boolean/Phrase	29,402
40	TX ("semi-structured" or semistructured or unstructured or informal or "in-depth" or indepth or "face-to-face" or structured or guide) N3 (interview* or discussion* or questionnaire*) OR TX ((focus group* or qualitative or ethnograph* or fieldwork or "field work" or "key informant") or (TX life experiences or TX human science or TX discourse* analysis or TX narrative analysis or TX lived experience* or TX field research or TX field studies or TX field study or TX giorgi* or TX husserl* or TX merleau ponty* or TX van kaam* or TX van manen* or TX spiegelberg* or TX colaizzi* or TX heidegger* or TX participant observ* or TX data saturat* or TX semiotics or TX heuristic or TX hermeneutic* or TX etic or TX emic or TX focus group* or TX purpos* sampl* or TX constant comparison or TX constant comparative or TX grounded research or TX grounded studies or TX grounded study or TX grounded theor* or TX phenomenol* or TX ethnon* or TX qualitative)	Limiters - Date of Publication: 19900101-20171231; English Language; Age Related: All Adult: 19+ years Search modes - Boolean/Phrase	125,146
41	S36 OR S37 OR S38 OR S39 OR S40	Search modes - Boolean/Phrase	140,464
42	S35 AND S41	Search modes - Boolean/Phrase	158

Embase Search Strategy 13 Oct 2017

1. exp Myocardial Revascularization/

2. ("myocardial revascularization" or "myocardial revascularisation" or "cardi* revascularization" or "cardi* revascularisation").ti,ab.

3. (coronary adj3 angioplast*).ti,ab.

4. ("coronary artery bypass" or CABG or "aortocoronary bypass" or "coronary bypass").ti,ab.

5. exp Percutaneous Coronary Intervention/

6. ("percutaneous coronary intervention*" or PCI or "coronary angioplast*").ti,ab.

7. exp Heart Diseases/

8. ("cardiac disease*" or "heart disease*").ti,ab.

9. ("myocardial ischemia" or "myocardial ischaemia" or "ischemic heart disease" or "ischaemic heart disease").ti,ab.

10. ("acute coronary syndrome" or ACS).ti,ab.

11. ("myocardial infarct*" or "heart attack*").ti,ab.

12. or/1-11

13. exp Rehabilitation/

14. rehabilitat*.ti,ab.

15. habilitation.ti,ab.

16. "Physical and Rehabilitation Medicine"/

17. Rehabilitation Centers/

18. Rehabilitation Nursing/

19. "secondary prevention".mp.

20. or/13-19

21. exp Exercise/

22. exp Exercise Therapy/

23. exp Sports/

24. Physical Fitness/

25. "Physical Education and Training"/

26. Physical Exertion/

27. (exercis* or "physical exercis*").ti,ab.

28. sport*.ti,ab.

29. (physical* adj3 (fit* or fitness or train* or therap* or activit*)).ti,ab.

30. (train* adj4 (strength* or aerobic* or exercis*)).ti,ab.

31. (fitness or exertion*).ti,ab.

32. or/21-31

33. 12 and 20

34. 32 and 33

35. limit 34 to (yr="1990 -Current" and adult <18 to 64 years>)

36. qualitative research/ or grounded theory/

37. (qualitative or qualitative study).tw.

38. (("semi-structured" or semistructured or unstructured or informal or "in-depth" or indepth or "face-to-face" or structured or guide) adj3 (interview* or discussion* or questionnaire*)).tw.

39. (focus group* or qualitative or ethnograph* or fieldwork or "field work" or "key informant").mp. or (life experiences or human science or discourse* analysis or narrative analysis or lived experience* or field research or field studies or field study or giorgi* or husserl* or merleau ponty* or van kaam* or van manen* or spiegelberg* or colaizzi* or heidegger* or participant observ* or data saturat* or semiotics or heuristic or hermeneutic* or etic or emic or focus group* or purpos* sampl* or constant comparison or constant comparative or grounded research or grounded studies or grounded study or grounded theor* or phenomenol* or ethnon*).tw. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word]

40. or/36-39

41. 35 and 40

Appendix 3: PEO screening selection tool

Details of study

Title:

Authors:

Source:

Reviewer's name: **Date:**		
	Criteria	**Complete this column Yes/No or undecided**
Participants:	Are the adults aged 18 years and above? Does the study include individuals diagnosed with ACS, MI, NSTEMI, STEMI, Heart attack, unstable angina, including post CABG and PCI?	
Exposure:	Are or have the individuals attended Cardiac rehabilitation? Or, exposed to secondary prevention advice?	
Outcomes:	Is the data collected from participant views, or experience, or perceptions or perspectives of **previous** physical activity, fitness, exercise, exertion experience prior to ACS or cardiac rehab?	
Data Collection:	Is the data collected from semi structured, structured or focus group interviews?	
Action with rationale	Include study in review?	

Appendix 4: Reviewer discussion re study inclusion/exclusion

The following five Abstracts were included in SMcH but were not included in CH list. Discussion as follows:

Author	Title	Participants	Exposure	Outcomes	Inclusion/Exclusion
Rankin, S.,H., et al. (2002)	Recovery trajectory of unpartnered elders after myocardial infarction: an analysis of daily diaries	Yes – individuals with MI (65 yrs.)	No – they were not attending Cardiac rehab or secondary prevention	No – it was a daily diary with Likert scales	No – do not include based on Exposure and Outcome result
Sriskantharajah, J., & Kai, J., (2007)	Promoting physical activity amount south Asian women with coronary heart disease and diabetes: what might help?	Yes – women with CHD and/or diabetes (26-70 yrs.)	No cardiac rehab or secondary prevention mentioned (identified from GP practice)	Yes – semi structured interview	No – do not include based on Exposure result
Condon, C., & McCarthy, G., (2006)	Lifestyle changes following acute myocardial infarction: patients perspectives	Yes – AMI (53 yrs.)	Yes – they were identified from phase 1 cardiac rehab	No - Semi structured interviews were about lifestyle changes - not specific for exercise	No – do not include based on Outcome result
Mohan, S., et al. (2008)	Lifestyle of Asian Indians with coronary heart disease: the Australian context (2008)	Unsure – study doesn't confirm diagnosis of CHD (31 – 80 yrs.)	No – not attending cardiac rehab – recruited from media advertising and included family members	No – semi structured views of lifestyle not specific to exercise	No – do not include based on Exposure and Outcomes result
Al-Hassan, M., & Wierenga, M., (2000)	Exercise participation decisions of Jordanian myocardial infarction patients: application of the decisional conflict theory	Yes – uncomplicated MI patients (50 yrs.)	No – attending cardiology clinics but discharged from hospital 6 months to 1 year prior to data collection	No – data collected by quantitative measures	No – do not include based on Exposure and Outcome result

Appendix 5: Bank of descriptive codes to inform analytical themes

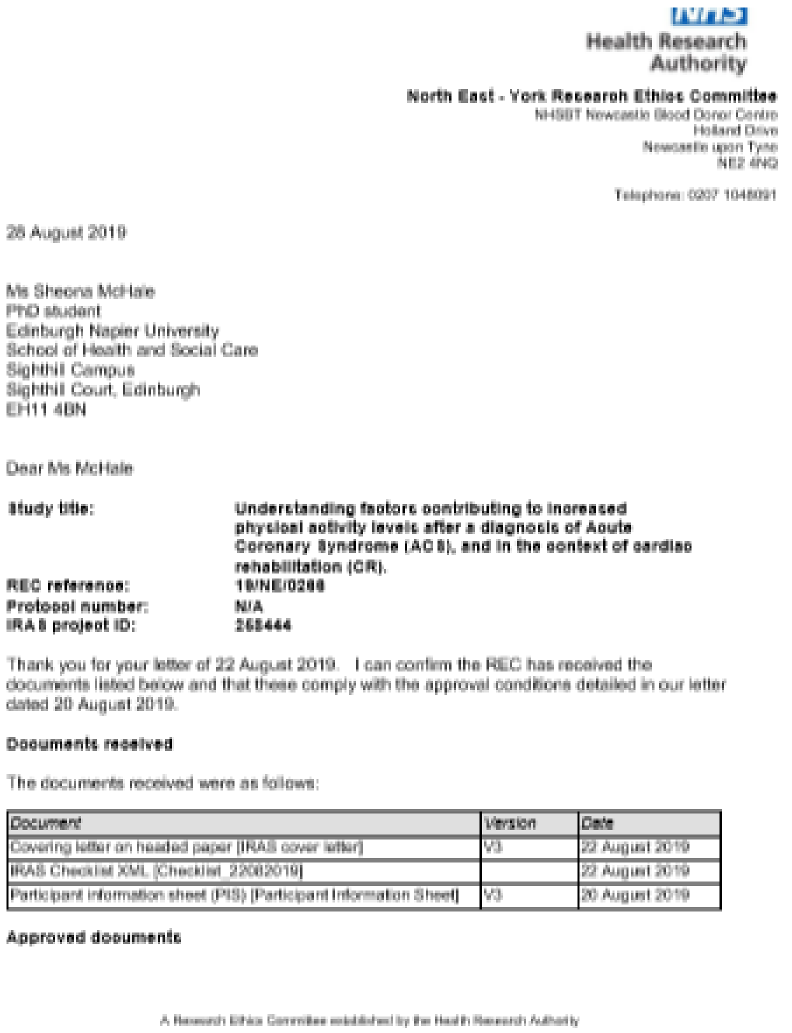
How does previous experience of physical activity influence engagement in physical activity during cardiac rehabilitation?

Codes & Descriptive Themes (hierarchical code)

Codes	Descriptive code	Suggested hierarchical themes	Analytical themes
I got more confident so don't need support	Self confidence	Perceptions of self-confidence and perceptions of self-reliance	Self-perceptions of an exercise identity
High level of self-efficacy - ability			
I know what to do			
I can do it			
Regaining confidence with exercise			
Loss of confidence			
Exercise is natural	Physical/psychological self-reliance		
Belief in ability to exercise independent of experts			
Non-attendance and continuing exercise			
Managing emotions			
I can do it better myself			
Feeling the need to increase effort			
working harder than before			
Fitter than CR norm			
Can perform activities with no limitations after surgery			
Capable of managing CHD			
Able to put body under pressure			
I can do it myself			
Mild heart attack	severity of illness	Perceptions of severity of cardiac condition	
Fear of exertion levels			
social and psychological benefits			
Restricted by medical orders			
Awareness of mortality			
Reduced severity of illness			
Not limited by surgery			
I am fitter than before	A Fitness Identity	Perceptions of fitness identity	
Self-image –v- CR image			
I have been a fit man			
I am fit based on perceptions of stereotyped sedentary retirement activities			
Resisting diagnostic labels			
I am Fit and a threatened self			
Seeking support from CR re exertion levels		Motivators to exercise	

Motivated by habit and altered to include health beliefs	**motivation**		
Enjoying exercise			
Returning to normal			
Enjoying competition			
Pre-existing motivational strategies			
Exercise is a habit			
Motivated by fitness			
Motivated to be active			
CR exercise aimed at an older age	**Age comparisons with CR exercise**	**Age appropriateness of CR**	**Experience of exercise-based Perceptions of CR**
I am young			
Age is natural			
Too old for CR exercise			
Age appropriate exercise			
Preference for alternative activities to CR	**Appropriateness of exercise during CR**	**Appropriateness of CR exercise**	
Already Active – don't need to attend			
exercise has limitations when compared to medical intervention			
CR exercise too strenuous - Don't want to overdo it			
Preference for daily activities			
Concerns re CR exertion levels			
Activities not as intense as CR			
Occupational exercise is enough			
Preference for familiar exercise			
Seeking emotional support	**Expectations of CR exercise**	**communication**	**Communication Factors**
Did not meet expectations			
Expected exercise support			
Trusting in the experts			
Expecting a range of activities			
Seeking individualised exercise goals			
Accessing exercise advice			
Uncertain of purpose of CR	**Post-event advice/communication**		
Unconvincing communication			
CR defined as exercise			
CR an aid return to a level of functioning			

Appendix 6: Health Research Authority favourable opinion



Health Research
Authority

North East - York Research Ethics Committee
NHSBT Newcastle Blood Donor Centre
Holland Drive
Newcastle upon Tyne
NE2 4NQ

Telephone: 0207 1048091

28 August 2019

Ms Sheona McHale
PhD student
Edinburgh Napier University
School of Health and Social Care
Sighthill Campus
Sighthill Court, Edinburgh
EH11 4BN

Dear Ms McHale

Study title:	**Understanding factors contributing to increased physical activity levels after a diagnosis of Acute Coronary Syndrome (ACS), and in the context of cardiac rehabilitation (CR).**
REC reference:	**19/NE/0266**
Protocol number:	**N/A**
IRAS project ID:	**265444**

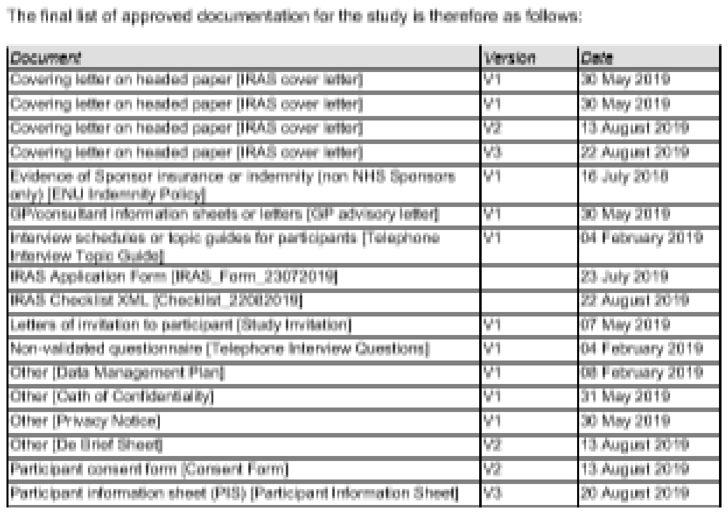
Thank you for your letter of 22 August 2019. I can confirm the REC has received the documents listed below and that these comply with the approval conditions detailed in our letter dated 20 August 2019.

Documents received

The documents received were as follows:

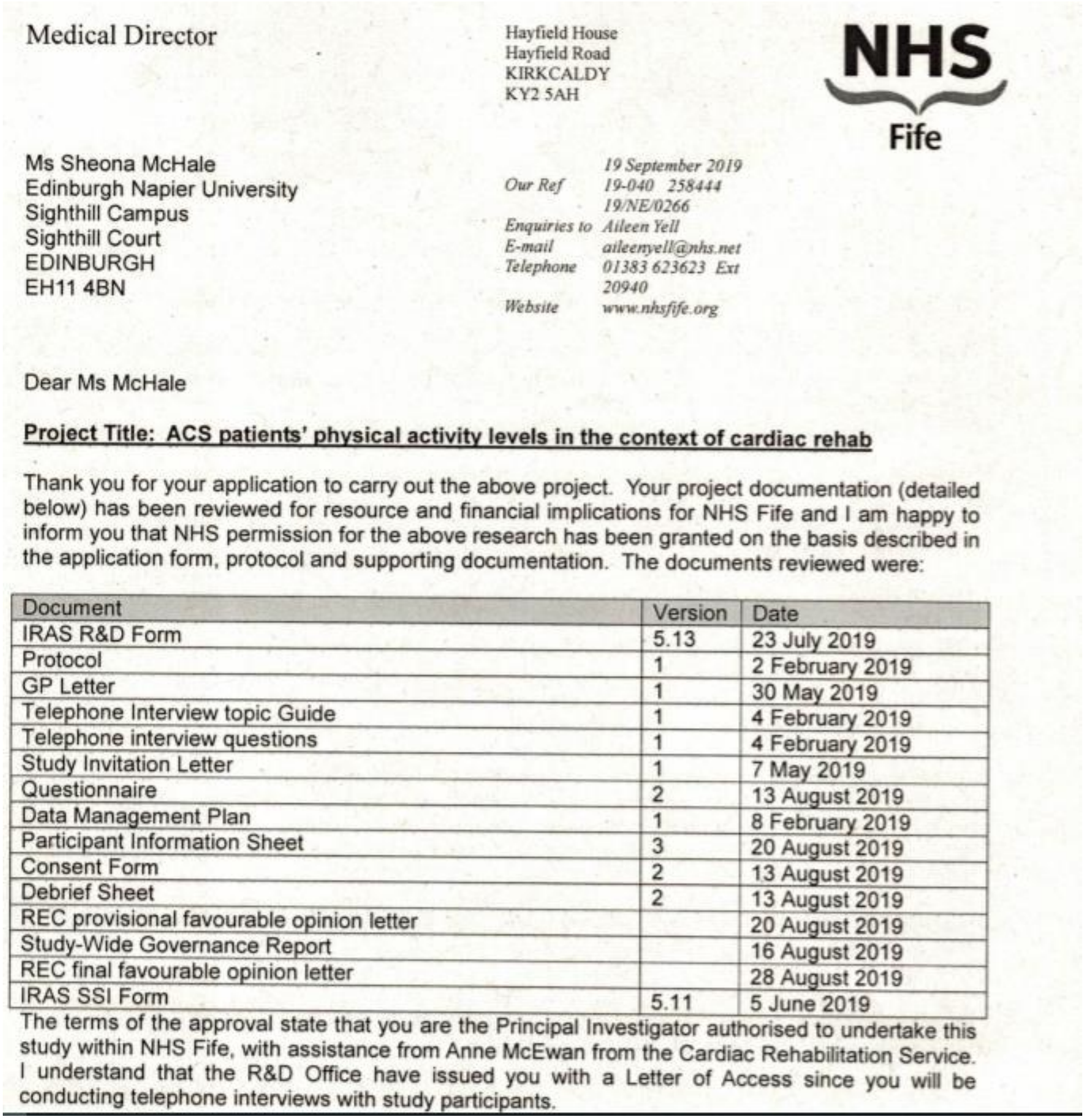
Document	*Version*	*Date*
Covering letter on headed paper [IRAS cover letter]	V3	22 August 2019
IRAS Checklist XML [Checklist_22082019]		22 August 2019
Participant information sheet (PIS) [Participant Information Sheet]	V3	20 August 2019

Approved documents



The final list of approved documentation for the study is therefore as follows:

Document	*Version*	*Date*
Covering letter on headed paper [IRAS cover letter]	V1	30 May 2019
Covering letter on headed paper [IRAS cover letter]	V1	30 May 2019
Covering letter on headed paper [IRAS cover letter]	V2	13 August 2019
Covering letter on headed paper [IRAS cover letter]	V3	22 August 2019
Evidence of Sponsor insurance or indemnity (non NHS Sponsors only) [ENU Indemnity Policy]	V1	16 July 2018
GP/consultant information sheets or letters [GP advisory letter]	V1	30 May 2019
Interview schedules or topic guides for participants [Telephone Interview Topic Guide]	V1	04 February 2019
IRAS Application Form [IRAS_Form_23072019]		23 July 2019
IRAS Checklist XML [Checklist_22082019]		22 August 2019
Letters of invitation to participant [Study Invitation]	V1	07 May 2019
Non-validated questionnaire [Telephone Interview Questions]	V1	04 February 2019
Other [Data Management Plan]	V1	08 February 2019
Other [Oath of Confidentiality]	V1	31 May 2019
Other [Privacy Notice]	V1	30 May 2019
Other [De Brief Sheet]	V2	13 August 2019
Participant consent form [Consent Form]	V2	13 August 2019
Participant information sheet (PIS) [Participant Information Sheet]	V3	20 August 2019



Medical Director

Hayfield House
Hayfield Road
KIRKCALDY
KY2 5AH

NHS
Fife

Ms Sheona McHale
Edinburgh Napier University
Sighthill Campus
Sighthill Court
EDINBURGH
EH11 4BN

19 September 2019
Our Ref *19-040 258444*
19/NE/0266
Enquiries to *Aileen Yell*
E-mail *aileenyell@nhs.net*
Telephone *01383 623623 Ext 20940*
Website *www.nhsfife.org*

Dear Ms McHale

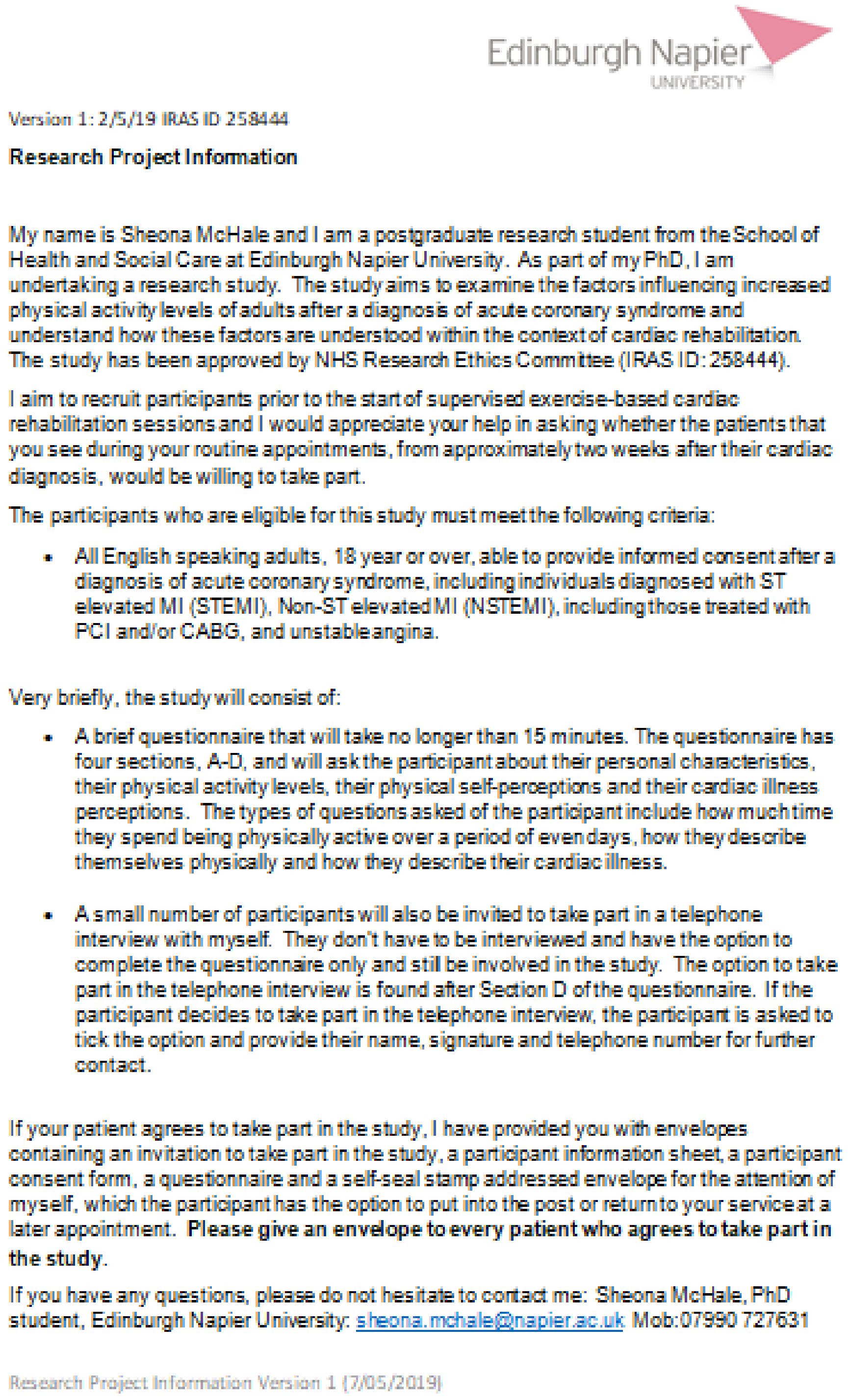
Project Title: ACS patients' physical activity levels in the context of cardiac rehab

Thank you for your application to carry out the above project. Your project documentation (detailed below) has been reviewed for resource and financial implications for NHS Fife and I am happy to inform you that NHS permission for the above research has been granted on the basis described in the application form, protocol and supporting documentation. The documents reviewed were:

Document	Version	Date
IRAS R&D Form	5.13	23 July 2019
Protocol	1	2 February 2019
GP Letter	1	30 May 2019
Telephone Interview topic Guide	1	4 February 2019
Telephone interview questions	1	4 February 2019
Study Invitation Letter	1	7 May 2019
Questionnaire	2	13 August 2019
Data Management Plan	1	8 February 2019
Participant Information Sheet	3	20 August 2019
Consent Form	2	13 August 2019
Debrief Sheet	2	13 August 2019
REC provisional favourable opinion letter		20 August 2019
Study-Wide Governance Report		16 August 2019
REC final favourable opinion letter		28 August 2019
IRAS SSI Form	5.11	5 June 2019

The terms of the approval state that you are the Principal Investigator authorised to undertake this study within NHS Fife, with assistance from Anne McEwan from the Cardiac Rehabilitation Service. I understand that the R&D Office have issued you with a Letter of Access since you will be conducting telephone interviews with study participants.

Appendix 7: Research project information sheet for cardiac rehabilitation staff



Edinburgh Napier
UNIVERSITY

Version 1: 2/5/19 IRAS ID 258444

Research Project Information

My name is Sheona McHale and I am a postgraduate research student from the School of Health and Social Care at Edinburgh Napier University. As part of my PhD, I am undertaking a research study. The study aims to examine the factors influencing increased physical activity levels of adults after a diagnosis of acute coronary syndrome and understand how these factors are understood within the context of cardiac rehabilitation. The study has been approved by NHS Research Ethics Committee (IRAS ID: 258444).

I aim to recruit participants prior to the start of supervised exercise-based cardiac rehabilitation sessions and I would appreciate your help in asking whether the patients that you see during your routine appointments, from approximately two weeks after their cardiac diagnosis, would be willing to take part.

The participants who are eligible for this study must meet the following criteria:

- All English speaking adults, 18 year or over, able to provide informed consent after a diagnosis of acute coronary syndrome, including individuals diagnosed with ST elevated MI (STEMI), Non-ST elevated MI (NSTEMI), including those treated with PCI and/or CABG, and unstable angina.

Very briefly, the study will consist of:

- A brief questionnaire that will take no longer than 15 minutes. The questionnaire has four sections, A-D, and will ask the participant about their personal characteristics, their physical activity levels, their physical self-perceptions and their cardiac illness perceptions. The types of questions asked of the participant include how much time they spend being physically active over a period of even days, how they describe themselves physically and how they describe their cardiac illness.

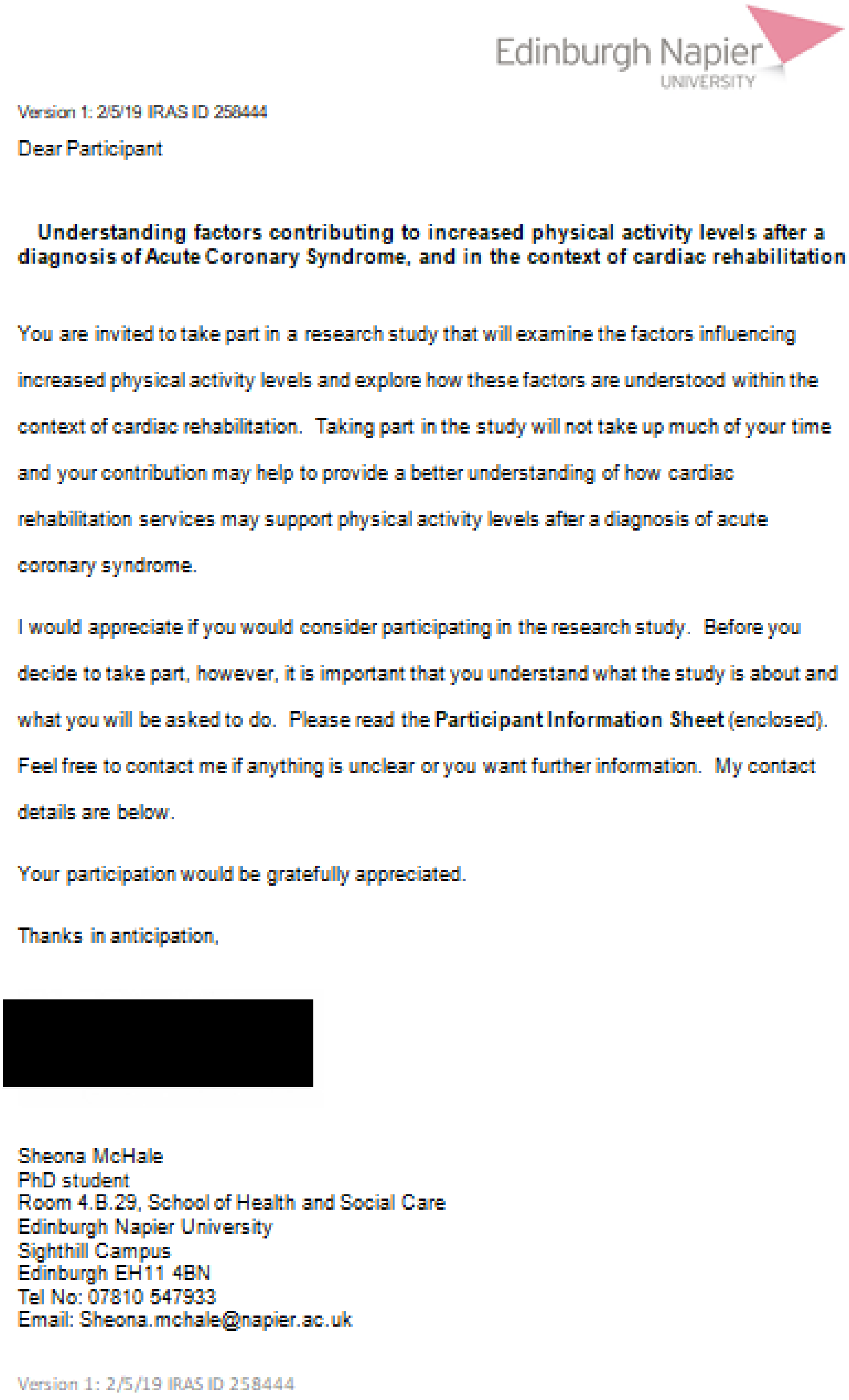
- A small number of participants will also be invited to take part in a telephone interview with myself. They don't have to be interviewed and have the option to complete the questionnaire only and still be involved in the study. The option to take part in the telephone interview is found after Section D of the questionnaire. If the participant decides to take part in the telephone interview, the participant is asked to tick the option and provide their name, signature and telephone number for further contact.

If your patient agrees to take part in the study, I have provided you with envelopes containing an invitation to take part in the study, a participant information sheet, a participant consent form, a questionnaire and a self-seal stamp addressed envelope for the attention of myself, which the participant has the option to put into the post or return to your service at a later appointment. **Please give an envelope to every patient who agrees to take part in the study.**

If you have any questions, please do not hesitate to contact me: Sheona McHale, PhD student, Edinburgh Napier University: sheona.mchale@napier.ac.uk Mob:07990 727631

Research Project Information Version 1 (7/05/2019)

Appendix 8: Study invitation



Edinburgh Napier
UNIVERSITY

Version 1: 2/5/19 IRAS ID 258444

Dear Participant

Understanding factors contributing to increased physical activity levels after a diagnosis of Acute Coronary Syndrome, and in the context of cardiac rehabilitation

You are invited to take part in a research study that will examine the factors influencing increased physical activity levels and explore how these factors are understood within the context of cardiac rehabilitation. Taking part in the study will not take up much of your time and your contribution may help to provide a better understanding of how cardiac rehabilitation services may support physical activity levels after a diagnosis of acute coronary syndrome.

I would appreciate if you would consider participating in the research study. Before you decide to take part, however, it is important that you understand what the study is about and what you will be asked to do. Please read the **Participant Information Sheet** (enclosed). Feel free to contact me if anything is unclear or you want further information. My contact details are below.

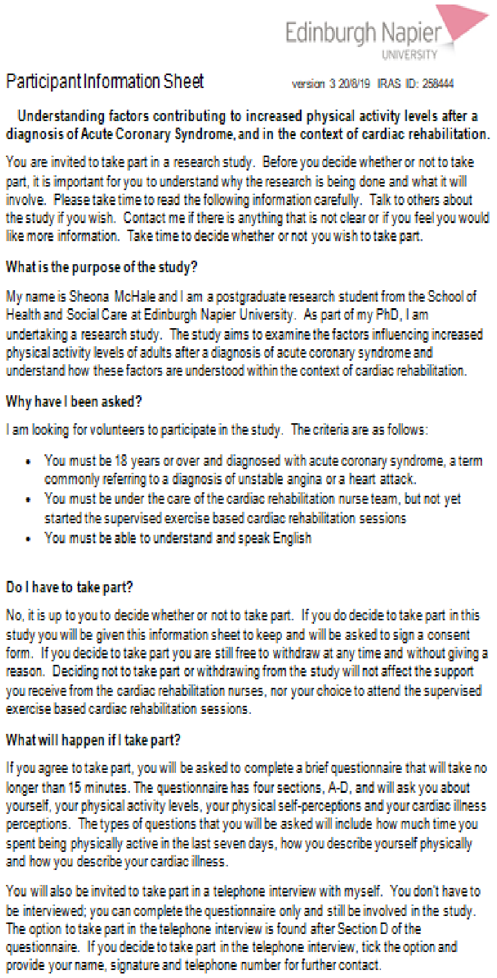
Your participation would be gratefully appreciated.

Thanks in anticipation,

[redacted]

Sheona McHale
PhD student
Room 4.B.29, School of Health and Social Care
Edinburgh Napier University
Sighthill Campus
Edinburgh EH11 4BN
Tel No: 07810 547933
Email: Sheona.mchale@napier.ac.uk

Appendix 9: Participant information sheet



Participant Infomation Sheet

version 3 20/8/19 IRAS ID: 258444

Understanding factors contributing to increased physical activity levels after a diagnosis of Acute Coronary Syndrome, and in the context of cardiac rehabilitation.

You are invited to take part in a research study. Before you decide whether or not to take part, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully. Talk to others about the study if you wish. Contact me if there is anything that is not clear or if you feel you would like more information. Take time to decide whether or not you wish to take part.

What is the purpose of the study?

My name is Sheona McHale and I am a postgraduate research student from the School of Health and Social Care at Edinburgh Napier University. As part of my PhD, I am undertaking a research study. The study aims to examine the factors influencing increased physical activity levels of adults after a diagnosis of acute coronary syndrome and understand how these factors are understood within the context of cardiac rehabilitation.

Why have I been asked?

I am looking for volunteers to participate in the study. The criteria are as follows:

- You must be 18 years or over and diagnosed with acute coronary syndrome, a term commonly referring to a diagnosis of unstable angina or a heart attack.
- You must be under the care of the cardiac rehabilitation nurse team, but not yet started the supervised exercise based cardiac rehabilitation sessions
- You must be able to understand and speak English

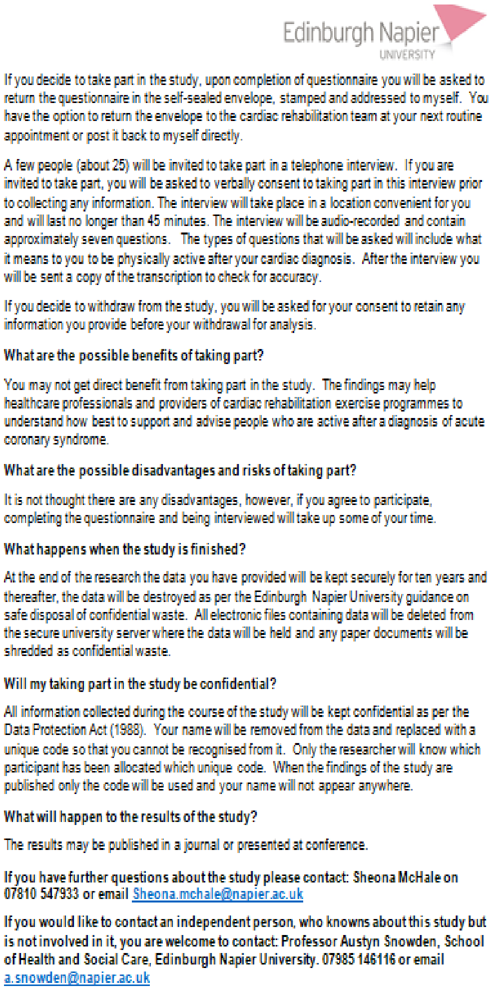
Do I have to take part?

No, it is up to you to decide whether or not to take part. If you do decide to take part in this study you will be given this information sheet to keep and will be asked to sign a consent form. If you decide to take part you are still free to withdraw at any time and without giving a reason. Deciding not to take part or withdrawing from the study will not affect the support you receive from the cardiac rehabilitation nurses, nor your choice to attend the supervised exercise based cardiac rehabilitation sessions.

What will happen if I take part?

If you agree to take part, you will be asked to complete a brief questionnaire that will take no longer than 15 minutes. The questionnaire has four sections, A-D, and will ask you about yourself, your physical activity levels, your physical self-perceptions and your cardiac illness perceptions. The types of questions that you will be asked will include how much time you spent being physically active in the last seven days, how you describe yourself physically and how you describe your cardiac illness.

You will also be invited to take part in a telephone interview with myself. You don't have to be interviewed; you can complete the questionnaire only and still be involved in the study. The option to take part in the telephone interview is found after Section D of the questionnaire. If you decide to take part in the telephone interview, tick the option and provide your name, signature and telephone number for further contact.



If you decide to take part in the study, upon completion of questionnaire you will be asked to return the questionnaire in the self-sealed envelope, stamped and addressed to myself. You have the option to return the envelope to the cardiac rehabilitation team at your next routine appointment or post it back to myself directly.

A few people (about 25) will be invited to take part in a telephone interview. If you are invited to take part, you will be asked to verbally consent to taking part in this interview prior to collecting any information. The interview will take place in a location convenient for you and will last no longer than 45 minutes. The interview will be audio-recorded and contain approximately seven questions. The types of questions that will be asked will include what it means to you to be physically active after your cardiac diagnosis. After the interview you will be sent a copy of the transcription to check for accuracy.

If you decide to withdraw from the study, you will be asked for your consent to retain any information you provide before your withdrawal for analysis.

What are the possible benefits of taking part?

You may not get direct benefit from taking part in the study. The findings may help healthcare professionals and providers of cardiac rehabilitation exercise programmes to understand how best to support and advise people who are active after a diagnosis of acute coronary syndrome.

What are the possible disadvantages and risks of taking part?

It is not thought there are any disadvantages, however, if you agree to participate, completing the questionnaire and being interviewed will take up some of your time.

What happens when the study is finished?

At the end of the research the data you have provided will be kept securely for ten years and thereafter, the data will be destroyed as per the Edinburgh Napier University guidance on safe disposal of confidential waste. All electronic files containing data will be deleted from the secure university server where the data will be held and any paper documents will be shredded as confidential waste.

Will my taking part in the study be confidential?

All information collected during the course of the study will be kept confidential as per the Data Protection Act (1988). Your name will be removed from the data and replaced with a unique code so that you cannot be recognised from it. Only the researcher will know which participant has been allocated which unique code. When the findings of the study are published only the code will be used and your name will not appear anywhere.

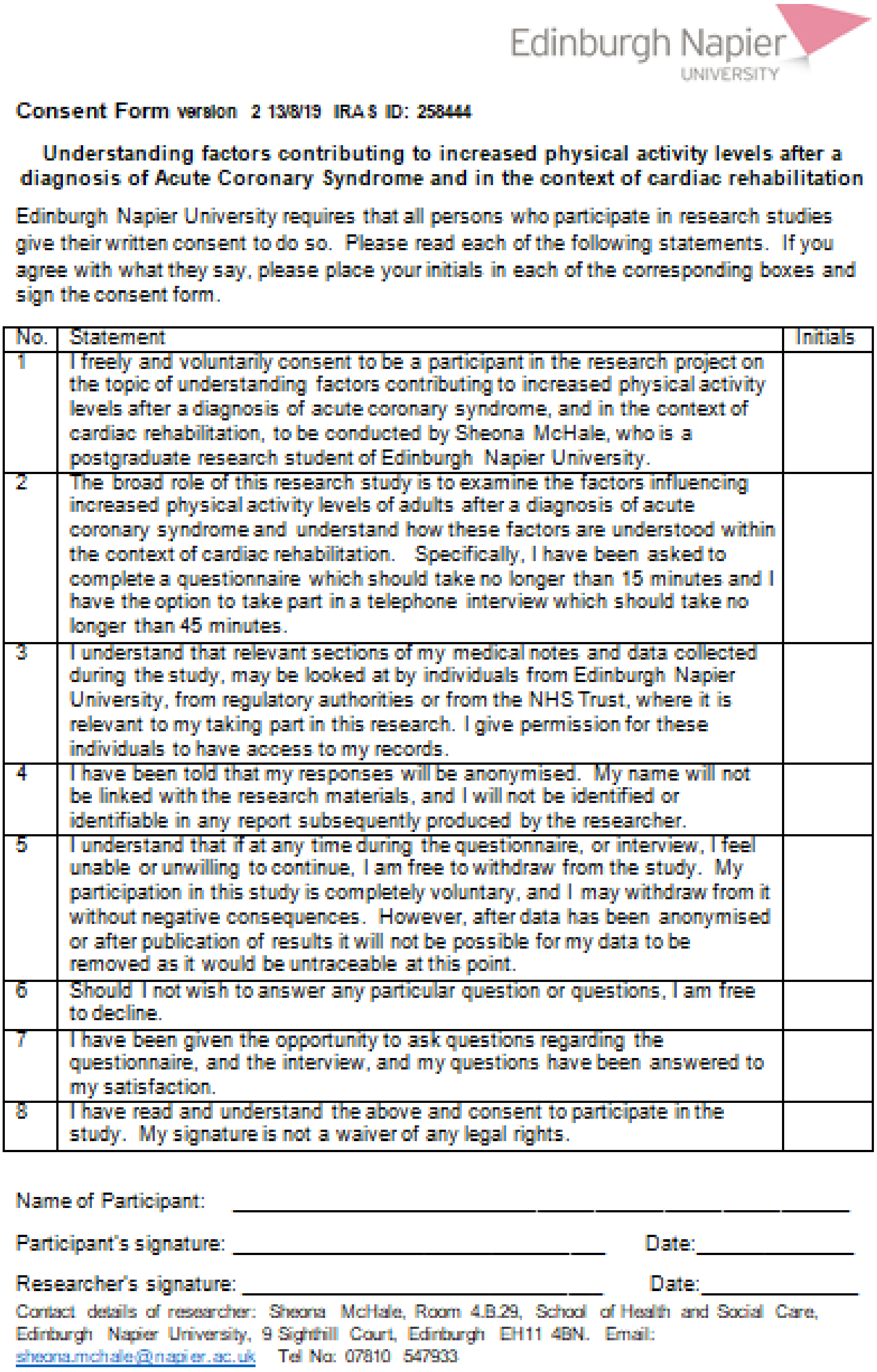
What will happen to the results of the study?

The results may be published in a journal or presented at conference.

If you have further questions about the study please contact: Sheona McHale on 07810 547933 or email Sheona.mchale@napier.ac.uk

If you would like to contact an independent person, who knowns about this study but is not involved in it, you are welcome to contact: Professor Austyn Snowden, School of Health and Social Care, Edinburgh Napier University. 07985 146116 or email a.snowden@napier.ac.uk

Appendix 10: Participant consent form



Edinburgh Napier
UNIVERSITY

Consent Form version 2 13/8/19 IRAS ID: 258444

Understanding factors contributing to increased physical activity levels after a diagnosis of Acute Coronary Syndrome and in the context of cardiac rehabilitation

Edinburgh Napier University requires that all persons who participate in research studies give their written consent to do so. Please read each of the following statements. If you agree with what they say, please place your initials in each of the corresponding boxes and sign the consent form.

No.	Statement	Initials
1	I freely and voluntarily consent to be a participant in the research project on the topic of understanding factors contributing to increased physical activity levels after a diagnosis of acute coronary syndrome, and in the context of cardiac rehabilitation, to be conducted by Sheona McHale, who is a postgraduate research student of Edinburgh Napier University.	
2	The broad role of this research study is to examine the factors influencing increased physical activity levels of adults after a diagnosis of acute coronary syndrome and understand how these factors are understood within the context of cardiac rehabilitation. Specifically, I have been asked to complete a questionnaire which should take no longer than 15 minutes and I have the option to take part in a telephone interview which should take no longer than 45 minutes.	
3	I understand that relevant sections of my medical notes and data collected during the study, may be looked at by individuals from Edinburgh Napier University, from regulatory authorities or from the NHS Trust, where it is relevant to my taking part in this research. I give permission for these individuals to have access to my records.	
4	I have been told that my responses will be anonymised. My name will not be linked with the research materials, and I will not be identified or identifiable in any report subsequently produced by the researcher.	
5	I understand that if at any time during the questionnaire, or interview, I feel unable or unwilling to continue, I am free to withdraw from the study. My participation in this study is completely voluntary, and I may withdraw from it without negative consequences. However, after data has been anonymised or after publication of results it will not be possible for my data to be removed as it would be untraceable at this point.	
6	Should I not wish to answer any particular question or questions, I am free to decline.	
7	I have been given the opportunity to ask questions regarding the questionnaire, and the interview, and my questions have been answered to my satisfaction.	
8	I have read and understand the above and consent to participate in the study. My signature is not a waiver of any legal rights.	

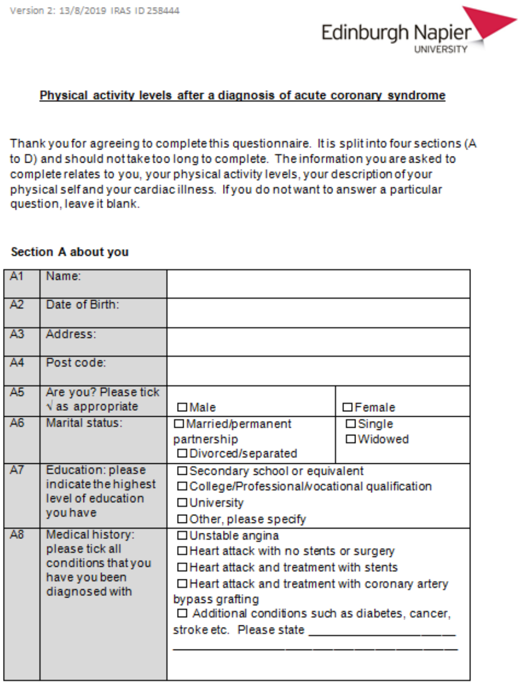
Name of Participant: ______________________________

Participant's signature: ______________________ Date:__________

Researcher's signature: ______________________ Date:__________

Contact details of researcher: Sheona McHale, Room 4.B.29, School of Health and Social Care, Edinburgh Napier University, 9 Sighthill Court, Edinburgh EH11 4BN. Email: sheona.mchale@napier.ac.uk Tel No: 07810 547933

Appendix 11: Quantitative study questionnaire



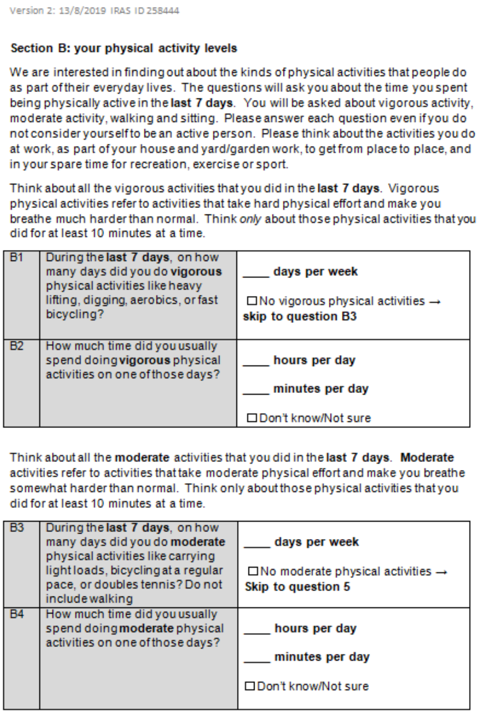
Edinburgh Napier
UNIVERSITY

Physical activity levels after a diagnosis of acute coronary syndrome

Thank you for agreeing to complete this questionnaire. It is split into four sections (A to D) and should not take too long to complete. The information you are asked to complete relates to you, your physical activity levels, your description of your physical self and your cardiac illness. If you do not want to answer a particular question, leave it blank.

Section A about you

A1	Name:		
A2	Date of Birth:		
A3	Address:		
A4	Post code:		
A5	Are you? Please tick √ as appropriate	☐ Male	☐ Female
A6	Marital status:	☐ Married/permanent partnership ☐ Divorced/separated	☐ Single ☐ Widowed
A7	Education: please indicate the highest level of education you have	☐ Secondary school or equivalent ☐ College/Professional/vocational qualification ☐ University ☐ Other, please specify	
A8	Medical history: please tick all conditions that you have you been diagnosed with	☐ Unstable angina ☐ Heart attack with no stents or surgery ☐ Heart attack and treatment with stents ☐ Heart attack and treatment with coronary artery bypass grafting ☐ Additional conditions such as diabetes, cancer, stroke etc. Please state ______________________ ____	



Section B: your physical activity levels

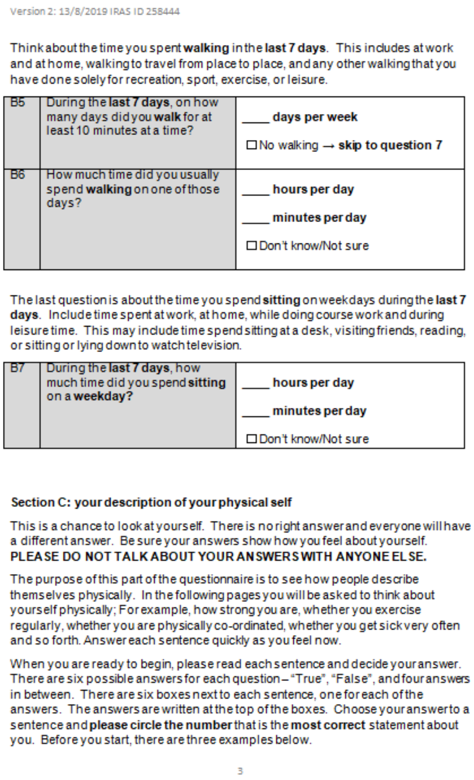
We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. You will be asked about vigorous activity, moderate activity, walking and sitting. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard/garden work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the vigorous activities that you did in the **last 7 days**. Vigorous physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

B1	During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?	____ **days per week** ☐ No vigorous physical activities → **skip to question B3**
B2	How much time did you usually spend doing **vigorous** physical activities on one of those days?	____ **hours per day** ____ **minutes per day** ☐ Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

B3	During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking	____ **days per week** ☐ No moderate physical activities → **Skip to question 5**
B4	How much time did you usually spend doing **moderate** physical activities on one of those days?	____ **hours per day** ____ **minutes per day** ☐ Don't know/Not sure



Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.

B5	During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?	____ **days per week** ☐ No walking → **skip to question 7**
B6	How much time did you usually spend **walking** on one of those days?	____ **hours per day** ____ **minutes per day** ☐ Don't know/Not sure

The last question is about the time you spend **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spend sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

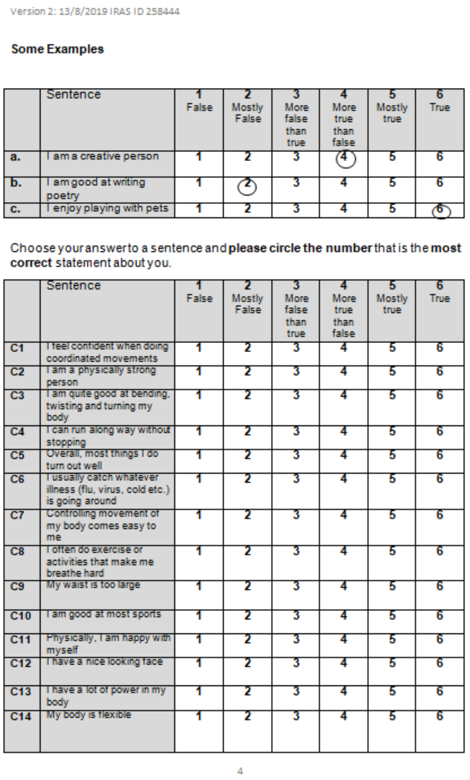
B7	During the **last 7 days**, how much time did you spend **sitting** on a **weekday?**	____ **hours per day** ____ **minutes per day** ☐ Don't know/Not sure

Section C: your description of your physical self

This is a chance to look at yourself. There is no right answer and everyone will have a different answer. Be sure your answers show how you feel about yourself. **PLEASE DO NOT TALK ABOUT YOUR ANSWERS WITH ANYONE ELSE.**

The purpose of this part of the questionnaire is to see how people describe themselves physically. In the following pages you will be asked to think about yourself physically; For example, how strong you are, whether you exercise regularly, whether you are physically co-ordinated, whether you get sick very often and so forth. Answer each sentence quickly as you feel now.

When you are ready to begin, please read each sentence and decide your answer. There are six possible answers for each question – "True", "False", and four answers in between. There are six boxes next to each sentence, one for each of the answers. The answers are written at the top of the boxes. Choose your answer to a sentence and **please circle the number** that is the **most correct** statement about you. Before you start, there are three examples below.



Some Examples

	Sentence	**1** False	**2** Mostly False	**3** More false than true	**4** More true than false	**5** Mostly true	**6** True
a.	I am a creative person	**1**	**2**	**3**	[✓ **4**]	**5**	**6**
b.	I am good at writing poetry	**1**	[✓ **2**]	**3**	**4**	**5**	**6**
c.	I enjoy playing with pets	**1**	**2**	**3**	**4**	**5**	[✓ **6**]

Choose your answer to a sentence and **please circle the number** that is the **most correct** statement about you.

	Sentence	**1** False	**2** Mostly False	**3** More false than true	**4** More true than false	**5** Mostly true	**6** True
C1	I feel confident when doing coordinated movements	**1**	**2**	**3**	**4**	**5**	**6**
C2	I am a physically strong person	**1**	**2**	**3**	**4**	**5**	**6**
C3	I am quite good at bending, twisting and turning my body	**1**	**2**	**3**	**4**	**5**	**6**
C4	I can run along way without stopping	**1**	**2**	**3**	**4**	**5**	**6**
C5	Overall, most things I do turn out well	**1**	**2**	**3**	**4**	**5**	**6**
C6	I usually catch whatever illness (flu, virus, cold etc.) is going around	**1**	**2**	**3**	**4**	**5**	**6**
C7	Controlling movement of my body comes easy to me	**1**	**2**	**3**	**4**	**5**	**6**
C8	I often do exercise or activities that make me breathe hard	**1**	**2**	**3**	**4**	**5**	**6**
C9	My waist is too large	**1**	**2**	**3**	**4**	**5**	**6**
C10	I am good at most sports	**1**	**2**	**3**	**4**	**5**	**6**
C11	Physically, I am happy with myself	**1**	**2**	**3**	**4**	**5**	**6**
C12	I have a nice looking face	**1**	**2**	**3**	**4**	**5**	**6**
C13	I have a lot of power in my body	**1**	**2**	**3**	**4**	**5**	**6**
C14	My body is flexible	**1**	**2**	**3**	**4**	**5**	**6**

	Sentence	1 False	2 Mostly False	3 More false than true	4 More true than false	5 Mostly true	6 True
C15	I am sick so often that I cannot do all the things I want to do	1	2	3	4	5	6
C16	I am good at co-ordinated movements	1	2	3	4	5	6
C17	I have too much fat on my body	1	2	3	4	5	6
C18	I am better looking than most of my friends	1	2	3	4	5	6
C19	I can perform movements smoothly in most physical activities	1	2	3	4	5	6
C20	I do physically active things (e.g. jog, dance, bicycle, aerobics, gym, swim) at least three times per week	1	2	3	4	5	6
C21	I am overweight	1	2	3	4	5	6
C22	I have good sports skills	1	2	3	4	5	6
C23	Physically, I feel good about myself	1	2	3	4	5	6
C24	Overall, I am no good	1	2	3	4	5	6
C25	I get sick a lot	1	2	3	4	5	6
C26	I find my body handles coordinated movements with ease	1	2	3	4	5	6
C27	I do lots of sports, dance, gym, or other physical activities	1	2	3	4	5	6
C28	I am good looking	1	2	3	4	5	6
C29	I could do well in a test of strength	1	2	3	4	5	6
C30	I can be physically active for a long period of time without getting tired	1	2	3	4	5	6
C31	Most things I do, I do well	1	2	3	4	5	6
C32	When I get sick, it takes me a long time to get better	1	2	3	4	5	6
C33	I do sports, exercise, dance or other physical activities almost every day	1	2	3	4	5	6
C34	I play sports well	1	2	3	4	5	6
C35	I feel good about who I am physically	1	2	3	4	5	6

	Sentence	1 False	2 Mostly False	3 More false than true	4 More true than false	5 Mostly true	6 True
C36	I think I would perform well on a test measuring flexibility	1	2	3	4	5	6
C37	I am good at endurance activities like distance running, aerobics, bicycling, swimming, or cross-country, skiing	1	2	3	4	5	6
C38	Overall, I have a lot to be proud of	1	2	3	4	5	6
C39	I have to go to the doctor because of illness more than most people my age	1	2	3	4	5	6
C40	Nothing I ever do seems to turn out right	1	2	3	4	5	6

Section D: your description of your cardiac condition now

The illness the next section refers to is your cardiac diagnosis of either a heart attack or unstable angina. For the following questions, **please circle** the number that best corresponds to your views:

D1	**How much does your illness affect your life?** 0 1 2 3 4 5 6 7 8 9 10 no affect at all — severely affects my life
D2	**How long do you think your illness will continue?** 0 1 2 3 4 5 6 7 8 9 10 a very short time — Forever
D3	**How much control do you feel you have over your illness?** 0 1 2 3 4 5 6 7 8 9 10 absolutely no control — extreme amount of control
D4	**How much do you think your treatment can help your illness?** 0 1 2 3 4 5 6 7 8 9 10 not at all — extremely helpful
D5	**How much do you experience symptoms from your illness?** 0 1 2 3 4 5 6 7 8 9 10 no symptoms at all — many severe symptoms
D6	**How concerned are you about your illness?** 0 1 2 3 4 5 6 7 8 9 10 not at all concerned — extremely concerned

D7	**How well do you feel you understand your illness?** 0 1 2 3 4 5 6 7 8 9 10 don't understand at all — understand very clearly
D8	**How much does your illness affect you emotionally? (E.g., does it make you angry, scared, upset or depressed?)** 0 1 2 3 4 5 6 7 8 9 10 not at all affected emotionally — extremely affected emotionally
D9	**Please list in rank-order the three most important factors that you believe caused <u>your illness.</u> *The most important causes for me:-*** **1.** ________________ **2.** ________________ **3.** ________________

Thank you for taking the time to complete this questionnaire. I would appreciate if you would consider taking part in a telephone interview with myself. Before you decide to take part in this study, please read the Participant Information Sheet.

I am happy to be contacted by telephone ☐

I agree to participate in a telephone interview ☐

Name of participant: ________________________

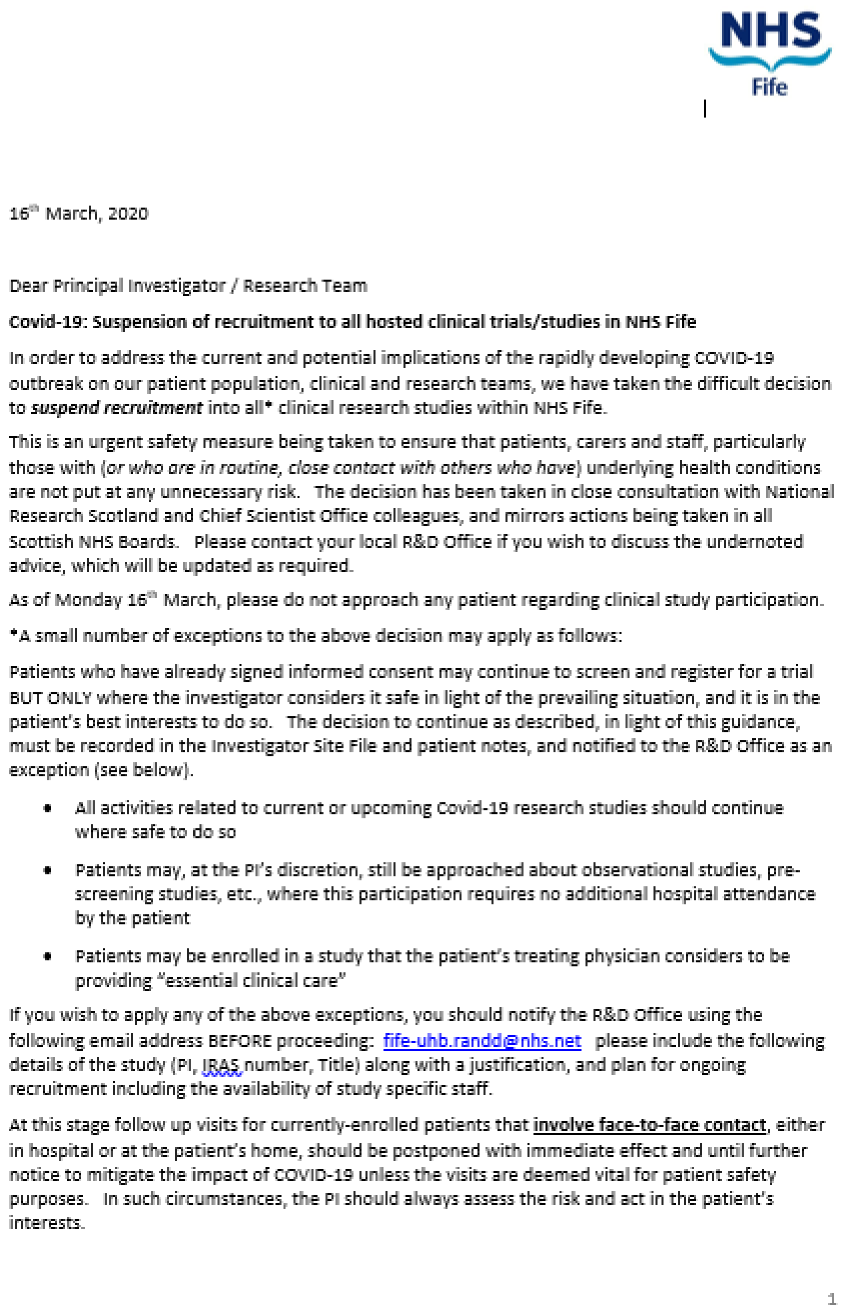
Signature of participant: ________________________

Date: ________________________

Telephone Number: ________________________

Upon completion of this questionnaire, please fold the questionnaire to fit into the supplied self-sealed envelope. The envelope is stamped and addressed to the researcher at Edinburgh Napier University. You have the option of either returning the sealed envelope to the cardiac rehabilitation nurse at your next appointment or posting the envelope directly to the researcher.

Appendix 12: R & D suspension of study recruitment



NHS
Fife

16th March, 2020

Dear Principal Investigator / Research Team

Covid-19: Suspension of recruitment to all hosted clinical trials/studies in NHS Fife

In order to address the current and potential implications of the rapidly developing COVID-19 outbreak on our patient population, clinical and research teams, we have taken the difficult decision to ***suspend recruitment*** into all* clinical research studies within NHS Fife.

This is an urgent safety measure being taken to ensure that patients, carers and staff, particularly those with (*or who are in routine, close contact with others who have*) underlying health conditions are not put at any unnecessary risk. The decision has been taken in close consultation with National Research Scotland and Chief Scientist Office colleagues, and mirrors actions being taken in all Scottish NHS Boards. Please contact your local R&D Office if you wish to discuss the undernoted advice, which will be updated as required.

As of Monday 16th March, please do not approach any patient regarding clinical study participation.

*A small number of exceptions to the above decision may apply as follows:

Patients who have already signed informed consent may continue to screen and register for a trial BUT ONLY where the investigator considers it safe in light of the prevailing situation, and it is in the patient's best interests to do so. The decision to continue as described, in light of this guidance, must be recorded in the Investigator Site File and patient notes, and notified to the R&D Office as an exception (see below).

- All activities related to current or upcoming Covid-19 research studies should continue where safe to do so
- Patients may, at the PI's discretion, still be approached about observational studies, pre-screening studies, etc., where this participation requires no additional hospital attendance by the patient
- Patients may be enrolled in a study that the patient's treating physician considers to be providing "essential clinical care"

If you wish to apply any of the above exceptions, you should notify the R&D Office using the following email address BEFORE proceeding: fife-uhb.randd@nhs.net please include the following details of the study (PI, IRAS number, Title) along with a justification, and plan for ongoing recruitment including the availability of study specific staff.

At this stage follow up visits for currently-enrolled patients that **involve face-to-face contact**, either in hospital or at the patient's home, should be postponed with immediate effect and until further notice to mitigate the impact of COVID-19 unless the visits are deemed vital for patient safety purposes. In such circumstances, the PI should always assess the risk and act in the patient's interests.

Research teams are asked to comply with the following:

1) Work with sponsors to agree arrangements for carrying out follow-up (hospital or at-home) visits remotely wherever possible
2) Maintain contact with your patients to provide reassurance, to let them know about any changes in arrangements, and to encourage them to remain within the study
3) Postpone any external monitoring visits unless there is a subject safety issue. Where possible please make arrangements to participate in remote monitoring
4) Postpone any site initiation visits or site selection visits unless they involve studies related to COVID-19
5) Protocol deviations- The MHRA expect there to be an increase in protocol deviations but have requested that these are documented in the normal manner
6) IMP supplies for our hosted CTIMPs should be discussed with Sponsors and with your local Pharmacy team who support your study. All patients should continue to receive their Investigational Medicinal Product (IMP) if you as PI (or in discussion with the CI/Sponsor) deem this the right thing to do. Supply of these medications should be carried out in a manner deemed to be of lowest risk. If a courier is to be used, Participants must consent verbally to providing contact details for these shipping purposes.

MHRA advice is available at https://mhrainspectorate.blog.gov.uk/2020/03/12/advice-for-management-of-clinical-trials-in-relation-to-coronavirus/

HRA advice is available at https://www.hra.nhs.uk/planning-and-improving-research/policies-standards-legislation/covid-19-guidance-sponsors-sites-and-researchers/

Finally, for now, we recognise that our colleagues throughout the service are responding to an unprecedented set of circumstances. It may be that our research staff are asked to support the efforts of colleagues in providing care as this stress on the system continues. We will expect that research support staff will do whatever they can, while also recognising that a significant volume of research activity will continue – increasing SAE, AE, Protocol deviation reporting, ongoing follow-up, new activities seeing patients remotely. We will at all times respond pragmatically, and provide whatever capacity is available when requested.

Please forward this letter to the sponsor and chief investigators. Ongoing contingency planning is underway and further correspondence will follow should the situation change.

Should have any queries please direct them to myself Dr Amanda Wood, Assistant R&D Director, tel 01383 623623 ext 20955 amanda.wood3@nhs.net

Yours sincerely,

Professor Alex Baldacchino, R&D Director, NHS Fife

Queen Margaret Hospital

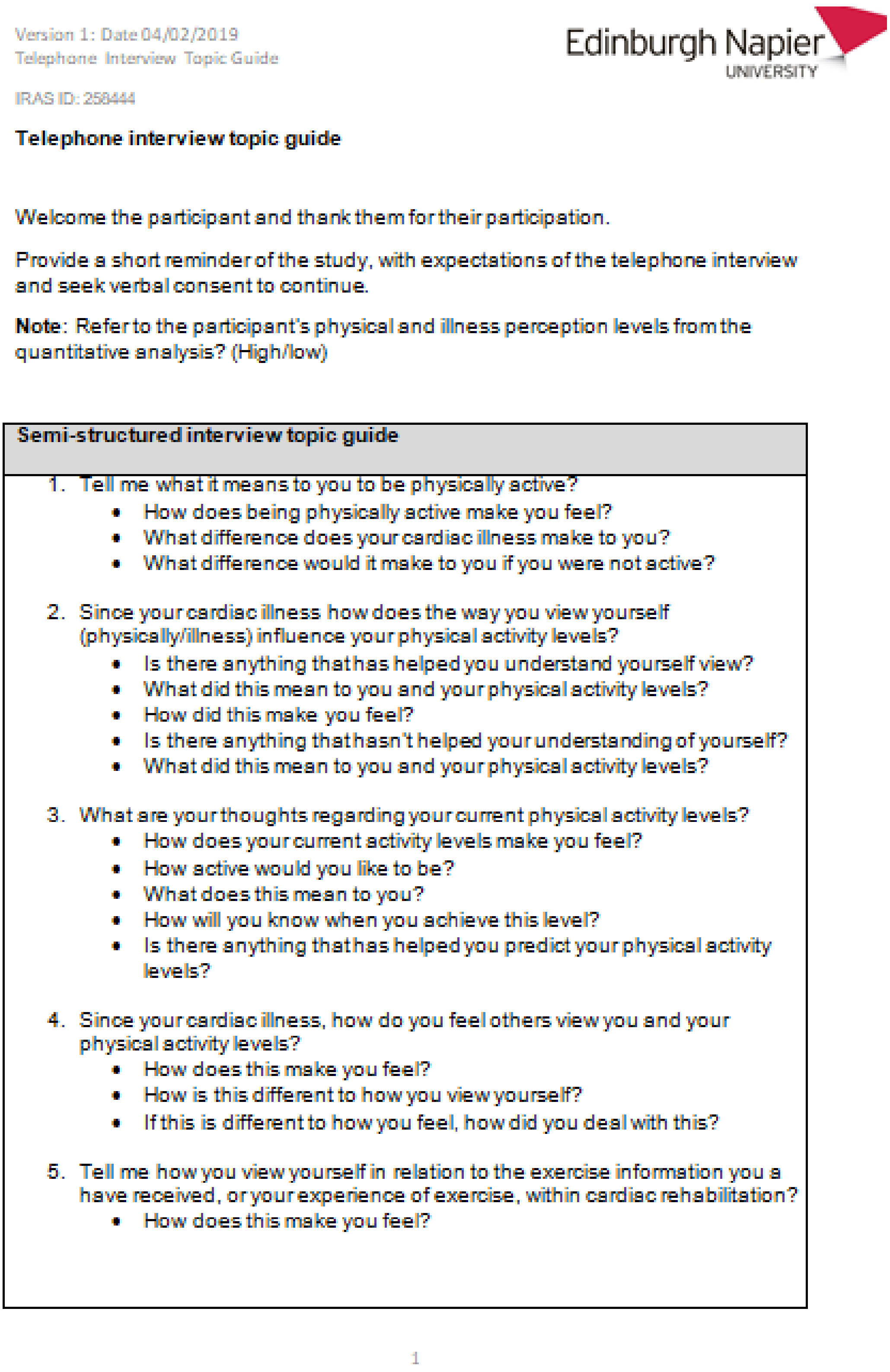
Dunfermline

KY12 0SU

Tel 01383 623623 ext 20955

fife-uhb.randd@nhs.net

Appendix 13: Qualitative telephone interview topic guide



Edinburgh Napier
UNIVERSITY

IRAS ID: 258444

Telephone interview topic guide

Welcome the participant and thank them for their participation.

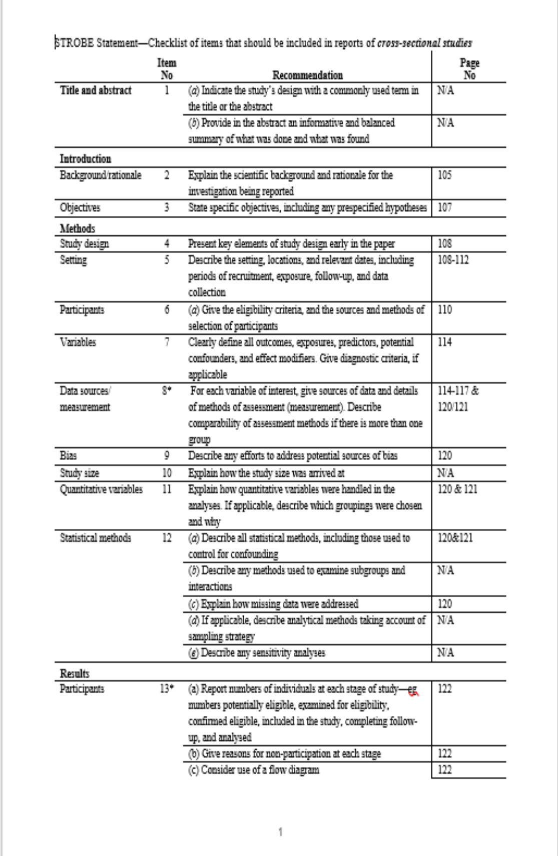
Provide a short reminder of the study, with expectations of the telephone interview and seek verbal consent to continue.

Note: Refer to the participant's physical and illness perception levels from the quantitative analysis? (High/low)

Semi-structured interview topic guide

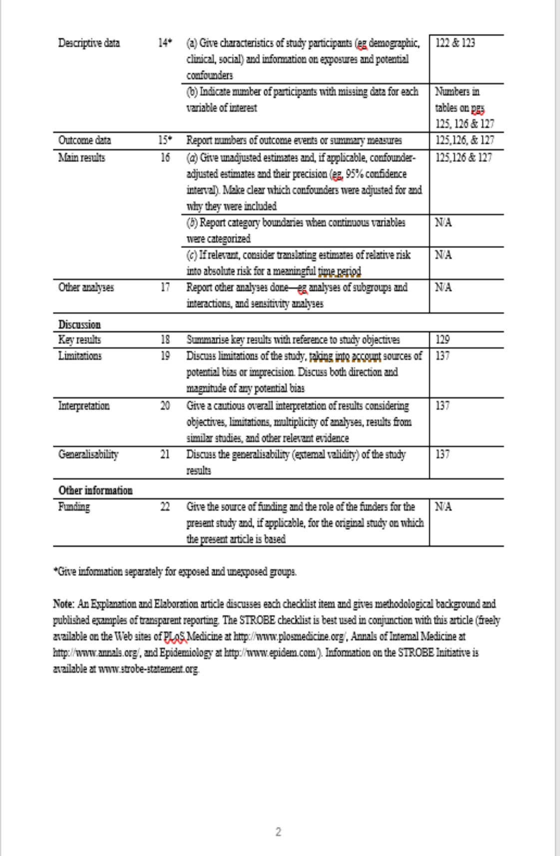
1. Tell me what it means to you to be physically active?
    - How does being physically active make you feel?
    - What difference does your cardiac illness make to you?
    - What difference would it make to you if you were not active?
2. Since your cardiac illness how does the way you view yourself (physically/illness) influence your physical activity levels?
    - Is there anything that has helped you understand yourself view?
    - What did this mean to you and your physical activity levels?
    - How did this make you feel?
    - Is there anything that hasn't helped your understanding of yourself?
    - What did this mean to you and your physical activity levels?
3. What are your thoughts regarding your current physical activity levels?
    - How does your current activity levels make you feel?
    - How active would you like to be?
    - What does this mean to you?
    - How will you know when you achieve this level?
    - Is there anything that has helped you predict your physical activity levels?
4. Since your cardiac illness, how do you feel others view you and your physical activity levels?
    - How does this make you feel?
    - How is this different to how you view yourself?
    - If this is different to how you feel, how did you deal with this?
5. Tell me how you view yourself in relation to the exercise information you a have received, or your experience of exercise, within cardiac rehabilitation?
    - How does this make you feel?

Appendix 14: STROBE checklist



STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	**Recommendation**	**Page No**
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	N/A
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	N/A
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	105
Objectives	3	State specific objectives, including any prespecified hypotheses	107
Methods			
Study design	4	Present key elements of study design early in the paper	108
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	108-112
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	110
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	114
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	114-117 & 120/121
Bias	9	Describe any efforts to address potential sources of bias	120
Study size	10	Explain how the study size was arrived at	N/A
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	120 & 121
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	120&121
		(*b*) Describe any methods used to examine subgroups and interactions	N/A
		(*c*) Explain how missing data were addressed	120
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	N/A
		(*e*) Describe any sensitivity analyses	N/A
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	122
		(b) Give reasons for non-participation at each stage	122
		(c) Consider use of a flow diagram	122

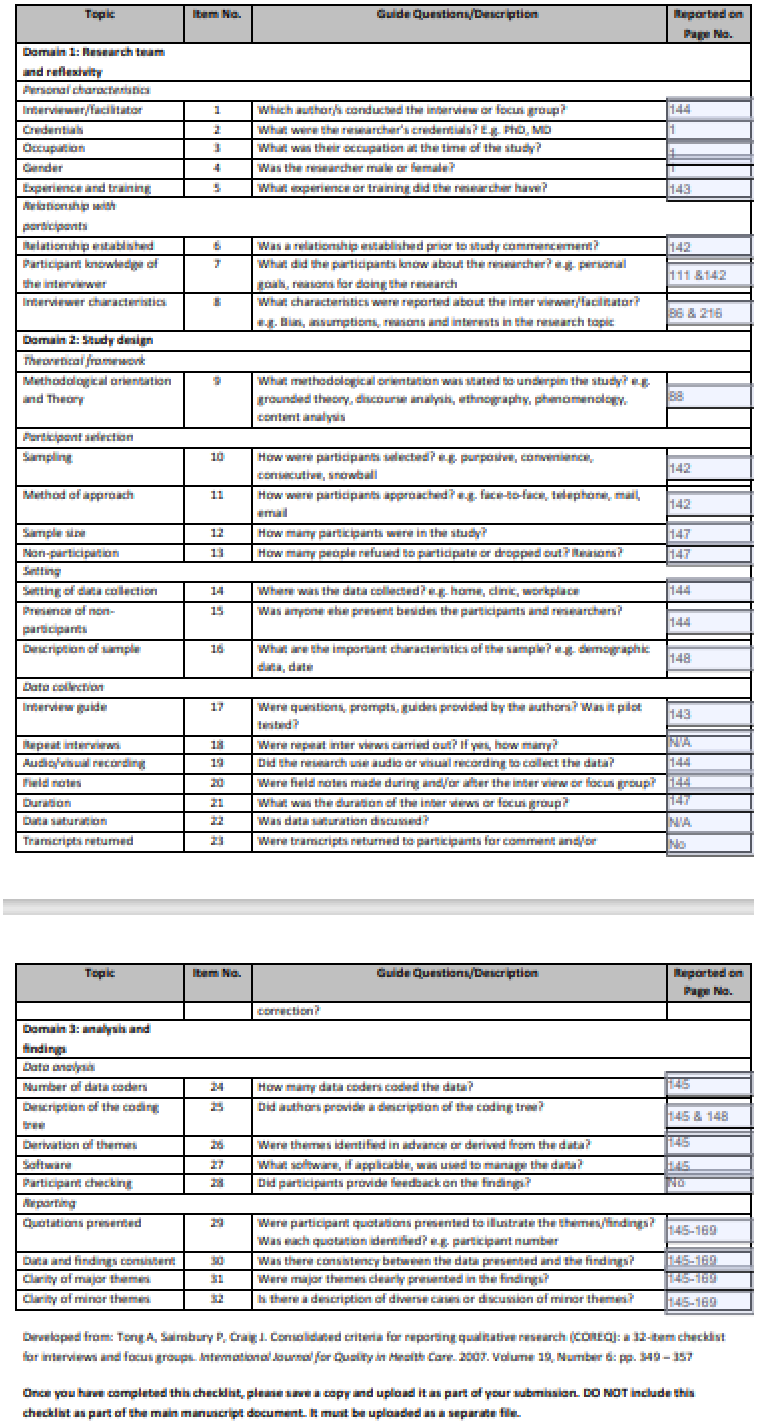


Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	122 & 123
		(b) Indicate number of participants with missing data for each variable of interest	Numbers in tables on pgs 125, 126 & 127
Outcome data	15*	Report numbers of outcome events or summary measures	125,126, & 127
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	125,126 & 127
		(*b*) Report category boundaries when continuous variables were categorized	N/A
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	129
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	137
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	137
Generalisability	21	Discuss the generalisability (external validity) of the study results	137
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	N/A

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

Appendix 15: COREQ checklist



Topic	Item No.	Guide Questions/Description	Reported on Page No.
Domain 1: Research team and reflexivity			
Personal characteristics			
Interviewer/facilitator	1	Which author/s conducted the interview or focus group?	144
Credentials	2	What were the researcher's credentials? E.g. PhD, MD	1
Occupation	3	What was their occupation at the time of the study?	1
Gender	4	Was the researcher male or female?	1
Experience and training	5	What experience or training did the researcher have?	143
Relationship with participants			
Relationship established	6	Was a relationship established prior to study commencement?	142
Participant knowledge of the interviewer	7	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	111 &142
Interviewer characteristics	8	What characteristics were reported about the inter viewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	86 & 216
Domain 2: Study design			
Theoretical framework			
Methodological orientation and Theory	9	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	88
Participant selection			
Sampling	10	How were participants selected? e.g. purposive, convenience, consecutive, snowball	142
Method of approach	11	How were participants approached? e.g. face-to-face, telephone, mail, email	142
Sample size	12	How many participants were in the study?	147
Non-participation	13	How many people refused to participate or dropped out? Reasons?	147
Setting			
Setting of data collection	14	Where was the data collected? e.g. home, clinic, workplace	144
Presence of non-participants	15	Was anyone else present besides the participants and researchers?	144
Description of sample	16	What are the important characteristics of the sample? e.g. demographic data, date	148
Data collection			
Interview guide	17	Were questions, prompts, guides provided by the authors? Was it pilot tested?	143
Repeat interviews	18	Were repeat inter views carried out? If yes, how many?	N/A
Audio/visual recording	19	Did the research use audio or visual recording to collect the data?	144
Field notes	20	Were field notes made during and/or after the inter view or focus group?	144
Duration	21	What was the duration of the inter views or focus group?	147
Data saturation	22	Was data saturation discussed?	N/A
Transcripts returned	23	Were transcripts returned to participants for comment and/or correction?	No
Domain 3: analysis and findings			
Data analysis			
Number of data coders	24	How many data coders coded the data?	145
Description of the coding tree	25	Did authors provide a description of the coding tree?	145 & 148
Derivation of themes	26	Were themes identified in advance or derived from the data?	145
Software	27	What software, if applicable, was used to manage the data?	145
Participant checking	28	Did participants provide feedback on the findings?	No
Reporting			
Quotations presented	29	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	145-169
Data and findings consistent	30	Was there consistency between the data presented and the findings?	145-169
Clarity of major themes	31	Were major themes clearly presented in the findings?	145-169
Clarity of minor themes	32	Is there a description of diverse cases or discussion of minor themes?	145-169

Developed from: Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*. 2007. Volume 19, Number 6: pp. 349 – 357

Once you have completed this checklist, please save a copy and upload it as part of your submission. DO NOT include this checklist as part of the main manuscript document. It must be uploaded as a separate file.