PHYSIOTHERAPY MANAGEMENT OF PATIENTS WITH CORONARY ARTERY DISEASE: A REPORT ON CURRENT PRACTICE IN SOUTH AFRICA

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DECLARATION

I, Jamie Reizenberg, declare that this research is my own work. It is being submitted for the degree of Master of Science in Physiotherapy at the University of Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University.

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ABSTRACT

Introduction

Coronary artery disease (CAD) is a global health problem and remains a major cause of morbidity and mortality internationally. South Africa has a high prevalence of CAD, with many patients requiring medical, surgical and physiotherapy management. Physiotherapists play an important role in providing cardiac rehabilitation to CAD patients in the hospital and out-patient settings. The last report on physiotherapy management of patients with CAD was published in 2011.

Objectives

This study aimed to establish the number and years of experience of physiotherapists who work in the cardiopulmonary field and are currently involved in the care and rehabilitation of patients with CAD; determine the current physiotherapy interventions and outcome measures used in the management of patients with CAD; identify the referral systems used for referring patients with CAD to physiotherapy rehabilitation within the acute care and out-patient settings; identify the clinical settings (e.g. acute care or outpatient clinic) in which physiotherapy rehabilitation interventions for patients with CAD currently take place, the frequency of these interventions (acute and chronic phase), physiotherapists' involvement in providing structured phase three cardiac rehabilitation programmes in an outpatient setting, and outcome measurement tools used in patient care.

Methodology

A descriptive cross-sectional study using a survey questionnaire was performed. The authors of the 2011 report provided permission to use a modified version of their questionnaire for this survey. The modified questionnaire underwent content and face validation, and the final version of the questionnaire was captured on REDcap. Ethical clearance was obtained through the University of Witwatersrand Human Research Ethics (Medical) Committee before commencement of the survey (Clearance Certificate Number M220313). The link to the questionnaire was electronically distributed via the secretariate of the SASP to their physiotherapy members in South Africa. Responses from physiotherapists involved in rehabilitation of patients with CAD in the acute care or out-patient setting were included in analysis whereas responses received from physiotherapy students, assistants or technicians were excluded from analysis. Descriptive statistics were used to summarise the data as numbers and percentages (categorical data) and means and standard deviations (normally distributed continuous data) or median and interquartile ranges (non-normally distributed continuous data) and range (minimum and maximum). An inductive approach to coding was used to analyze the qualitative responses to the open-ended questions. Codes were identified and grouped into themes to build a comprehensive image of the collective responses of the participants. Questionnaires with more than 50% of incomplete responses were not included in the data analysis.

Results

Forty-six questionnaires were submitted to REDcap of which 37 were included in the final analysis. Results showed that most physiotherapists working in the hospital setting, in private practice (n=28, 76%) provided care to patients with CAD. Most physiotherapists working in a cardiopulmonary capacity had an average of 10 years of experience and were treating patients in the medical ICU (n=26, 70%) and surgical wards (n=26, 70%) post coronary artery bypass graft (CABG) surgery (n=21, 72%) and post myocardial infarction (MI) (n=21, 72%). Patients with CAD were mostly referred to physiotherapy by a specialist or surgeon in both the in-hospital and out-patient settings. In-hospital treatment was mostly provided twice daily (n=20, 67%). ACBT (n=25, 81%), DBE (n=23, 74%), incentive spirometry (n=21, 68%), manual techniques (n=22, 71%), circulatory exercises (n=25, 80%), graded mobilisation (n=26, 84%), and home exercise guidelines (n=23, 74%) were mostly used in the hospital setting. In the out-patient setting, strengthening exercises (n= 15, 50%), home exercise programmes consisting of specific exercises (n= 15, 50%), graded mobilisation (n=14, 47%), home exercises guidelines (n=12, 40%) and ACBT (n=12, 40%) were commonly used, however, many physiotherapists did not provide out-patient care to CAD patients (n=14, 47%). Of those who did provide out-patient care, (n=11) 38% reported providing this service once a week. Presence of secretions (n=23, 82%), incentive spirometry (n=18, 64%), VAS pain scale (n=17, 61%), and the 6MWT (n=17, 61%) were the most common outcome measurements used. The provision of phase three cardiac rehabilitation remains insufficient at (n=7, 23%), similar to the findings of the 2011 study.

Conclusion

Results of the present study were similar to that of the 2011 report. Treatment interventions such as breathing exercises and early mobilisation were in line with the literature. South African physiotherapists still mostly provide manual techniques as part of patient care. Phase two and three cardiac rehabilitation programmes are scarce despite a large population of CAD patients requiring rehabilitation. This study lays the foundation for further research in this field. Physiotherapy management of CAD patients in the public healthcare setting should be explored using the survey. Future research should include reporting on the clinical profiles of patients undergoing CABG surgery in South Africa, as well as the effect that physiotherapy has on their outcomes. Barriers and facilitators to physiotherapy provision of CAD patients should be explored.

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LIST OF ABBREVIATIONS

6MWT	- 6 Minute Walk Test
CABG	- Coronary Artery Bypass Graft
CAD	- Coronary Artery Disease
CPAx	- Chelsea Physical Assessment Tool
DEMMI	- de Morton Mobility Index
ECG	- Electrocardiogram
FSS-ICU	- Functional Status Score for the Intensive Care Unit
HIV	- Human immunodeficiency Virus
ICU	- Intensive Care Unit
IS	- Incentive Spirometer
MRC	- Medical Research Council
MMRC	- Modified Medical Research Council
NSTEMI	- Non ST Elevation Myocardial Infarction
NYHA	- New York Heart Association
PCI	- Percutaneous Coronary Intervention
PFIT	- Physical Function in ICU Test
SASP	- South African Society of Physiotherapy
SF-36	- Short Form 36 Questionnaire
SPPB	- Short Physical Performance Battery
STEMI	- ST Elevation Myocardial Infarction
VAS	- Visual Analog Scale

CHAPTER 1

1. INTRODUCTION

1.1 BACKGROUND

Coronary artery disease (CAD) is a global health problem and a disease which has long plagued South African citizens (Roos & Van Aswegen, 2011). It remains a major cause of mortality internationally (Anderson et al., 2016). In 2018, The Global Burden of Disease Study (2019) listed South Africa within the top three African countries highly affected by incidences of heart disease (Roth et al., 2020). In South Africa, CAD is one of the top 10 causes of mortality alongside Human Immunodeficiency Virus (HIV) and Tuberculosis (Abdelatif et al., 2021). Nowbar (2019) reported that westernised lifestyles have increased the risks of developing CAD in South Africans. Risk factors such as poor nutritional status, obesity, excessive alcohol consumption, smoking habits and sedentary lifestyles are relevant to Africans due to rapid development of the country (Shehu et al, 2023). Most of these risk factors are behavioural risk factors. A considerable portion of the South African population live in poor socioeconomic conditions which further contributes to the development of CAD through behavioural risk factors. More than 60% of global deaths occur due to cardiac diseases and yet there is still a gap in national health policies in sub-Saharan Africa for their respective management (Hamid et al., 2019). According to Heine et al. (2019), even though South Africa has been at the forefront by providing the highest number of cardiac rehabilitation programmes in Africa, the demand for these programmes remains greater than the capacity. It is therefore understandable why the population of patients suffering with CAD and who experience associated incidences have increased, despite the overall decrease in mortality (Anderson et al., 2016). Physiotherapists who provide cardiac rehabilitation programmes play a pivotal role in educating patients with cardiovascular diseases about managing the condition safely to avoid cardiac events. The programmes consist of education regarding healthy lifestyle changes, proper nutrition, and supervised physical activity.

Physiotherapists are valuable in the management of patients with CAD in the acute and chronic phases of rehabilitation. Monyeki et al. (2012), confirm that physiotherapists are mainly responsible for exercise and mobilisation programmes for patients with CAD within the acute setting, after cardiac events. In a study undertaken by Roos & Van Aswegen (2011), it was noted that CAD presented earlier in those living with human immunodeficiency virus (HIV) which is rampant in South Africa. Owing to many reasons, patients with HIV are diagnosed with CAD earlier than the average and therefore require long-term cardiac monitoring and rehabilitation (Roos et al., 2014).

Roos and Van Aswegen (2011) provided the first report on the role of physiotherapy in the management of SA adults with CAD. Whether the physiotherapy management of these patients in South Africa has changed throughout the last decade is the question. It is undeniable that physiotherapy as a discipline is constantly evolving. Over the years, physiotherapy has evolved to adapt to progressions in medical and surgical regimes. Health care professionals are intentionally trying to better service the population to decrease the burden CAD places on the South African health care system. Since the emergence of evidence-based practice, research and initiative are praised and encouraged amongst physiotherapists because it allows for better allocation of resources and better outcomes for patients (World Physiotherapy, 2023). Evidence based practice entails physiotherapists making decisions regarding patient care by evaluating the best available research and considering the values and beliefs of the individual (Veras et al., 2016; World Physiotherapy, 2023). Through translation of the research findings into clinical practice, physiotherapists can treat their patients effectively, efficiently, and most importantly holistically, in their journey with CAD.

1.2 PROBLEM STATEMENT AND JUSTIFICATION OF RESEARCH

Coronary artery disease is a major cause of mortality internationally (Anderson et al., 2016). South Africa is a rapidly developing country that is deeply affected by CAD. Due to Africa's rapid development, an ever-increasing population combined with an increasing number of individuals with multiple risk factors (e.g. diabetes mellitus, obesity, smoking), the prevalence of CAD is increasing (Shehu et al, 2023). Whilst it is common knowledge that physiotherapists play a vital role throughout different stages in the management of this condition (Main & Denehy, 2016), current practice in South Africa has not been comprehensively updated since 2011. South African physiotherapists manage patients in the acute phase of rehabilitation (after cardiovascular incidents and post-operatively) and continue the rehabilitation process post discharge from hospital. Currently, the last study investigating the physiotherapy management of patients with CAD in South Africa was published in 2011 and only accounted for physiotherapy practice in the Gauteng province. In the 2011 report by Roos & van Aswegen it was stated that evidence-based interventions in patient management were inconsistent and that physiotherapists were not involved in out-patient cardiac rehabilitation programmes for these patients. This study will contribute to the available body of literature about CAD and account for the current physiotherapy practice throughout South Africa. Reporting on the current management could provide an opportunity to assess whether current management in South Africa is evidence-based.

1.3 RESEARCH QUESTION

What is the current physiotherapy management of patients with coronary artery disease in South Africa?

1.4 SIGNIFICANCE OF RESEARCH

The study conducted by Roos & Van Aswegen (2011), focused on the physiotherapy management of patients with CAD specifically in the Gauteng province. The study revealed that the use of evidence-based interventions were inconsistent and that phase three cardiac rehabilitation was poorly implemented and maintained. An updated report may provide insight into how the physiotherapy management of patients with CAD has evolved alongside the medical and/or surgical management of this patient population over the last ten years. Findings will contribute to the limited body of knowledge that exists about the physiotherapy management of patients with CAD in a South African setting. This study could form the foundation on which further research could be done to determine the efficacy of treatment interventions used in the management of patients with CAD on their clinical outcomes.

1.5 RESEARCH AIM

To determine the current physiotherapy management of patients with CAD in South Africa.

1.6 RESEARCH OBJECTIVES

- To establish the number and years of experience of physiotherapists who work in a cardiopulmonary field and are currently involved in the care and rehabilitation of patients with CAD.
- To determine the current physiotherapy interventions and outcome measures used in the management of patients with CAD.
- To identify the referral systems used for referring patients with CAD to physiotherapy rehabilitation within the acute care and out-patient settings.
- To identify the clinical settings (e.g. acute care or outpatient clinic) in which physiotherapy rehabilitation interventions for patients with CAD currently take place, the frequency of these interventions (acute and chronic phase), and physiotherapists' involvement in providing structured phase three cardiac rehabilitation programmes in an outpatient setting.

1.7 TYPE OF STUDY

A descriptive cross-sectional study using a survey questionnaire was performed.

CHAPTER 2

2. LITERATURE REVIEW

Literature search was performed using Google scholar, Pedro, Cochrane database and PubMed. The search was filtered to the years 2013 to 2025. Key words used to search for appropriate literature included: coronary artery disease, cardiac rehabilitation, coronary artery bypass graft surgery, coronary artery disease in South Africa, physiotherapy, cardiac rehabilitation, incentive spirometry, cardiac rehabilitation outcome measures, manual techniques, early mobilization, incentive spirometry, breathing exercises, frequency of cardiac rehabilitation, 6 Minute Walk Test, amount of secretions, post-operative pulmonary complications, coronary artery disease South Africa. Only literature written in English language were used.

2.1 INCIDENCE AND PREVALENCE OF CORONARY ARTERY DISEASE

Cardiovascular disease is a leading cause of morbidity and mortality globally (Hamid et al., 2019). Fifteen percent of deaths worldwide are attributed to CAD (De Waure et al., 2013) with the sub-Saharan African population being diagnosed nearly two decades earlier than populations in high income countries (Yuyun et al., 2020). Coronary artery disease involves blockages within the coronary arteries due to atherosclerosis resulting in narrowing of the vessel and consequently decreased blood flow to the myocardium (Graham et al., 2020).

Coronary artery disease is associated with a high incidence of hospital admission and cardiac events such as myocardial infarction, cerebrovascular incidents and death (De Waure et al., 2013). Urbanisation of Africa has led to an increased prevalence of CAD due to lifestyle risk factors such as poor nutrition, smoking habits, obesity and sedentary lifestyles (Nowbar, 2019). Additionally, individuals with HIV develop atherosclerosis earlier than the general population which is important to note as HIV infected individuals living in South Africa constitute the majority of the sub-Saharan African HIV positive population (Manga, 2015). The global burden of atherosclerotic cardiovascular-related disease has tripled in the last twenty years with more than fifteen percent of the cardiovascular disease burden attributed to HIV being in South Africa, Lesotho, Swaziland and Botswana (Shah et al., 2018). Persons living with HIV are diagnosed with CAD earlier than non-infected persons due to vascular dysfunction caused by viral replication, altered lipid profiles, medication toxicity, lifestyle factors and chronic inflammation (Hsue et al., 2012). Shah et al. (2018) state the possibility for CAD correlation to the HIV population could be due to chronic inflammation contributing to endothelial dysfunction, and systemic and arterial inflammation.

2.2 SURGICAL MANAGEMENT OF CAD AND THE ROLE OF THE PHYSIOTHERAPIST IN THE ACUTE HOSPITAL SETTING

Surgical Procedures

Invasive surgical interventions are deemed necessary when patients with CAD are not optimized with medical intervention alone and are at high risk of cardiac events (Main & Denehy, 2016).

Percutaneous coronary interventions (PCI) refer to a group of procedures employed for the revascularization of coronary arteries (Main & Denehy, 2016). Percutaneous coronary intervention includes coronary angiography and revascularisation procedures such as balloon angioplasty and the placement of intracoronary stents (Kolkhaila et al., 2018). Kolkhaila et al. (2018) describe PCI as a diagnostic and therapeutic procedure. Coronary artery disease is caused by atherosclerosis within the coronary arteries with the formation of plaques resulting from intimal thickening and lipid accumulation (Main & Denehy, 2016). Revascularisation of the coronary arteries is achieved through accessing peripheral arteries, usually the femoral or radial arteries, to mechanically dilate stenosed segments of the coronary arteries thus restoring perfusion to the myocardium (Kolkhaila et al., 2018). Though often performed during acute coronary syndromes such as in an acute myocardial infarction when a patient presents with debilitating symptoms (e.g. chest pain, left arm pain, jaw or back pain, decreased exercise tolerance, shortness of breath), PCI are also performed in patients who do not respond optimally to medical management of CAD (discussed in section 2.3 below) (Kolkhaila et al., 2018).

Coronary artery bypass grafting (CABG) involves surgically bypassing stenosed arteries using venous or arterial graft conduits commonly grafted from the saphenous vein, left internal thoracic artery, or the right internal mammary artery (Main & Denehy, 2016). Arteries are preferred conduits since their patency is higher than that of veins in the long term (Main & Denehy, 2016). A variety of options exist for vessels that may be used as vascular conduits for CABG surgery. The surgeon will consider the patient's past medical history and the morphological characteristics of the conduit and coronary arteries to make the decision (Martínez-González et al., 2017). Morphological characteristics of the graft such as length, wall thickness, and luminal diameter are considered as these will affect the durability, permeability, and therefore long-term function of the graft (Martínez-González et al., 2017). Martínez-González et al. (2017) reviewed morphological studies on conduits used in CABG surgery. They reported that the internal thoracic artery, radial artery, and right gastroepiploic artery are the best conduits for long-term patency due to their similarities to the grafted coronary arteries.

Coronary artery bypass graft surgery is performed under general anesthetic, via a median sternotomy with cardiopulmonary bypass or with the heart arrested (Main & Denehy, 2016). The procedure takes two to three hours if no complications arise (Main & Denehy, 2016). Post-operative complications are common and significantly contribute to morbidity and mortality. Patients may experience complications such as wound sepsis, cerebrovascular accidents, pericardial effusion, and renal failure (Montrief et al., 2018) Common post-operative pulmonary complications include pneumonia, pleural effusion and atelectasis (Mali & Haghaninejad, 2019). For the physiotherapy management of these conditions, refer to section: physiotherapy interventions.

Post-operative Complications

In a review discussing anesthesia complications, Mills (2018) describes anesthesia and post-operative analgesia as constituents of impairing respiratory drive, immune function, and the patient's ability to actively cough. Anesthetic drugs such as propofol, barbiturates, and opioids such as morphine contribute to imbalances in immune markers (c-reactive protein markers), which further contribute to the development of postoperative pulmonary complications post-CABG (Mali & Haghaninejad, 2019). Morphine is known to cause respiratory depression and reduction in macrophage activity, thereby further contributing to post-operative pulmonary dysfunction (Mali & Haghaninejad, 2019).

When describing respiratory physiotherapy management in the critical care unit, Pathmanathan et al. (2015), reinforce this by stating that when a patient is mechanically ventilated and sedated the cough reflex is impaired (mucociliary function is diminished), the presence of secretions is a potential growth medium for bacteria which may lead to pneumonia. Additionally, the presence of the endotracheal tube also interferes with the cough reflex and can cause the transfer of bacteria from the oropharynx (Pathmnathan et al., 2015).

The prolonged supine position of the patient during CABG surgery also contributes to ventilation-perfusion mismatch, contributing to pulmonary dysfunction and the development of pulmonary complications such as atelectasis and pneumonia (Mali & Haghaninejad, 2019). Atelectasis is commonly associated with anesthesia (Mills, 2018). In a prolonged supine position, the functional residual capacity of the lungs may decrease, leading to the collapse of alveoli in dependent lung regions, causing atelectasis (Pathmanathan et al., 2015).

Physiotherapy Interventions

Cardiac rehabilitation consists of three phases: phase one refers to rehabilitation that begins in the acute stage of recovery, during admission to the intensive care unit after cardiac events

(McMahon et al., 2017), aimed at preventing deconditioning post-surgery (Main & Denehy, 2016). Phase two cardiac rehabilitation is a programme that continues for six to 12 weeks after hospital discharge, where patients' physical activity and exercise plans are monitored and adjusted under supervision. Phase three involves a supervised exercise rehabilitation programme designed collaboratively between the patient and therapist to achieve patient-specific goals (McMahon et al., 2017). In the United States, cardiac rehabilitation is a class one recommendation for patients with CAD and for those who are survivors of cardiac events (Graham et al., 2020). Pesah et al. (2017) reviewed the delivery of cardiac rehabilitation around the world and found that information was only available for half of the countries globally.

Anderson et al. (2016), and Denehy et al. (2018) note the initiation of cardiac rehabilitation phase one with the pre-operative assessment of patients with CAD (as part of physiotherapy intervention) to determine risk factors for the development of acute cardiac events, postoperative complications as well as to encourage patient compliance through providing education (Main & Denehy, 2016). In the acute setting, this assessment is often only viable in non-emergency cases (Lomi & Westerdahl, 2013). The cardiac procedure or surgery is explained to patients, and the post-operative precautions are emphasized during the pre-operative assessment (Lomi & Westerdahl, 2013). This is usually an experience that allows patients the opportunity to discuss their goals and expectations for post-operative care and life beyond the hospital stay with the physiotherapist.

Early commencement of respiratory physiotherapy as part of phase one cardiac rehabilitation often begins in the ICU as soon as patients are extubated and hemodynamically stable post-CABG surgery (Main & Denehy, 2016). Peripheral and respiratory muscle strength are benefits of early mobilization (Pathmanathan et al., 2015). Early commencement of respiratory physiotherapy as part of phase one cardiac rehabilitation prevents post-operative pulmonary complications by encouraging breathing exercises to maintain optimal lung volumes, encourage effective coughing, and aid the removal of secretions.

Westerdahl & Olsén (2011), Lomi & Westerdahl (2013), and Ravaliya (2013) highlight common treatment interventions used for patients with CAD post-CABG. These interventions and patient management in the acute setting are phase one of cardiac rehabilitation. Westerdahl & Olsen (2011) investigated chest physiotherapy and breathing exercises post-cardiac surgery in Sweden. Positive expiratory pressure exercises with resistance levels between two and 20 cm H_2O were used by most physiotherapists. In the first few days post-operatively, patients were recommended to perform their breathing exercises every hour and during physiotherapy treatment between four and 30 repetitions per session. Coughing

facilitation was also commonly used. Lomi & Westerdahl (2013) also investigated physiotherapy management of patients' post-cardiac surgery in Greece. Deep breathing exercises and incentive spirometry were the most common treatment interventions used in the first four days after surgery. During the first two days post-operatively, patients were instructed to perform their breathing exercises one to four times a day, and repetitions varied between one and 40 breaths. Other interventions used in their studies include exercises and early mobilization to decrease the likelihood of developing neuromuscular weakness, improve circulation, and ultimately improve mobility and function during the hospital stay (Lomi & Westerdahl, 2013; Westerdahl & Olsen, 2011). Exercises done post-operatively may include gentle shoulder or thoracic range of motion exercises (Sturgess et al., 2014; Westerdahl & Moller 2010), circulatory exercises, graded mobilization in and out of bed, strength exercises, and transferring out of bed (Galih et al., 2022; Westerdahl & Moller, 2010). An active thoracic exercise programme provided with standard physiotherapy post-CABG improved active thoracic range of motion, reduced pain (in the sternum, thorax, anterior chest and shoulders), and enhanced health-related quality of life in a single-blinded pilot trial in Australia (Sturgess et al., 2014). Early mobilization out of bed improves overall circulation, oxygen perfusion and prevents post-operative respiratory complications such as atelectasis and pleural effusions (Galih et al., 2022). In Iran, studies showed that respiratory exercises and early mobilization were both part of phase one cardiac rehabilitation and when initiated as early as two hours after extubation, were beneficial (Galih et al., 2022).

Similarly, in a retrospective study by Ravaliya (2013), 65 patients who underwent CABG surgery in India were managed with pre-operative and post-operative breathing exercises (with incentive spirometry), thoracic mobility exercises and early mobilization. Eighty percent of patients did not experience post-operative complications and were found to be functionally independent from as early as day six post-operatively.

Early commencement of respiratory exercises such as deep breathing exercises, thoracic expansion exercises, and diaphragmatic breathing immediately after extubation can improve lung function and reduce chest pain post-CABG surgery (Pathmanathan et al., 2015; Galih et al., 2022); however, specific breathing exercises vary, and no standard appears to exist amongst physiotherapists globally. Breathing exercises improve functional residual capacity, tidal volumes, and oxygenation (Pathmanathan et al., 2015). Breathing exercises also involve effective cough training with wound support to facilitate clearance of secretions, further preventing atelectasis and pneumonia (Pathmanathan et al., 2015; Galih et al., 2022). Incentive spirometers were also useful in avoiding atelectasis by increasing lung volume; the patient is encouraged to deeply inhale through the device which gives biofeedback based on how much volume has been inspired (Pathmanathan et al., 2015).

After assessing the patient and identifying impairments, physiotherapists may use manual techniques such as chest wall percussions, vibrations, and shaking to facilitate the clearance of mucus. When indicated and deemed safe, physiotherapists may apply manual chest physiotherapy techniques (Pathmanathan et al., 2015). They also perform suctioning if the patient cannot effectively expectorate tenacious secretions (Pathmanathan et al., 2015) due to poor cough effort. Respiratory physiotherapy techniques promote lung expansion, enhance respiratory muscle strength, and help remove secretions post-CABG surgery (Mohammed et al., 2020). Early initiation of respiratory physiotherapy techniques is both safe and effective when patients are fully assessed and hemodynamically stable after surgery (Pathmanathan et al., 2015).

In Australia, physiotherapists have shifted their focus toward prioritizing exercise-based rehabilitation rather than exclusively relying on conventional breathing exercises and airway clearance techniques (Denehy et al., 2018). Mobilization is emphasized, and other interventions are employed when indicated; this approach has yielded positive results, such as improved physical and cognitive functional outcomes at hospital discharge (Denehy et al., 2018). Additionally, Anderson et al. (2016) described how exercise-based rehabilitation for patients with CAD produced the best outcomes in reducing hospital stay length and the risk of developing post-operative complications. Albus et al. (2019), Anderson et al. (2016), and Galih et al. (2022) reported that exercise-based cardiac rehabilitation enhanced overall health-related quality of life when delivered alongside psychological and educational interventions. Lifestyle changes and distress management further lowered the risk of cardiac incidents (Anderson et al., 2016). Benefits of cardiac rehabilitation in low- to middle-income countries included improvements in systolic blood pressure, functional capacity, and quality of life (Mamataz et al., 2022).

In Sweden, during phase one cardiac rehabilitation, patients received one to three treatments per day and most treatments focused on exercise, mobilisation and chest clearance techniques (Westerdahl & Olsen, 2011). In Greece, patients received up to six treatments daily (Lomi & Westerdahl, 2013).

2.2.1 South African Physiotherapy Management of Patients with CAD who Underwent Surgical Management

In South Africa, physiotherapists treating patients with CAD reported using various treatment techniques to manage patients' post-surgery (Roos & Van Aswegen, 2011). Chest physiotherapy techniques including chest wall percussions, vibrations, shaking, postural

drainage, breathing exercises (e.g. deep breathing exercises, active cycle of breathing technique, intermittent positive pressure breathing, positive expiratory pressure, incentive spirometry), and supported coughing were utilized (Roos & Van Aswegen, 2011). Patients were also managed with graded mobilization, strengthening exercises, home exercise programmes, and education regarding post-operative CABG sternal precautions, and CAD risk factors (Roos & Van Aswegen, 2011).

A study by Maddocks & Cobbing (2017) in Kwazulu-Natal, South Africa, investigated the perceptions of patients who underwent CABG surgery who received early cardiac rehabilitation phase one in a government institution. The physiotherapists in this study utilized early mobilization out of bed during the first three days post-operatively and respiratory care during admission (Maddocks & Cobbing, 2017). On the third post-operative day, group classes were initiated consisting of low to moderate-intensity exercises such as marching on the spot, squatting and education regarding CAD risk factors and exercise guidelines (Maddocks & Cobbing, 2017). Patients concluded that the programme was beneficial for their functional capacity at discharge but felt that the programme lacked a patient-centered approach. Had they been educated on individualized risk factor modification; they would have been better equipped to make lifelong changes and continue participation in cardiac rehabilitation after discharge. Poor communication between participants and health care workers was a barrier to fully understanding the education on CAD prevention. Participants also felt that there was a lack of information provided by health care workers. Phase one cardiac rehabilitation was only carried out by physiotherapists, and this was the only institution performing CABG surgery in the region (Maddocks & Cobbing, 2017). This study did not indicate the frequency of treatment sessions in the first three days post-CABG surgery, however, does mention that after the third post-operative day, patients were then placed into exercise groups which took place biweekly.

In a clinical trial, Hanekom & Klopper (2014) assessed the benefits of an intensity-based exercise programme during phase one of cardiac rehabilitation of post-CABG patients in a private institution in Cape Town, South Africa. The study reported that the functional capacity of the exercise group was significantly higher than the control group at discharge from the hospital (Hanekom & Klopper, 2014). Both the control and intervention groups received one pre-operative physiotherapy session before surgery and routine chest physiotherapy with early mobilization within the ICU. The intervention group received an intensity-regulated exercise programme based on cardiovascular responses to exercise and the presence or absence of unwanted symptoms (e.g. chest pain, dizziness, dyspnoea).

In Gauteng, South Africa, patients received treatment one to two times daily during the hospital stay (Roos & Van Aswegen, 2011). Some participants in Gauteng who worked in an out-patient setting provided phase two and three cardiac rehabilitation on a weekly basis after hospital discharge; however, of the total group of participants, most physiotherapists did not provide a phase two or three cardiac rehabilitation programme (Roos & Van Aswegen, 2011).

2.3 CONSERVATIVE MANAGEMENT OF CAD AND THE ROLE OF THE PHYSIOTHERAPIST IN THE IN-PATIENT AND OUT-PATIENT SETTING

Conservative management of CAD is possible in low to moderate risk, stable patients and involves optimisation of anti-anginal medication, lifestyle and diet change, smoking cessation, weight loss and exercise programmes (Rezkallah & Kloner, 2023). The goal of such management is to reduce risks of acute cardiac events and improve quality of life (Main & Denehy, 2016). Diagnosis of CAD is made through various diagnostic tests; however, may be made provisionally based on risk and the presence of ischaemic symptoms (Main & Denehy, 2016).

Computerised tomography coronary angiogram is a diagnostic imaging tool used to visualise arterial blood flow to the heart. Without left main coronary artery disease or proximal triple vessel disease on computerised tomography coronary angiogram, Rezkallah & Kloner (2023) suggest conservative medical management. Low to moderate risk is defined by this study as experiencing symptoms of CAD such as mild angina, New York Heart Association classification of below three and left ventricular ejection fraction above 35% (Rezkallah & Kloner, 2023).

Through ten skin electrodes, the twelve lead electrocardiogram (ECG) represent and depict the electrical activity of the heart (Main & Denehy, 2016). The voltage between electrodes in the frontal and sagittal planes depict a pattern or waveform associated with depolarization and repolarization of the myocardium (Main & Denehy, 2016). Cardiac pathology can be diagnosed based on the presence and absence of normal P,Q,R,S,T components of the waveform and also based on the duration, regularity, distance between, and amplitude of the waveform on the ECG (Main & Denehy, 2016). The electrocardiogram is one of the most common diagnostic tools used in diagnosing CAD in symptomatic patients (Main & Denehy, 2016).

Acute myocardial infarction can be seen by changes (specifically elevation) in the S and T component of the ECG which classifies what is known as a STEMI (S-T elevation myocardial infarction) (Main & Denehy, 2016). A myocardial infarction may still present in the absence

of S-T elevation, and this is known as an NSTEMI (non S-T elevation myocardial infarction). In the event of an NSTEMI, myocardial infarction may be diagnosed with positive biomarkers on blood tests (usually Troponin levels) which indicate myocardial necrosis (Main & Denehy, 2016). Myocardial damage due to ischaemia and arrhythmias is detected and diagnosed using a stress ECG where the patient walks on a treadmill; the workload is progressively increased by increasing the gradient and speed on the treadmill and abnormalities in the blood pressure and abnormalities on ECG are monitored (Main & Denehy, 2016). With S-T segment depression, T wave inversion and lowered systolic blood pressure are indicators of myocardial ischaemia (Main & Denehy, 2016)

Various combinations of medication may be used to manage CAD. Antiplatelet agents such as aspirin and non-steroidal anti-inflammatory drugs have various mechanisms for preventing thrombotic events (Malakar et al., 2019). Beta-blockers may be used independently or with a calcium antagonist to prevent ischemia of the myocardium by reducing heart rate and metabolic requirements of the heart (Malakar et al., 2019). Beta-blockers are reported to relieve angina by reducing oxygen demand on the myocardium while improving oxygen supply (Malakar et al., 2019).

Physiotherapists provide cardiac rehabilitation programmes at various stages of CAD, playing an important role in providing education regarding lifestyle change and establishing graded exercise programmes (Denehy et al., 2018). Regardless of whether a patient receives conservative or surgical management, cardiac rehabilitation is important in establishing behaviours that prevent fatal cardiac events (De Waure et al., 2013). In conjunction with drug therapy and psychological support, tailored exercise programmes address problems such as a sedentary lifestyle, nutritional deficiency, correction of lipid profile abnormalities and glucose levels, and management of stress and obesity (De Waure et al., 2013). A systematic review by De Waure et al. (2013), reported that in the USA and Europe, the benefits of cardiac rehabilitation initiation included a reduction in total cardiovascular mortality (reduction by 13%) and hospital admissions due to myocardial infarction, percutaneous transluminal coronary angioplasty, angina and CABG. Despite the many benefits provided by cardiac rehabilitation, barriers to delivery of this service exists. Barriers to phase two and three cardiac rehabilitation programmes such as lack of transportation, lack of medical insurance and loss of income during hospital admission, resulted in poor compliance as reported by McMahon et al. (2017) in the United States of America. For barriers to cardiac rehabilitation in South Africa, refer to section 2.4.

Phase one of cardiac rehabilitation begins during hospital admission due to chronic coronary disease (Yue et al., 2022). During phase one of cardiac rehabilitation, a physiotherapist may

consult a patient pre-operatively to assess cardiorespiratory function, provide education, and begin goal setting. Education regarding risk factors, mobilization out of bed, walking, and even stair climbing is supervised by physiotherapists in the hospital. These functional activities are used to gauge functional capacity and establish symptoms or limitations (Main & Denehy, 2016). A home exercise programme that encourages patients to walk every day and increase their distance and speed over time while monitoring symptoms is encouraged before hospital discharge (Main & Denehy, 2016). Before discharge from the hospital, patients should be educated on how to rate their perceived level of exertion using the BORG rating of perceived exertion scale and understand the symptoms and limitations of exercise (Main & Denehy, 2016). Basic home exercises may also be prescribed alongside the walking programme with guidelines regarding the type, frequency, and intensity of regular activity. Phase one of cardiac rehabilitation enhances functional capacity and cardiopulmonary function (Tian et al., 2019).

Phase two of cardiac rehabilitation begins at hospital discharge and may continue up to 12 weeks (McMahon et al., 2017). Phase two cardiac rehabilitation involves supervised outpatient exercise programmes (McMahon et al., 2017) and risk factor management (Kachur et al., 2017). During this phase of rehabilitation, physiotherapists may reinforce home exercises and progress walking time to ideally 30 minutes, twice a day (Main & Denehy, 2016). This part of the prescription should be individualized per patient as the programme needs to be realistic and safe for the patient to do independently (Main & Denehy, 2016). Patients who have undergone CABG or valve replacement surgery, PCI, have known stable heart failure, stable angina, post-pacemaker insertion, post-heart transplantation, and other atherosclerotic diseases such as transient ischaemic attacks, are all eligible for cardiac rehabilitation (Kachue et al., 2017, Main & Denehy, 2016).

The exercise training component of phase two and three cardiac rehabilitation has numerous positive effects including facilitating return to function, secondary prevention of cardiac events, and improved quality of life (Main & Denehy, 2016). Exercise may reduce the incidence of cardiovascular events by improving artery endothelial function and reducing inflammation (Main & Denehy, 2016). Regular exercise training reduces the likelihood of cardiovascular events by preventing thrombus formation and the potential for dangerous cardiac arrhythmias (Main & Denehy, 2016). During phase two of cardiac rehabilitation, exercise programmes are the foundation of establishing active lifestyles. The treating physiotherapist should encourage an overall elevated level of safe and manageable activity for the patient at this stage (Main & Denehy, 2016).

Pedretti et al. (2018) found that 89% of European countries provided phase three cardiac rehabilitation programmes. Phase three of cardiac rehabilitation begins at 12 weeks post-hospital discharge. During phase three of cardiac rehabilitation, patients set goals with their physiotherapist to achieve their ideal functional capacity level to participate in activities important to their quality of life. During this phase of cardiac rehabilitation, patients participate in resistance and aerobic exercise training based on their exercise capacity. Exercise programmes may be progressed or remain the same to maintain a level of physical activity the patient is satisfied with. The effects of exercise with increased load are monitored by the physiotherapist and feedback from the patient regarding symptoms is noted (Main & Denehy, 2016). Once the patient is comfortable, supervision with exercise is reduced and the patient continues their programme at home or within their community.

In order for phase three cardiac rehabilitation programmes to be safe, the programme should ideally be functioning in a safe and controlled environment where all multi-disciplinary team members are equipped to manage emergencies. Equipment should be checked regularly, water available, emergency equipment should be readily available and in good working condition, venue access should be identified and clearly labelled, and temperature and ventilation should be well controlled (Main & Denehy, 2016).

After phase three of cardiac rehabilitation (12 weeks), the patient no longer requires supervision with exercise and risk factor modification. The patient is expected to maintain their preferred level of physical activity and follow up with their primary care physician as recommended.

2.3.1 South African Physiotherapy Management of Patients with CAD who Underwent Conservative Management

Updated literature about cardiac rehabilitation and conservative management of patients with CAD is limited in South Africa compared to around the world.

Heine et al. (2019) reported on the delivery of cardiac rehabilitation in Africa. They reported that of the cardiac rehabilitation programmes listed in Africa, South Africa provided majority (72%) of cardiac rehabilitation programmes. Cardiac rehabilitation programmes were defined by a team of health care professionals providing an initial assessment, a structured and supervised exercise regime, and at least one other strategy to manage CAD risk factors (Heine et al., 2019). Physicians, allied health care practitioners and community-based health care workers were referring patients to such programmes. Some patients were self-referred (Heine et al., 2019). Patients with acute coronary syndrome, cardiomyopathy, CAD requiring

PCI and congenital heart conditions were all accepted into cardiac rehabilitation programmes in South Africa (Heine et al., 2019).

Most programmes were found to be privately funded in South Africa, with participants from the upper-middle income population. It was noted that the team of health care professionals running such programmes usually consisted of a dietician, a physiotherapist, a biokineticist and an administrative assistant (Heine et al., 2019). All programmes provided an initial assessment, risk factor management, an exercise programme, education and a re-assessment upon discharge from the programme. What was found to be lacking in South African programmes was education on nutrition, stress management, smoking cessation and return to work counselling (Heine et al., 2019).

The management of patients with CAD was not investigated in South Africa prior to 2011, nor has it been since Roos & Van Aswegen (2011) study. At the time of the survey conducted by Roos & Van Aswegen (2011), questionnaires were distributed to 187 physiotherapists working in both the government and private health care sectors in Gauteng. Only 68% of these physiotherapists were involved in managing patients with CAD (Roos & Van Aswegen, 2011). Of these, only ten physiotherapists provided outpatient treatment to patients with CAD; however, the specific interventions used in the outpatient setting were not noted (Roos & Van Aswegen, 2011). It was not reported whether patients seen in the outpatient setting for cardiac rehabilitation were solely managed conservatively.

In recent years, exercise has become an important focus in cardiac rehabilitation programmes since evidence exists proving physical activity alongside lifestyle education favourably influences blood pressure, insulin sensitivity, lipid profiles, weight, and glucose homeostasis (Main & Denehy, 2016). This was demonstrated in the South African context through a randomized controlled trial by Roos et al. (2014) who investigated the effects of an education and home-based pedometer walking programme on ischemic heart disease risk factors in people infected with HIV. The control group received usual clinic follow-up for chronic medication and monitoring of vital signs. The intervention group received pedometers, activity diaries and five in-contact education sessions where topics such as ischaemic heart disease risk factors (in HIV positive individuals), benefits of exercise and how to monitor intensity of activities were discussed. The intervention group showed greater functional capacity at six month follow-up as 6MWT distances had greatly improved. Positive changes were seen in high-density lipoprotein profiles, blood glucose levels and waist-to-hip-ratios.

2.4 CHALLENGES TO THE PROVISION OF CARDIAC REHABILITATION SERVICES IN SOUTH AFRICA

One of the barriers to phase two and three cardiac rehabilitation provision by physiotherapists to patients with CAD, was inconsistent referral patterns from doctors (Roos & Van Aswegen, 2011). It is possible that physicians do not fully understand the benefits of an out-patient rehabilitation programme to patient recovery from CAD or CABG surgery. This lack of knowledge may contribute to poor referral of patients to cardiac rehabilitation which was also highlighted by McMahon et al. (2017).

Another challenge to the provision of cardiac rehabilitation services in South Africa is lack of communication. Maddocks & Cobbing (2017) reported that poor communication between health care workers and patients during the acute phase of rehabilitation contributed to a lack of understanding of the purpose and content of the programme. This led to poor referral and unequal access to cardiac rehabilitation programmes in Kwazulu-Natal, South Africa.

Lastly, lack of resources (e.g. space, time, and equipment) and poor patient compliance are barriers to the provision of phase three cardiac rehabilitation programmes in Gauteng province (Roos & Van Aswegen, 2011). These may also be barriers to service delivery related to cardiac rehabilitation within the larger context of South Africa and need to be explored in future research.

2.5 OUTCOME MEASURES USED IN PATIENT CARE

Outcome measures are measurement tools developed to assess the efficacy of treatment interventions, used at intervals throughout rehabilitation. Outcome measures are used by physiotherapists to objectively evaluate patient progress and assist in facilitating evidence-based practice (Main & Denehy, 2016). Evidence-based practice involves physiotherapists using the best available research to guide decision-making regarding patient management (Veras et al., 2016). Multiple outcome measures exist and may be utilized in cardiac rehabilitation. Outcome measures may be used as baseline measures or exit outcome measures from rehabilitation programmes (Main & Denehy, 2016). Exercise-based cardiac rehabilitation aims to address muscle strength, function, management of breathlessness, and functional exercise capacity (Marzuca-Nassr et al., 2022).

Outcome measures listed as options on the modified questionnaire used in this study will be discussed. Outcome measures in the modified questionnaire were similar to Roos & van Aswegen's 2011 publication; however, others were added based on the researcher's clinical experience in the field.

Visual Analogue Scale (VAS)

The Visual Analogue Scale (VAS) is a widely used tool for assessing pain and subsequent symptom relief. The VAS involves the patient indicating the severity of their pain in a continuous line, with one end (zero) indicating no pain and the opposite end (ten) indicating worst possible pain (Karcioglu et al., 2018). Scores between three and nine range between mild, moderate and severe pain. None of the South African literature pertaining to physiotherapy management of patients with CAD or post-CABG reported on this as an outcome measure.

Modified BORG Dyspnoea Scale

The BORG rating of perceived exertion scale is a numerical scale used to subjectively assess a patient's perceived level of exercise effort with feeling short of breath (Scherr et al., 2013). The scale is reliable and relatively simple, requiring little time to complete. The participant can select a number between zero and ten. Zero indicates no shortness of breath during exercise, a score of five indicates severe shortness of breath, and a score of ten indicates extreme shortness of breath with exertion. A study by Scherr et al. (2013) assessed a large cohort of participants during exercise testing. It was found that the BORG rating of perceived exertion scale highly correlated with heart rate and blood lactate concentration values. When prescribing exercise-based rehabilitation for patients with CAD, rating of perceived exertion and exercise intensity are important components in ensuring optimal exercise for health benefits and the safety of the prescribed programme (Scherr et al., 2013).

Roos et al. (2014) investigated the effects of an education and home-based pedometer walking programme on ischaemic heart disease risk factors in people infected with HIV. Participants of this study were taught to palpate their pulse for heart rate values and rate their perceived level of exertion using the BORG scale when participating in the walking programme They were also taught how to monitor the progression of their walking programme by aiming for a moderate level of exertion according to the BORG scale.

New York Heart Association (NYHA)

The NYHA classification is a functional classification used to classify the severity of heart failure symptoms and to establish the risk of morbidity and mortality in patients with heart failure (Bredy et al., 2018). Heart failure is a condition characterized by symptoms of exercise intolerance and cardiac congestion due to cardiac disease which may be congenital or acquired (Bredy et al., 2018). In a cohort of adults with congenital heart disease, Bredy et al. (2018) found that the NYHA classification was valid when classifying functional limitations. Objective measures of exercise capacity such as VO2 peak were highly correlated with the

NYHA classification tool. None of the South African literature pertaining to physiotherapy management of patients with CAD or post-CABG reported on this as an outcome measure.

Medical Research Council Sum Score (MRC sum score)

The MRC sum score is a manual muscle strength test commonly used in the intensive care unit (ICU) and is the sum of the muscle strength of the upper and lower limbs in co-operative patients (Jang et al., 2019). It is a reliable, valid outcome measure and typically used to identify ICU-acquired weakness, a common effect of critical illness, and prolonged periods of bedrest. An MRC sum score of 48 or less out of 60 indicates ICU-acquired weakness. The MRC sum score is a valuable tool appropriate for phase one of cardiac rehabilitation when patients recover from cardiac surgery in the ICU. It is, however, worth noting that the MRC sum score is a measurement of general muscle strength and despite low scores, patients may improve functionally in the absence of strength (Corner et al., 2013). None of the South African literature pertaining to physiotherapy management of patients with CAD or post-CABG reported on this as an outcome measure.

Functional Status Score for the Intensive Care Unit

The FSS-ICU assesses five functional tasks that test strength, endurance and physical function. The five tasks are rolling, transferring from supine to sitting, unsupported sitting, sit to stand, and ambulation. The tasks are scored in total out of 35 and higher scores mean higher functional independence. Main & Denehy (2016) regard these as clinically essential aspects of function. In a study done by Parry et al. (2015), the FSS-ICU was compared to Physical Function in Intensive Care Test (PFIT) and was found to be one of the most established outcome measures in terms of reliability and validity. It was shown to be responsive to change. This is meaningful when managing patients in the ICU as change allows for adaptation in intervention and ideally informs clinicians of patients' future trajectories regarding discharge home and reintegration into society. None of the South African literature pertaining to physiotherapy management of patients with CAD or post-CABG reported on this as an outcome measure.

Chelsea Critical Care Physical Assessment Tool

The Chelsea Critical Care Physical Assessment Tool (CPAx) is a pictorial chart scoring ten domains of physical ability out of fifty. Each domain is rated between zero (complete dependence) and five (complete independence) and added up. The ten domains are respiratory function, cough, bed mobility, moving from supine to sitting over the edge of the bed, dynamic sitting, sit to stand, standing balance, transferring from a bed to a chair, stepping and grip strength. The CPAx tool was developed to provide a holistic, practical and reproducible measure of physical function specifically in critically ill patients. Corner et al.

(2013) found the CPAx tool to have strong, positive correlations with the Glasgow Coma Scale (GCS), peak flow, cough and muscle strength in a cohort of patients admitted to the ICU. It was also valid, with strong internal consistency amongst physiotherapists. None of the South African literature pertaining to physiotherapy management of patients with CAD or post-CABG reported on this as an outcome measure.

De Morton Mobility Index (DEMMI)

In a study by Sommers et al. (2016), The De Morton Mobility Index's (DEMMI) clinometric properties were evaluated in the ICU patient population. It was originally developed to assess level of function in the elderly patient population but was also found to be reliable, valid and clinically feasible for the ICU population. This outcome measure assesses 15 domains of physical mobility with scores ranging from zero to one hundred with greater scores indicating greater independence. None of the South African literature pertaining to physiotherapy management of patients with CAD or post-CABG reported on this as an outcome measure.

Intensive Care Unit Mobility Scale

The ICU mobility scale is a ten-point mobility score used to assess the highest level of function of a patient during ICU admission. Tipping et al. (2016) conducted an observational study in Australia and New Zealand ICUs and found the ICU mobility scale to have a high construct validity. It was highly correlated to muscle strength and mobility with scores predicting mortality at 90-days post ICU discharge. None of the South African literature pertaining to physiotherapy management of patients with CAD or post-CABG reported on this as an outcome measure.

Physical Function in Intensive Care Test (PFIT)

The PFIT outcome measure involves assessing five functional activities: sit to stand assistance, marching on the spot, cadence, shoulder flexion and knee extension while the patient is admitted in the ICU. Each test is scored out of ten with ten meaning the patient can perform the movement without any difficulty. The PFIT is said to have well established validity and reliability and responsiveness to change and is therefore recommended for use in the ICU (Parry et al. 2015). In an observational study in Australia, Parry et al. (2015) found the PFIT to have excellent construct validity which is useful for physiotherapists when prescribing exercise and evaluating function within the ICU setting. None of the South African literature pertaining to physiotherapy management of patients with CAD or post-CABG reported on this as an outcome measure.

Incentive Spirometry (IS)

Despite advances in surgical and medical management, post-operative pulmonary complications are still common. For various reasons such as periods of bedrest, mechanical ventilation, and the effects of anaesthesia, respiratory muscle strength is affected post-CABG surgery (Westerdahl & Olsen, 2011). In a randomized control trial performed by Sweity et al. (2021), it was reported that the use of IS before and after CABG surgery reduced the incidence of atelectasis, reduced the number of hours of mechanical ventilation post-operatively and decreased the length of hospital stay. Incentive spirometry involves a handheld breathing device used to improve inspiratory volume by mimicking sighing or yawning (Sweity et al., 2021). Effective inhalation is encouraged, facilitating the expansion of the lateral and basal segments of the lungs. The device provides visual feedback to the patient about the rate and volume of inspired air per breath. The use of the IS device by patients after CABG surgery, as part of standard physiotherapy care, may prevent complications such as atelectasis by reducing pleural tension, improving lung expansion, and ventilation-perfusion (Sweity et al., 2021). In contrast, in a systematic review and meta-analysis, Sullivan et al. (2020) sought to investigate whether the use of IS prevented post-operative pulmonary complications in cardiac, thoracic and upper abdominal surgery patients. Their review found that IS alone did not prevent post-operative pulmonary complications nor did it affect length of hospital stay compared to other chest physiotherapy techniques (Sullivan et al., 2020).

A national survey on chest physiotherapy and breathing exercises post cardiac surgery was done by Westerdahl & Olsen (2011) in Sweden. They reported that incentive spirometers were not commonly used due to inadequate literature supporting efficacy.

In Greece, Lomi & Westerdahl (2013) reported that approximately 90% of physiotherapists used deep breathing exercises and incentive spirometry after cardiac surgery.

Roos & van Aswegen (2011) reported that physiotherapists used incentive spirometry as a treatment intervention rather than as an outcome measure when managing patients with CAD. No other South African literature exists for the use of IS as an outcome measure in the management of patients with CAD.

Six Minute Walk Test (6MWT)

The 6MWT is an established outcome measure used to assess functional exercise capacity in the form of distance walked in patients with chronic cardiac and pulmonary diseases (Papathanasiou et al., 2013). In the Netherlands, Uszko-Lenser et al. (2017) found the 6MWT to be valid, reliable and easily reproducible in patients with chronic heart failure. The 6MWT intends to mimic the energy requirements of activities of daily living and is, therefore, an

indicator of prognosis and a predictor of hospitalization and death (Papathanasiou et al., 2013). Multiple factors such as being overweight, chronic lung conditions, poor muscle mass, musculoskeletal disorders, and poor cognitive ability are associated with a shorter 6MWT distance (Papathanasiou et al., 2013).

A clinical trial done by Hanekom & Klopper (2014) where the benefits of an intensity-based exercise programme during phase one of cardiac rehabilitation of post-CABG patients in a private institution in South Africa were assessed. The study reported that the functional capacity of the exercise group was significantly higher than the control group at discharge from the hospital. Functional capacity was evaluated using the 6MWT and the intervention group achieved substantially better results with the 6MWT at hospital discharge.

Roos et al. (2014) investigated the effects of an education and home-based pedometer walking programme on ischaemic heart disease risk factors in people infected with HIV. The study took place in a clinic in Johannesburg, Gauteng. The control group received standard care from the clinic involving regular follow-up, medication allocation, and monitoring of vital signs. The intervention group received pedometers. The intervention took place over 12 months and showed that the intervention group had improved systolic blood pressure measurements and an improved distance with the 6MWT. Other findings included improved waist-to-hip ratios, high-density lipoprotein levels, and improved glucose levels.

Heine et al. (2019) reported that 93% of clinicians providing cardiac rehabilitation programmes in Africa were using the 6MWT as a measure of functional capacity.

One Minute Sit to Stand Test

Other popular cardiorespiratory outcome measures used in cardiac rehabilitation are the one-minute sit to stand (1-min STS) test, the three minute sit to stand test (3-min STS) and the short physical performance battery score test (SPPB). In a cross-sectional study performed in Switzerland, Strassmann et al. (2013) tested participants aged 20-79 years of age (with and without chronic diseases) in 42 Swiss communities and found the 1-min STS test is effective in identifying patients with decreased lower limb strength and experiencing difficulty with mobility. The 1-min STS test is simple, easily reproducible, and correlates highly with endurance tests such as the 6MWT (Strassmann et al., 2013). The test requires less resources to perform in comparison to the 6MWT. The 1-min STS test gives physiotherapists an indication of lower limb muscular strength and endurance, both of which are essential to completing activities of daily living (Strassmann et al., 2013). None of the South African literature pertaining to physiotherapy management of patients with CAD or post-CABG reported on this as an outcome measure.

Three Minute Sit to Stand

The three minute sit to stand test (3-min STS) is conducted in the same manner as the 1-min STS test but is done for three minutes. Aguilaniu et al. (2014) evaluated the physiological and symptomatic effects of the 3MSTS in 40 patients with COPD. The 3-min STST produced similar responses to that obtained from patients participating in a 6MWT, showing a high correlation between the two tests. Aguiliniu et al. (2014) only included patients with stable COPD. However, it is worth mentioning that these tests also indicate treatment interventions' efficacy in any cardiorespiratory rehabilitation group since pulse oximetry, heart rate, and perceived fatigue and dyspnoea are recorded. None of the South African literature pertaining to physiotherapy management of patients with CAD or post-CABG reported on this as an outcome measure.

Short Physical Performance Battery Test (SPPB)

The SPPB test uses lower limb physical strength as an indicator of frailty and a predictor of disability and length of hospital admission (Rinaldo et al., 2022). Following a bidaily cardiac rehabilitation programme in elderly patients post cardiac events, the SPPB was shown to have a minimal clinical importance difference of > 1 in Italy (Rinaldo et al., 2022). A low score on the SPPB is correlated with a higher level of functional limitation or disability. The SPPB is an inexpensive tool and is easily reproducible.

Amount of secretions

Neither South African nor international literature on physiotherapy management of patients with CAD or post-CABG reports this as an outcome measure. Therefore, amount of secretions is a unique outcome measure used by participants in this study.

Peak Flow

Peak expiratory flow (PEF) is measured with a handheld peak flow meter to evaluate the rate at which air can be forcefully exhaled from the lungs. It is commonly used as an assessment of respiratory function during or after pulmonary rehabilitation. So et al. (2016) investigated the correlation between pulmonary function and PEF in a cohort of COPD patients and found that a greater variability in PEF (measured daily) categorised patients as unstable: prone to exacerbation, higher likelihood of hospital admission and poor physical function (a shorter 6MWT).

Expiratory peak flow rate is a one of the measurements of respiratory muscle strength. Post-operatively, a low expiratory peak flow rate was associated with difficulty coughing and expelling secretions. Gimenes et al. (2012) evaluated the

maximal inspiratory pressure, maximal expiratory pressure and expiratory peak flow rate of 61 patients with CAD who underwent CABG surgery in Brazil. Patients were evaluated pre-operatively and post-operatively. Expiratory peak flow rates were positively correlated to maximal inspiratory pressures and maximal expiratory pressures. Expiratory peak flow rates were significantly lower than pre-operative values on the fifth post-operative day. This was possibly caused by pain, the use of cardiopulmonary bypass, and the length of mechanical ventilation.

Nijmegen Questionnaire

The Nijmegen questionnaire is a screening tool, and an outcome measurement tool used to diagnose breathing pattern disorders, specifically hyperventilation syndrome. Participants answer 16 questions with total scores of 23 and above indicating the presence of hyperventilation breathing disorder commonly seen in individuals with chronic pulmonary disease such as in asthma and chronic obstructive pulmonary disease (COPD). In a sample of Greek patients with stable mild to moderate asthma, the Nijmegen questionnaire was found to be reliable and valid, also showing a moderate correlation to the BORG scale (Grammatopoulou et al., 2014). The questionnaire is valuable in understanding and treating the symptoms of patients participating in cardiac rehabilitation since many individuals suffer from chronic cardiopulmonary diseases and require long-term management tools.

In a cross-sectional study in South Africa, Hurst (2024) investigated whether patients who underwent cardiac surgery via median sternotomy experienced breathing pattern disorders post-hospital discharge. The Nijmegen questionnaire was one of the six outcome measurement tools used. Findings confirmed that breathing pattern disorders were highly prevalent in this patient population (Hurst, 2024).

The Short Form 36 (SF-36)

The Short Form (SF-36) is a validated health-related questionnaire used to assess quality of life (Corner et al., 2013). The questionnaire assesses physical and mental components. Dibben et al. (2021) reviewed exercise-based cardiac rehabilitation in patients with coronary heart failure and found that patients within the exercise group scored higher on SF-36 questionnaires at short-term follow-up. A higher score on SF-36 indicates better health-related quality of life. The SF-36 questionnaire is, however, only appropriate for patient populations with the cognitive ability to comprehend the questions and answer appropriately (Doiron et al., 2018). None of the South African literature regarding physiotherapy management of patients with CAD or post-CABG reported this as an outcome measure.

2.6 **CONCLUSION**

Literature about cardiac rehabilitation for patients with CAD in South Africa is outdated and limited. Sub-Saharan Africa is deeply affected by communicable and non-communicable diseases such as CAD. Despite this knowledge, it is unclear how many physiotherapists are managing this population in and out of hospitals in South Africa. It is unclear with which interventions and outcome measures patients are being managed, the frequency of such interventions, and the referral patterns involved in initiating cardiac rehabilitation. This study aims to provide insight into how physiotherapists have been managing patients with CAD in South Africa since 2011.

CHAPTER 3

3. METHODOLOGY

3.1 STUDY DESIGN

This study was a cross-sectional, quantitative and descriptive survey-based study. A survey-based study design was suitable as it enabled the researcher to potentially capture a large amount of data from South African participants across the country in a cost-effective and efficient way. Another benefit of the study design was the ability to capture quantitative and descriptive data simultaneously. Limitations of the study design include biased or inaccurate responses, inflexibility and sampling issues.

3.2 PARTICIPANTS

3.2.1 Sample Selection

Participants in this study were qualified physiotherapists registered with the South African Society of Physiotherapy (SASP), working in the private or government health care sectors in South Africa. PASA was intentionally excluded (as advised by the researcher's supervisor). PASA did not respond to invitations to participate in other postgraduate students survey-based studies.

3.2.2 Inclusion Criteria

The inclusion criteria for this study were all physiotherapists involved in rehabilitation of patients with CAD in the acute care or out-patient setting. Retired professionals and physiotherapy academics were included in this study due to their previous experience of working with CAD patients.

3.2.3 Exclusion Criteria

Physiotherapy students, physiotherapy assistants and physiotherapy technicians were not included in this survey due to limited clinical autonomy and experience in the field.

3.2.4 Sample Size

A sample of convenience was used based on the membership of the SASP for 2022 which was 4000 registered members, including 240 members registered with the Cardiopulmonary Physiotherapy Rehabilitation Group of the SASP. This sample size was confirmed telephonically with the SASP on 2022/06/04. A minimum response rate of 30% was expected for this survey (Nulty, 2008)

3.3 STUDY PROCEDURES

3.3.1 Instrumentation

Permission was obtained from the primary researcher (Professor Ronel Roos) for the adaptation and use of the questionnaire developed in 2009 which resulted in the 2011 publication: *Physiotherapy management of patients with Coronary Artery Disease: a report on current practice in South Africa*. Content validation was done on the original questionnaire before it was sent to participants. The content of the questionnaire used in this study was adapted with guidance from the supervisor and existing evidence in the research literature. The questionnaire includes the following sections: demographic information of participants; clinical settings; physiotherapy intervention strategies used; outcomes measurement tools used; frequency of physiotherapy service delivery; referral systems used for physiotherapy rehabilitation; and lastly, provision of structured post discharge cardiac rehabilitation programmes.

The questionnaire includes the following sections: demographic information of participants (objective number one); clinical settings (objective number four); physiotherapy intervention strategies used (objective number two); outcomes measurement tools used (objective number two); frequency of physiotherapy service delivery (objective number four); referral systems used for physiotherapy rehabilitation (objective number three); and lastly, provision of structured post discharge cardiac rehabilitation programmes (objective number four).

These sections address the study objectives of establishing the number and years of experience of physiotherapists who work in the cardiopulmonary field and are currently involved in the care and rehabilitation of patients with CAD; determining the current physiotherapy interventions and outcome measures used in the management of patients with CAD; identifying the referral systems used for referring patients with CAD to physiotherapy rehabilitation within the acute care and out-patient settings; identifying the clinical settings (e.g. acute care or outpatient clinic) in which physiotherapy rehabilitation interventions for patients with CAD currently take place; the frequency of these interventions (acute and chronic phase); physiotherapists' involvement in providing structured phase three cardiac rehabilitation programmes in an outpatient setting, and outcome measurement tools used in patient care.

To ensure content validation of the study questionnaire, three experts in the cardiopulmonary field of physiotherapy were invited to review the content of the questionnaire. Minor changes such as wording of the questions and listing of the outcome measures and treatment interventions were suggested and therefore included in the questionnaire. When the reviewers were satisfied with the changes made, the amended questionnaire was tested on a pilot group of five physiotherapists. This was done to test for face validity as these

physiotherapists were asked to comment on the ease of understanding of the questions within the questionnaire and the duration of time taken to complete the questionnaire. The pilot group of physiotherapists found the questionnaire easy to understand and answer, requiring no more than five minutes. Thereafter, the questionnaire was finalised. The final version of the questionnaire (Appendix A) was captured electronically using REDCap software (hosted by the University of the Witwatersrand). Data from the pilot study was not included in the final data analysis as the pilot study aim was to test face validity and amend the questionnaire thereafter if deemed necessary.

3.3.2 Data Collection Procedure

After completion of content and face validation of the questionnaire, the final version of the questionnaire was uploaded onto REDCap on the 23rd of August 2022. The researcher then made contact with the receptionist of the SASP via email on the 23rd of August 2022 requesting distribution of the questionnaire link to all registered members of the SASP. The email advertisement and link to the questionnaire was distributed by the SASP to its members on the 7th October 2022. The email advertisement included a participant information sheet which discussed the aims and objectives of the study, inclusion criteria, costs involved and risks of participating (Appendix B).

Participants were given six weeks from the 7th of October to complete the questionnaire. Consent to participate in the study was assumed for every completed questionnaire received as stated in the participant information sheet (Appendix B). Participants were thanked through the REDCap system after completing the questionnaire. The data collection procedure ended for the first time on the 18th of November 2022.

Due to poor response rate, the data collection procedure began again on the 15th of January 2023 and by April 2023 data were consolidated.

3.4 STATISTICAL ANALYSIS

The data captured on REDCap were exported to Excel in csv. file format and imported to IBM® Statistical Package for Social Sciences (SPSS) Version 29 for analysis. Descriptive statistics were used to summarise the data as numbers and percentages (categorical data) and means and standard deviations (normally distributed continuous data) or median and interquartile ranges (non-normally distributed continuous data) and range (minimum and maximum). Shapiro Wilk test was used to determine the distribution of continuous data. An inductive approach to coding was used to analyse the qualitative responses to the open-ended questions. Codes were identified and grouped into themes to build a comprehensive image of the collective responses of the participants. Questionnaires with more than 50% of incomplete responses were not included in the data analysis.

3.5 ETHICAL CONSIDERATIONS

The researcher successfully completed the Introduction to Research Ethics TRREE module 1 on 2021/04/15 (Appendix C). Ethical clearance was then obtained through the University of Witwatersrand Human Research Ethics (Medical) Committee before commencement of the survey (Clearance Certificate Number M220313) (Appendix D). Permission to distribute the survey questionnaire to all SASP members was requested via email correspondence on 2022/08/23 and was approved by the SASP President (Appendix E). The Declaration of Helsinki was adhered to by providing all participants with an information sheet introducing the researchers, university affiliation and stating the aims and objectives of the study. The information sheet was the first page that appeared when participants clicked the link to enter the REDCap survey. The information sheet stated that participation was voluntary and could be withdrawn at any time without any consequences. The costs involved in participating were listed as time and data. Informed consent was implied when participants submitted a completed questionnaire. Completed questionnaires were automatically coded by REDCap for anonymity and no personal information was requested from participants or used in the results of this survey.

CHAPTER 4

4. RESULTS

4.1 SCHEMATIC REPRESENTATION OF DATA COLLECTION PROCESS

During the study period 46 questionnaire responses were received, of which 37 were included in the final analysis. Figure 4.1 summarizes the flow of the study. The total membership of the CPRG of the SASP was 240 at the time of the study. Therefore, the response rate for this survey was 15% (n=37/240).

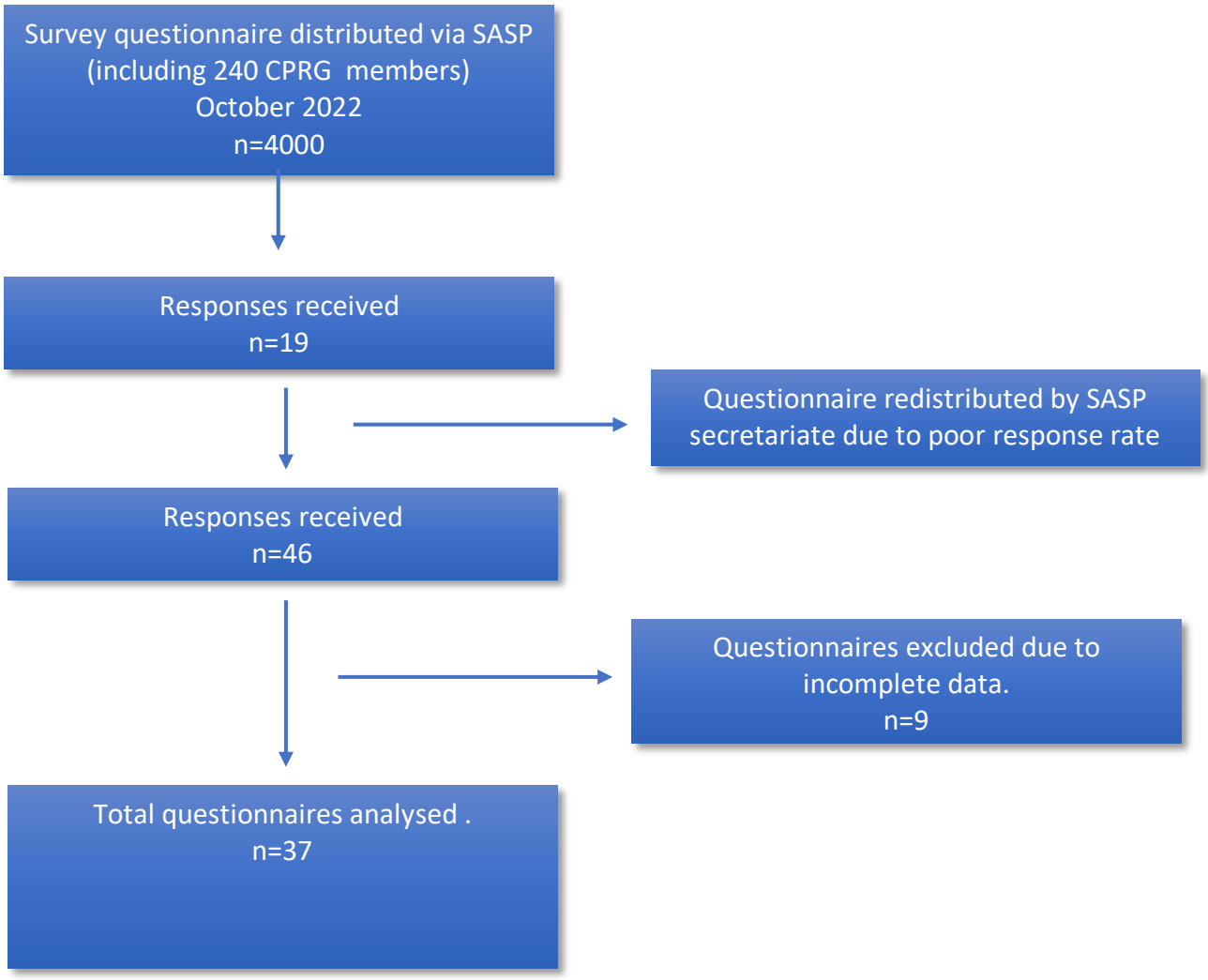


Figure 4.1: Flow Chart Representing the Data Collection Process

4.2 PARTICIPANT DEMOGRAPHICS

All participants in this study were registered with the HPCSA. Most were employed in the private healthcare sector (n=28, 76%) and were treating patients with CAD at their current place of employment. The mean age of participants was over 40 and the mean years of general physiotherapy experience was 19. The median of previous years of cardiorespiratory experience was under ten years. Table 4.1 provides a summary of participants' information.

Table 4.1: Demographics of Participants

Variable	Results
Current age (years) (mean, SD) (minimum – maximum range)	41.6 (+-11.3) (24 - 62)
HPCSA registered (n, %)	37 (100)
General years of experience (mean, SD) (minimum – maximum range)	18.6 (10.6) (2 - 42)
Current work environment (n, %) Government Private	 9 (24.3) 28 (75.5)
Provision of care to CAD patients at current place of employment (n, %)	28 (75.7)
Years of previous cardiorespiratory experience (median) (IQR 25th-75th percentiles)	6 (1 – 18)

4.3 CLINICAL SETTINGS AND SCENARIOS

Figure 4.2 shows that majority of participants currently working in the hospital were treating patients in the medical ICU (n=26, 70%) and surgical ward (n=26, 70%), medical ward (n=25, 68%) and cardiothoracic ICU (n=22, 60%).

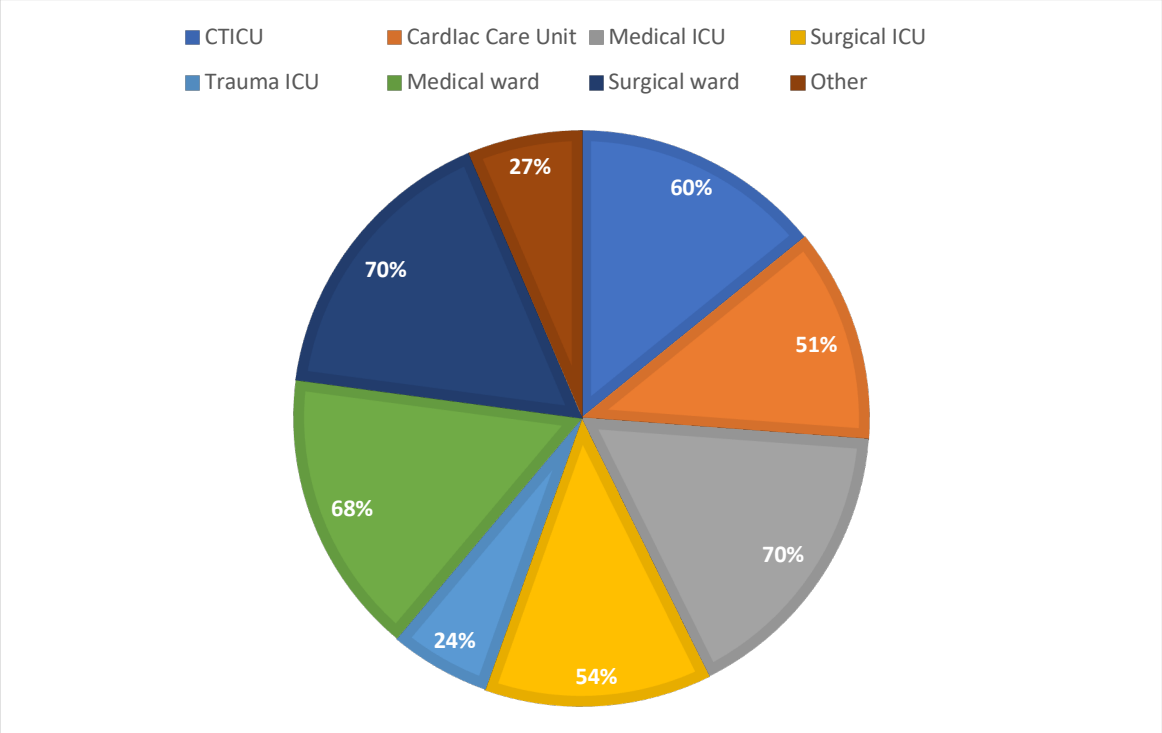
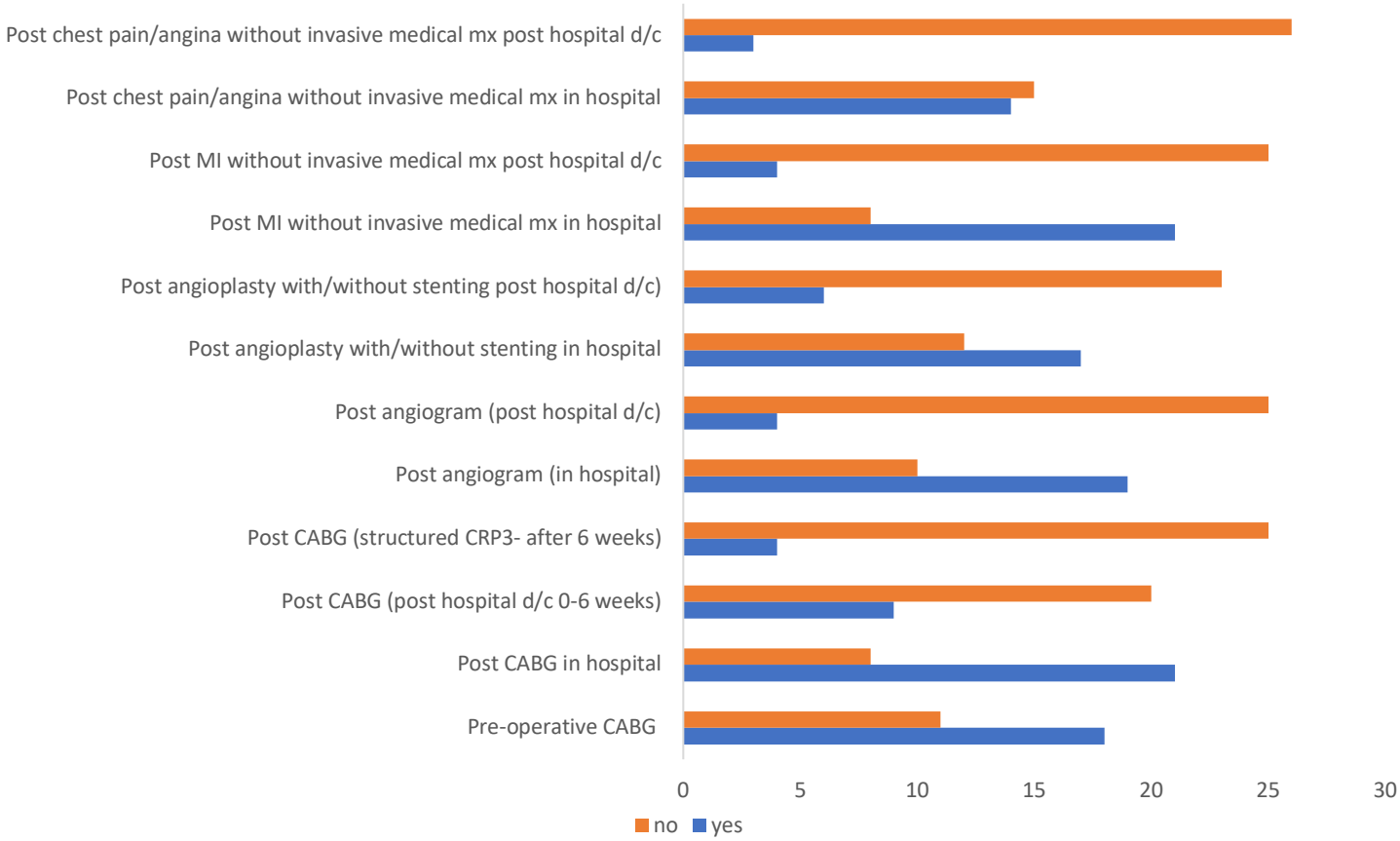


Figure 4.2: In-Hospital Settings in which Participants Treat Patients with CAD. CTICU = Cardiothoracic ICU

'Other' settings were indicated by participants (n=10, 27%) as orthopaedic ward, rehabilitation facility, general ICU, and High Care wards.

In conclusion, most physiotherapists treated patients with CAD in the hospital in the medical ICU and surgical ward.

Figure 4.3 shows that most physiotherapists reported treating patients' post-CABG surgery (n=21, 72%), and post-myocardial infarction without invasive medical management in the hospital (n=21, 72%). Physiotherapists provided pre-operative CABG management (n=18, 62.1%) and some reported treating patients post angiogram in hospital (n=19, 65.5%).



Abbreviations: mx- management; d/c- discharge; MI- myocardial infarction; CABG- coronary artery bypass graft; CRP3- cardiac rehabilitation phase three.

Figure 4.3: Clinical Scenarios Relevant to Participants who are Treating Patients with CAD in the Hospital Setting

Majority of physiotherapists treated patients post-CABG surgery in hospital and post-myocardial infarction without invasive medical management in hospital.

4.4 REFERRAL PATTERNS FOR PHYSIOTHERAPY MANAGEMENT OF PATIENTS WITH CAD IN IN-PATIENT AND OUT-PATIENT SETTINGS.

Participants reported that most patients with CAD were referred to physiotherapy in the in-patient setting and mostly by a specialist or surgeon (Figure 4.4).

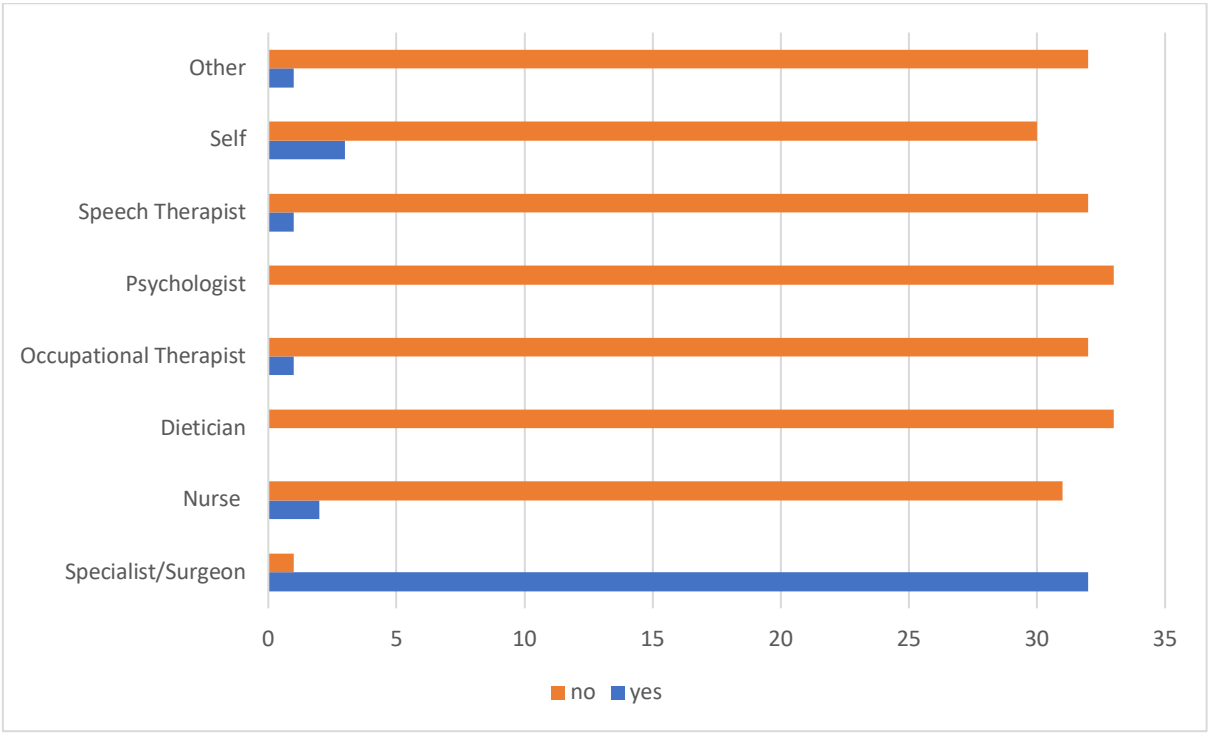


Figure 4.4: In-Patient Referral Patterns for Physiotherapy Management of Patients with CAD or CABG

One participant selected 'other', but did not provide an answer.

Similarly, in the out-patient setting, patients with CAD were mostly referred to physiotherapy by a specialist or surgeon. In some cases, however, patient referrals were made by the general practitioner, hospital-based physiotherapist, biokineticist, or patients referred themselves (Figure 4.5).

Specialists and surgeons are most commonly referring patients with CAD to physiotherapy in the in-patient and out-patient settings.

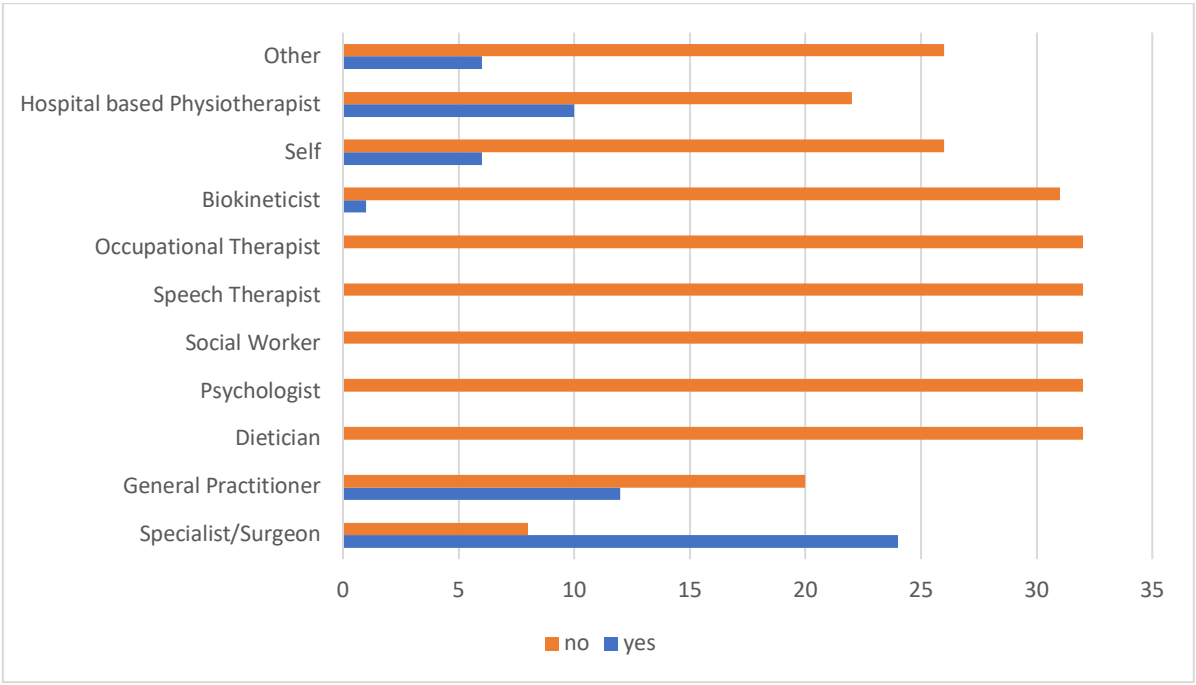


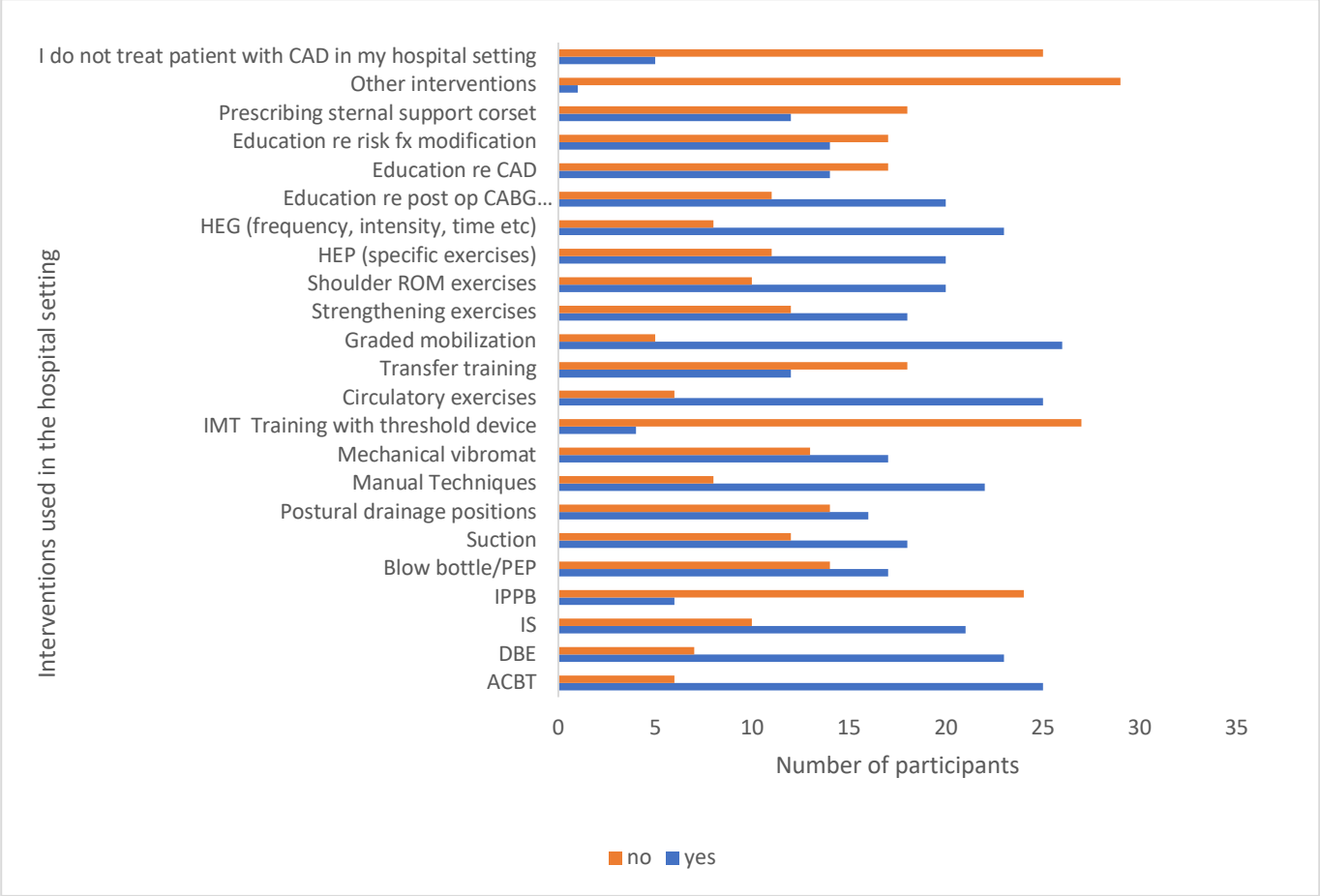
Figure 4.5: Bar Graph Showing Out-Patient Referral Patterns

'Other' represents three participants who did not provide an answer, one participant who indicated that they do not treat CAD in the out-patient setting, and one who indicated that patients were not referred to out-patient cardiac rehabilitation.

Specialists and surgeons are most commonly referring patients with CAD to physiotherapy in the in-patient and out-patient settings.

4.5 PHYSIOTHERAPY TREATMENT INTERVENTIONS USED IN THE MANAGEMENT OF PATIENTS WITH CAD IN AN IN-PATIENT SETTING

Participants were asked to indicate which treatment interventions they used for patient care in an in-hospital setting. Findings are summarised in Figure 4.6. Most participants working in hospital utilised ACBT (n=25, 81%), DBE (n=23, 74%), incentive spirometry (n=21, 68%), manual techniques (n=22, 71%), circulatory exercises (n=25, 80%), graded mobilisation (n=26, 84%), and home exercise guidelines (n=23, 74%). Some participants did not treat patients with CAD in a hospital setting.



Abbreviations: CAD- coronary artery disease, re-regarding; fx- factor; CABG- coronary artery bypass graft; HEG- home exercise guidelines; HEP- home exercise programme; ROM- range of motion; IMT- inspiratory muscle training; PEP- positive expiratory pressure; IPPB- intermittent positive pressure breathing; IS- incentive spirometry; DBE- deep breathing exercises; ACBT- active cycle of breathing techniques.

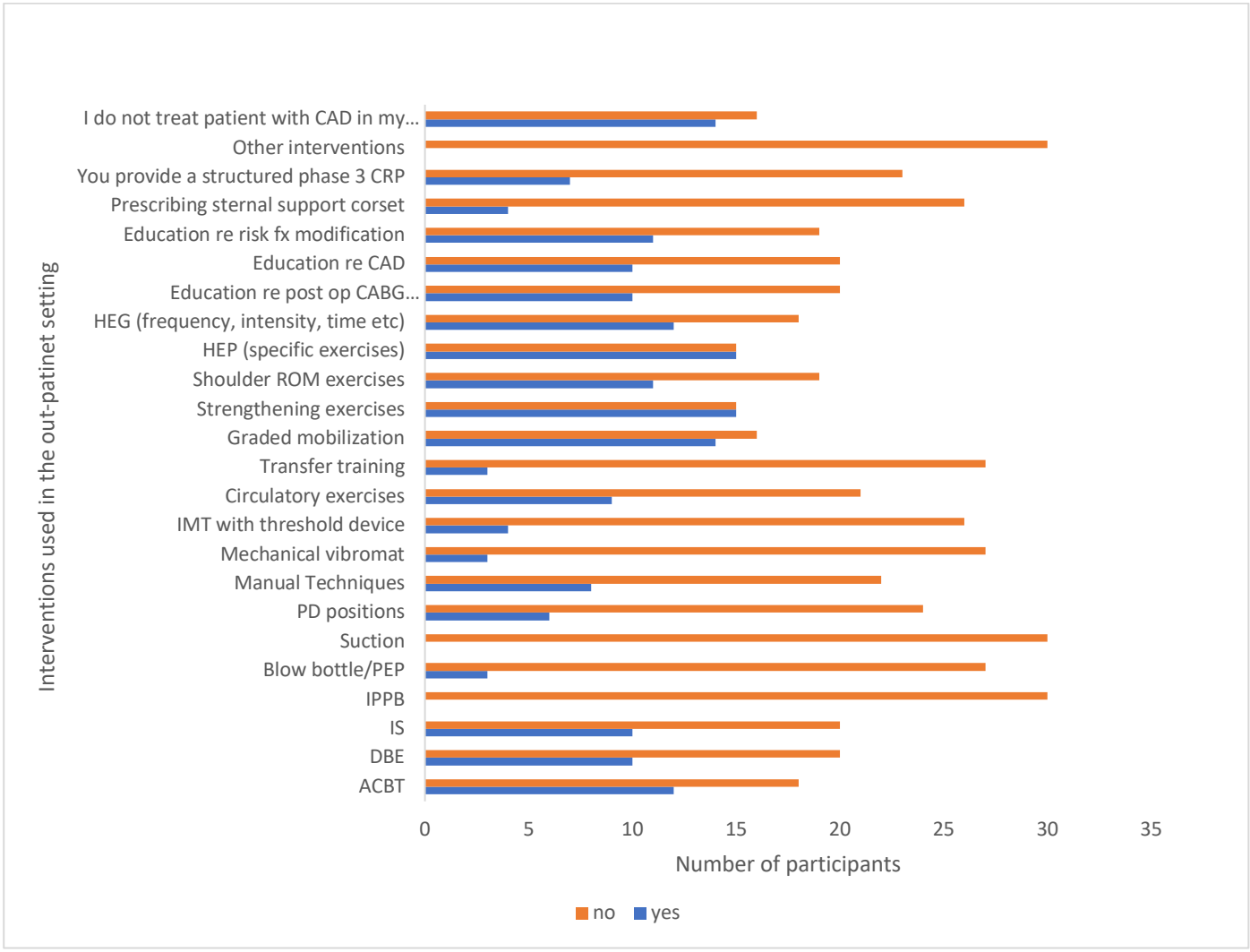
ACBT, DBE and IS were the most commonly used treatment interventions in-hospital.

Figure 4.6: Treatment Interventions used by Participants in Hospital Management of Patients with CAD

4.6 PHYSIOTHERAPY TREATMENT INTERVENTIONS USED IN THE MANAGEMENT OF PATIENTS WITH CAD IN AN OUT-PATIENT SETTING

Participants were asked to indicate which treatment interventions they used in patient care in an outpatient setting. Findings are summarised in Figure 4.7 below. Physiotherapists treating patients in the outpatient setting utilized strengthening exercises (n=15, 50%), home exercise programmes consisting of specific exercises (n=15, 50%), and graded mobilisation (n=14, 47%). Home exercise guidelines (n=12, 40%) and ACBT (n=12, 40%) were also

commonly used. Many participants reported not treating patients with CAD in the outpatient setting (n=14, 47%).



Abbreviations: CAD- coronary artery disease, CRP- cardiac rehabilitation programme; re-regarding; fx- factor; CABG- coronary artery bypass graft; HEG- home exercise guidelines; HEP- home exercise; ROM- range of motion; programme; IMT- inspiratory muscle training; PEP- positive expiratory pressure; IPPB- intermittent positive pressure breathing; IS- incentive spirometry; DBE- deep breathing exercises; ACBT- active cycle of breathing techniques.

Strengthening exercises, home exercise guidelines consisting of specific exercises and graded mobilisation were mostly used as treatment interventions in the out-patient setting.

Figure 4.7: Treatment Interventions used by Participants in Outpatient Management of Patients with CAD

4.7 FREQUENCY OF PHYSIOTHERAPY SERVICE DELIVERY TO PATIENTS WITH CAD IN THE IN- AND OUT-OF-HOSPITAL SETTINGS

Table 4.2 shows the frequency of physiotherapy interventions for patient care in the hospital and the outpatient settings. In hospital, interventions were mostly provided twice per day (n=20, 67%). The majority of respondents did not provide physiotherapy interventions in the outpatient setting, however, of those who did provide outpatient physiotherapy services, several (n=11, 38%) did provide this service once weekly.

Table 4.2: Frequency of Physiotherapy Service Delivery to Patients with CAD in In-Hospital and Outpatient Settings

	Number (%)
In Hospital	
Once daily	7 (23%)
Twice daily	20 (67%)
Three times daily	4 (13%)
More than three times daily	0
Do not provide PT in hospital	3 (10%)
Outpatient Setting	
Two to three times a week	3 (10%)
Once weekly	11 (38%)
Once in two weeks	4 (14%)
Once in a month	1 (3%)
Do not provide PT in an outpatient setting	12 (41%)

4.8 PROVISION OF PHASE THREE CARDIAC REHABILITATION

Figure 4.8 shows that only 33% (n=10) of participants reported providing a phase three cardiac rehabilitation programme in the out-patient setting. Most participants did not provide this service (n=20, 67%).

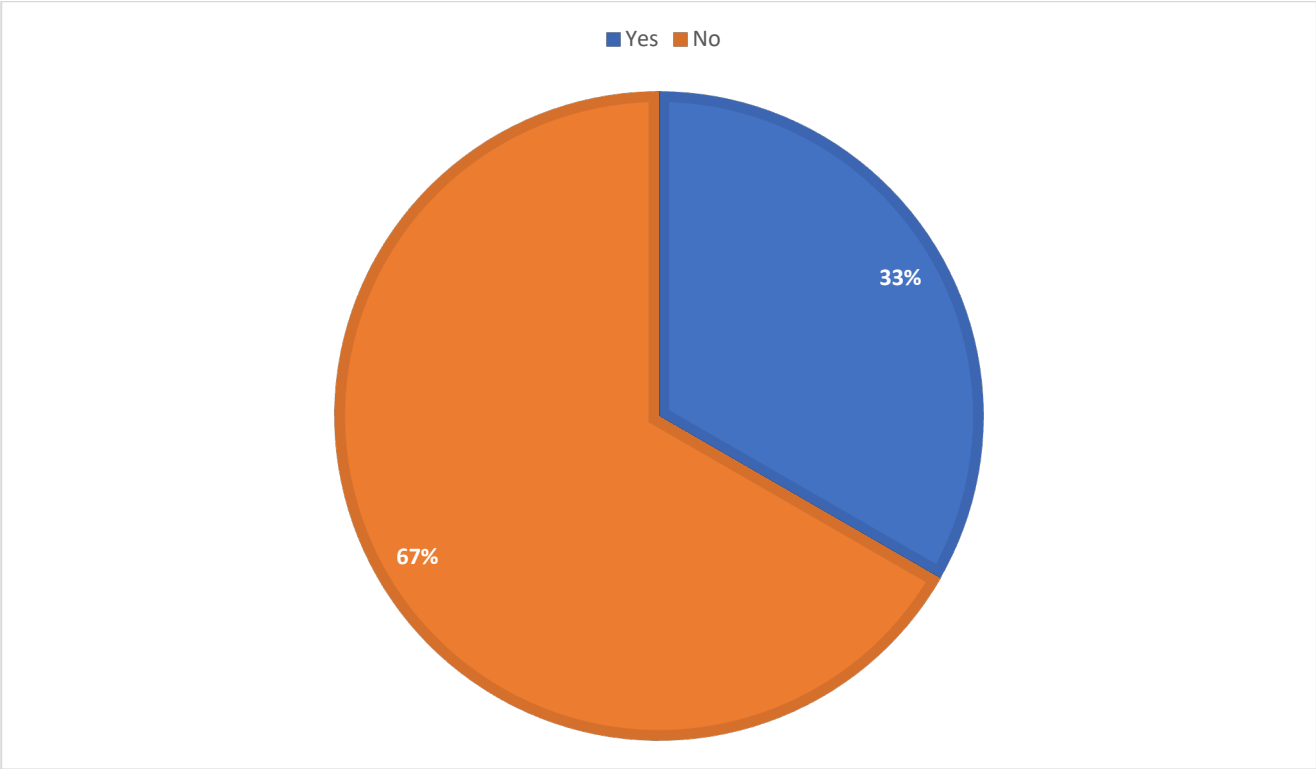
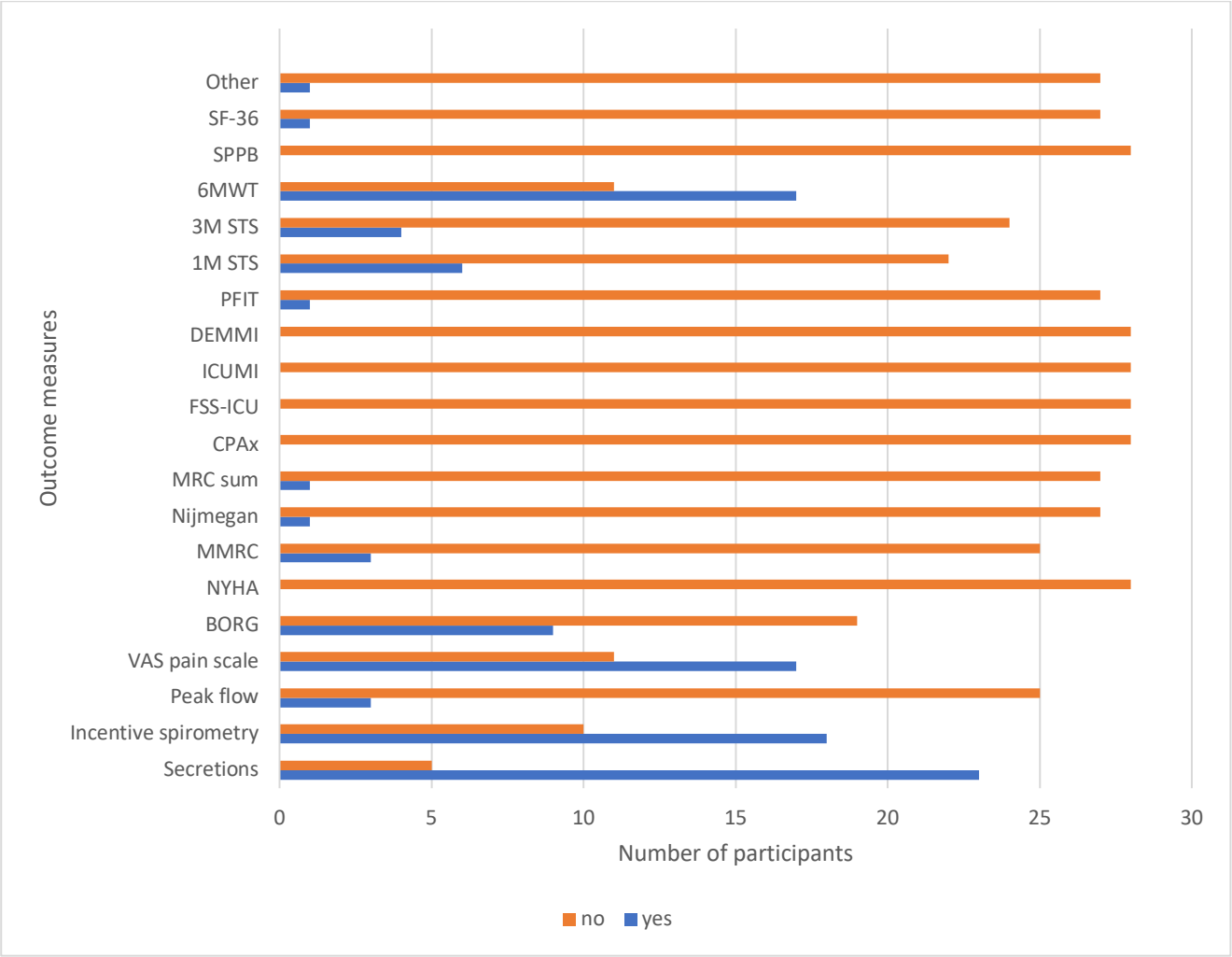


Figure 4.8: Phase three cardiac rehabilitation programmes provided in the out-patient setting

Most physiotherapists do not provide phase three cardiac rehabilitation in the out-patient setting.

4.9 OUTCOME MEASURES

Participants were asked to select which outcome measures they used when treating patients with CAD. Participants were allowed to select multiple options. Amount of secretions were the most common outcome measurement used (n=23, 82%), followed by incentive spirometry (n=18, 64%), the VAS pain scale (n=17, 61%) and the 6MWT (n=17, 61%).



Abbreviations: SF-36- Short Form-36; SPPB- Short Physical Performance Battery; 6MWT- 6-Minute Walk Test; 3M STS- 3-Minute Sit to Stand; 1M STS- 1-Minute Sit to Stand; PFIT- Physical Function Intensive Care Test; DEMMI- de Morton Mobility Index; ICUMI- ICU Mobility Index; FSS-ICU- Functional Status Score for the ICU; CPAx- Chelsea Critical Care Physical Assessment; MRC- Medical Research Council; MMRC- Modified Medical Research Council; NYHA- New York Heart Association; VAS- Visual Analog Scale.

Figure 4.9: Outcome Measure Tools used by Participants in Managing Patients with CAD

Amount of secretions and incentive spirometry were the most commonly used outcome measures for CAD patients.

'Other' was selected by one participant who indicated they used the 1-min STS despite it being listed for possible selection in the questionnaire.

The findings presented in this chapter will be interpreted and discussed in the next chapter. In addition, comparisons will be made between the findings of this study and those reported by other authors.

CHAPTER 5

5. DISCUSSION

Cardiovascular disease is a leading cause of morbidity and mortality globally (Hamid et al., 2019). The only previous study to investigate physiotherapy management of patients with CAD in South Africa was done by Roos & van Aswegen in 2011. The study investigated the physiotherapy management of patients with CAD in the Gauteng province. The present study investigated the number of years of experience of physiotherapists who work in the cardiopulmonary field who are currently involved in the care and rehabilitation of patients with CAD, the physiotherapy interventions and outcome measures used in the management of patients with CAD, the referral systems used for referring patients with CAD to in-patient and outpatient physiotherapy rehabilitation, the clinical settings in which physiotherapy rehabilitation interventions take place (acute care or out-patient clinic), the frequency of such interventions and physiotherapists involvement in providing a structured phase three cardiac rehabilitation programme in the out-patient setting. The findings of the current study expand on those reported by Roos & van Aswegen (2011) by providing information sourced from physiotherapy participants throughout South Africa. The response rate for this study was below 20% which is lower than the minimum response rate of 30% that Nulty (2008) suggested for survey-based study designs. Therefore, the findings should be interpreted as preliminary.

5.1 PROFILE OF SOUTH AFRICAN PHYSIOTHERAPISTS WHO MANAGE PATIENTS WITH CAD

The mean age of participants in this study was 41 years; on average, participants had more than 15 years of general work experience but less than 10 years of experience in cardiorespiratory care. Most participants reported that they managed patients with CAD as part of their current daily workload and most participants were employed in a private healthcare setting. Roos & van Aswegen (2011) did not report on the ages or years of experience of participants managing patients with CAD. Rather, their study aimed to investigate how many physiotherapists who work in the cardiopulmonary field were involved in the care and rehabilitation of patients with CAD. No other studies exist investigating the profile of South African physiotherapists managing patients with CAD which makes comparison with the findings of this study difficult.

This study offered valuable insights into the demographic details of physiotherapists treating CAD patients in South Africa.

5.2 IN-HOSPITAL PHYSIOTHERAPY PATIENT MANAGEMENT

In this study, most participants were managing patients with CAD in the hospital setting in private healthcare facilities. Most patients were treated by participants in the cardiothoracic ICU, medical ICU, and medical and surgical ward. The majority of patients seen by a physiotherapist in the in-patient setting were referred to physiotherapy by their treating surgeon or specialist.

Most participants reported treating patients twice a day in a private hospital setting, aligning with the findings of Roos and van Aswegen (2011), who noted that patients were generally treated twice daily; however, their study did not specify whether the clinical setting was government or private. It was highlighted that treatment interventions in the hospital depended on the patient's hemodynamic stability and medical condition at the time. In KwaZulu-Natal, South Africa, Maddocks & Cobbing (2017) did not report on the frequency of treatment for post-operative patients with CAD in the hospital but mentioned providing biweekly group exercise classes for those patients from day three post-operatively until discharge from the hospital. Hanekom & Klopper (2014) provided an intensity-based exercise programme to patients post-CABG surgery in Cape Town, South Africa, but did not report on the frequency of standard physiotherapy protocol for the control group nor for the intervention group.

In an out-dated study, Westerdahl & Moller (2010) reported that physiotherapists in Sweden provided one to three treatment sessions to patients on the first day post-CABG surgery, then twice daily on days two and three post-operatively. Treatment frequency was delivered in this manner to prevent the development of postoperative pulmonary complications and improve physical activity. Westerdahl & Olsen (2011) indicated that at a hospital in Sweden, patients were treated one to three times a day, while in Greece, Lomi & Westerdahl (2013) found that patients could receive treatment up to six times per day during the first five post-operative days. The frequency of interventions in the present study are similar to that of Westerdahl & Olsen (2011) despite differences in treatment interventions. It is possible that globally, physiotherapists understand the invasive nature of CABG surgery and patients' high risk of developing post-operative complications.

Most participants in this study used interventions such as ACBT, deep breathing exercises, manual techniques, and incentive spirometry as part of patient management in their in-hospital work environments. Roos & van Aswegen (2011) found that most of their participants used deep breathing exercises (n= 83/142), ACBT (n= 75/142), and manual chest physiotherapy techniques (n=79/142) as treatment interventions. Their study did not specify whether these were predominantly used in hospital or outpatient settings; however, the

results align closely with that of this study. Notably, incentive spirometers were not widely used in Sweden among post-operative cardiac patients due to insufficient literature supporting its efficacy (Westerdahl & Olsen, 2011). Furthermore, none of the physiotherapists who participated in the Westerdahl & Olsen (2011) study reported using manual chest physiotherapy techniques during the first four days post-operatively. Instead, physiotherapists used deep breathing exercises, PEP device breathing, huffing and coughing in the first few days post-operatively. (Westerdahl & Olsen, 2011). In a study conducted in Greece by Lomi & Westerdahl (2013), 90% of physiotherapists reported prescribing breathing exercises and incentive spirometry in the first four days following CABG surgery. In their national survey, none of the participants reported using manual techniques post-operatively. There were, however, discrepancies in how physiotherapists prescribed breathing exercises. Patients were encouraged to practice deep breathing exercises and IS one to four times a day, for one to 40 repetitions at a time (Lomi & Westerdahl, 2013). The prescription of deep breathing exercises and IS was not investigated in this study.

Manual techniques and breathing exercises including incentive spirometry seem to be a popular treatment intervention used by South African physiotherapists as reported in this study and by Roos & van Aswegen (2011). Potentially, these interventions are necessary due to the clinical profile of patients with CAD and those undergoing CABG surgery in South Africa. South Africa's patients with CAD could have more comorbidities such as chronic pulmonary diseases, a smoking history, or be immune-compromised compared to those in Greece and Sweden. These factors lead to an increased risk of infections or post-operative complications. Post-operative pulmonary complications (e.g. atelectasis, pneumonia, or pleural effusion) are common after CABG surgery (Galih et al., 2015). Complications during surgery, the patient's haemodynamic stability and level of consciousness post-surgery, differences in mechanical ventilation protocols, and physiotherapy resources (or lack thereof) are potential reasons for patients requiring longer periods of bedrest making these physiotherapy treatment techniques essential.

In this study, graded mobilization, circulatory techniques, and prescribed home exercise guidelines were commonly used by participants for patient management in hospitals. Similarly, Roos & van Aswegen (2011) reported that most of their participants used circulatory exercises (n=84/142), graded mobilization (n= 76/142), strengthening exercises (n=73/142), and home exercise programmes (n= 72/142) as treatment interventions for their patients in an in-hospital setting.

Denehy et al. (2018) reviewed advances in cardiorespiratory physiotherapy and their clinical impact. Their study is relevant to the present study as all patients undergoing CABG surgery

in South Africa are admitted to the ICU post-operatively. Physiotherapists working in the cardiorespiratory field globally were reported to prioritize early mobilization together with traditional breathing and chest clearance techniques post-operatively in the ICU, which positively influenced patients' functional capacity and hospital length of stay (Denehy et al., 2018).

A systematic review of the effects of early mobilisation after cardiac surgery by Santos et al. (2017), included nine randomised controlled trials where the intervention groups participated in upper and lower limb exercises, mobilisation in stages such as sitting over the edge of the bed, standing, sitting on a chair, walking and stair climbing post-operatively. Intervention groups showed favourable results in comparison to control groups where no intervention was provided. The presence of post-operative pulmonary complications, functional capacity, days of mechanical ventilation, length of ICU and hospital stay were all reduced. Interestingly, minimal differences were found between intervention groups and studies where control groups received other interventions. This systematic review highlighted the fact that globally, 'early' may be defined differently among physiotherapists. The same applies for prescription of exercise and graded mobilisation.

In a cross-sectional study by Supervia et al. (2019), it was reported that 55% of countries globally offered phase two cardiac rehabilitation programmes. The structure of cardiac rehabilitation programmes were defined by the provision of: an initial assessment, a structured exercise programme, an additional intervention addressing risk factor modification (e.g education, nutrition advice, stress management), and re-assessment at the end of the programme (Supervia et al., 2019). All African programmes met these structural components which serve as quality indicators, according to Supervia et al. (2019).

Some participants in this study reported doing education about post-operative CABG precautions and contraindications (n=20, 65%), education about CAD (n=14, 45%), and education on risk factor modification with their patients (n=14, 45%). Interestingly, more than 60% of participants indicated that they provided pre-operative management of patients before CABG surgery, and more than 70% reported treating patients post-CABG surgery in the hospital. These results raise concerns about a seeming lack of integration of education about disease management, precautions in relation to activity after surgery, and lifestyle modification into physiotherapy patient management. Phase one cardiac rehabilitation typically starts in the hospital setting, often following cardiac events. Furthermore, Roos & van Aswegen's (2011) study demonstrated that education was a frequent component of in-hospital physiotherapy management as reported by their participants. Considering the high burden of disease caused by CAD on South African healthcare systems, education (with

exercise and risk factor modification) provided in cardiac rehabilitation programmes should be prioritized as long-term preventative measures.

The present study lays a foundation for further research into the efficacy of early mobilisation and exercise in patients with CAD in a South African context. In light of the present study results, if South African physiotherapists focused on exercise and mobilisation in patient care, the presence of post-operative complications, length of hospital stay, feasibility of early mobilisation protocols, and functional capacity of patients at follow-up would be valuable outcome measures to investigate. This would provide more context into cardiac rehabilitation delivery in South Africa.

5.3 OUTPATIENT PHYSIOTHERAPY MANAGEMENT

Almost half of the participants in this study did not treat patients with CAD in the outpatient setting. Those who provided this service commonly used strengthening exercises, home exercise programmes consisting of specific exercises, home exercise guidelines, and graded mobilization. Among those who delivered outpatient care, one-third offered education about post-operative CABG precautions and contraindications, one-third educated patients on CAD, and slightly more provided information on risk factor modification. In the out-patient setting, some patients were referred to physiotherapy by a general practitioner and a hospital-based physiotherapist. Few patients were self-referred. Exercise-based cardiac rehabilitation is well-documented as a programme that enhances health-related quality of life for survivors of cardiac events and surgery when provided with education (Anderson et al., 2016). Exercise-based rehabilitation is crucial for improving functional capacity, cognitive capacity and health-related quality of life (Anderson et al., 2016). It significantly contributes to preventing cardiac events and subsequent readmissions (Anderson et al., 2016).

Roos & van Aswegen (2011) reported that ten physiotherapists provided a phase three cardiac rehabilitation programme at the hospital or their private practice. This service was provided once a week. Treatment interventions, referral systems, and the clinical profile of patients were not reported on in their study.

Based on Roos & van Aswegen (2011) study results and the current study findings, it is concerning to see that few physiotherapists are involved in providing outpatient cardiac rehabilitation. However, it is reassuring to note that, even though only a few physiotherapists manage patients with CAD in the outpatient setting, those who do provide this service do not overlook fundamental education.

5.4 PHASE THREE CARDIAC REHABILITATION

A phase three cardiac rehabilitation programme was provided by one third of participants in this study. Referral of patients to phase three cardiac rehabilitation was only done by some participants working in the hospital setting. In the out-patient setting, less than one-quarter of participants reported providing this programme, and the same number reported that they referred patients to other phase three cardiac rehabilitation programmes.

In the study by Roos & van Aswegen (2011), 16 participants referred patients to phase three cardiac rehabilitation programmes, and ten participants provided such programmes in either a hospital or private setting. When reviewing cardiac rehabilitation programme delivery in Africa, Heine et al. (2019) reported that physicians, allied healthcare practitioners, and community-based healthcare workers were involved in referring patients to cardiac rehabilitation programmes. In addition, the same review mentioned that some patients were self-referred (Heine et al., 2019). Patients' self-referral to phase three cardiac rehabilitation was also reported in the current study. The lack of referrals to phase three cardiac rehabilitation may stem from a persistent shortage of these programmes available in our country. Roos & van Aswegen (2011) noted that phase three cardiac rehabilitation programmes were rarely available due to insufficient equipment, time, and space. Some of the physiotherapists who did provide cardiac rehabilitation programmes reported discontinuing care due to poor patient adherence, changes in doctors' referral patterns, and transportation issues, as some patients lived far away (Roos & van Aswegen, 2011). Reasons listed by participants in this study were that patients were not referred to cardiac rehabilitation after hospital discharge, the patients were referred to a biokineticist, or due to physiotherapists not treating any patients in the out-patient setting with CAD.

According to the Health Professionals Council of South Africa (HPCSA) and the Health Professions Act 56 of 1974, the scope of practice for a biokineticist includes promoting physical function and preventing injury, as well as providing final phase rehabilitation with science-based exercise programme prescriptions. In South Africa, a physiotherapist serves as a first-line practitioner who can assess, diagnose, and treat a wide range of conditions. Physiotherapists manage patients with acute medical and surgical conditions within the hospital and ICU settings, and provide treatment for various conditions in outpatient settings. Additionally, physiotherapists may offer primary health care and education within the community. One participant in this study reported that patients were not referred to physiotherapy for phase three cardiac rehabilitation but rather to a biokineticist, which is concerning, given that a biokineticist's scope of practice does not include treating patients until they have fully recovered from their medical or surgical conditions. It would be more expected for a patient who has completed a phase three cardiac rehabilitation programme

with a physiotherapist to be referred by the physiotherapist, and then attend exercise programmes with a biokineticist for maintenance of physical activity levels.

It is common for patients admitted to the hospital with CAD and undergoing surgery to receive treatment from a physiotherapist. Medical aid or medical insurance often covers the cost of physiotherapy treatment during hospitalization; the physiotherapy practice is paid directly by the medical aid while the patient is admitted. The physiotherapy service becomes a prescribed minimum benefit, a set of services patients are eligible for regardless of the medical aid plan they have chosen. Prescribed minimum benefits ensure that certain services are accessible to all medical aid scheme members. Once patients are discharged from the hospital, outpatient services, such as cardiac rehabilitation programmes with a physiotherapist, must be paid for or claimed from a medical savings fund, if they have one. This can create another barrier to attendance at cardiac rehabilitation programmes and contribute to poor patient adherence. Patients may want to continue their rehabilitation journey after hospital discharge. Still, they may not do so due to financial constraints, even though they understand the consequences of not attending such a programme. The physiotherapist is then limited in providing a quality rehabilitation programme.

Though incorrect and potentially dangerous, it could be possible that some patients view attending the gym and exercising independently as more worthwhile as they already pay a monthly subscription for the gym membership. In this case, the gym membership would be more cost-effective as out-patient physiotherapy services would cost the patient per treatment session. The impact of these factors on patients' reasoning for attending or not attending formal cardiac rehabilitation programmes after hospital discharge should be explored in future research.

It is important to note that, depending on patients' functional ability, length of hospital stay, and the presence of post-operative complications, some patients do not follow up with phase two and three cardiac rehabilitation as out-patients because they are transferred to step-down facilities or rehabilitation centers at discharge from the hospital.

It is concerning that the data from this study and the report by Roos & van Aswegen (2011) indicate that few physiotherapists referred patients to phase three cardiac rehabilitation or provided it, despite more than a decade having elapsed between the two studies.

5.5 USE OF OUTCOME MEASUREMENT TOOLS BY PHYSIOTHERAPISTS IN THEIR PATIENT MANAGEMENT

Interestingly in this study, most participants indicated using amount of secretions removed as an outcome measurement tool to determine treatment effectiveness. Roos & van Aswegen (2011) study did not report on which outcome measurements participants in Gauteng were using at the time of their study. No other studies reported using amount of secretions removed as an outcome measure. Many participants reported providing patient care in an in-hospital setting, particularly in ICUs.

Manual chest physiotherapy techniques were a common treatment intervention utilized by participants in this study as well as in the Roos & van Aswegen (2011) study; this could potentially explain why participants used amount of secretions removed in a treatment session to assess treatment efficacy. Further research regarding patient clinical profiles and the incidence of postoperative pulmonary complications in South Africa is required. Ineffective coughing and, therefore, the retention of pulmonary secretions may occur for various reasons including prolonged mechanical ventilation, pneumonia, extended periods of bedrest, and respiratory muscle weakness (Mali & Haghaninejad, 2019; Pathmanathan et al., 2015). Additionally, barriers to providing early mobilization may necessitate the use of manual techniques to manage secretions. Physiotherapists employed in private practice may need to cover a hospital patient load independently. Mobilizing post-operative patients after CABG surgery can be challenging without a team of physiotherapists, particularly during the initial post-operative days, when multiple central venous lines, mediastinal, pericardial, and intercostal drains are present. A lack of multi-disciplinary teamwork also poses a barrier for a physiotherapist in this context. Unfortunately, nurses in the ICU and other wards are often understaffed and unable to assist with early mobilization.

Incentive spirometry, VAS pain scale and 6MWT were also frequently used outcome measurement tools in this study.

Incentive spirometry is not commonly used as an outcome measure in literature about patients with CAD, however, its efficacy in preventing post-operative pulmonary complications such as atelectasis has been well documented. Incentive spirometry performed two days before CABG surgery and continued post-operatively decreased the likelihood of atelectasis, as noted by Sweity et al. (2019) in a randomized controlled trial. Hours of mechanical ventilation and length of hospital stay were reduced. Arterial blood oxygen and oxygen saturation were significantly better in the intervention group of that study.

The use of incentive spirometry as an outcome measure in the present study highlights the need for further research regarding the clinical profile of patients with CAD in South Africa and the incidence of post-operative pulmonary complications such as atelectasis. The

incidence of atelectasis post-CABG may be high in South Africa. Utilizing the incentive spirometer device potentially assists physiotherapists in measuring improvements in lung volume based on the amount of inspired air achieved through the device and the patient's technique.

The VAS pain scale was commonly used by participants in the current study. Most participants treat patients in the hospital setting post-CABG surgery. Pain is inevitable after an invasive surgical procedure such as after CABG surgery where a median sternotomy is performed. Pain after cardiac surgery may negatively influence the patient's general condition and result in muscular impairments, irritability, respiratory disorders, and decreased mobility (Zubrzycki et al., 2018). Pain perception varies among individuals and if prolonged may affect the patient's psyche (Zubrzycki et al., 2018). No other literature exists where the VAS pain scale was used as an outcome measure in physiotherapy management of CAD patients in South Africa. Post-operative pain may be prevalent among patients who underwent CABG surgery in South Africa, leading physiotherapists to evaluate this frequently. It cannot be said that the common treatment interventions provided by participants in this study address pain specifically, however, the overall effect of physiotherapy treatment (e.g. manual chest therapy techniques, breathing exercises, general exercise therapy, and mobilisation) may positively affect patients' perception of pain. Moreover, avoiding bedrest could positively influence perception of pain. It is reasonable to conclude that regular assessment of a patient's level of pain with the VAS pain scale is therefore appropriate.

The 6MWT is a tool used to assess functional capacity in patients with cardiopulmonary diseases and impairments. It was used by the majority of participants in the present study which is supported by evidence in the literature. It was reported by Heine et al. (2019) that 93% of clinicians involved in cardiac rehabilitation in Africa used the 6MWT to measure functional capacity.

In South Africa, Hanekom & Klopper (2014) and Roos et al. (2014) also used the 6MWT as outcome measurement tool. In a cohort of patients post-CABG surgery, Hanekom & Klopper (2014) performed the 6MWT distance achieved at hospital discharge and again at 10 to 14 days post-discharge to determine the changes in functional capacity of patients in their intervention group. Patients in the intervention group participated in an intensity-regulated exercise programme in the hospital. The intervention group showed significantly better results compared to the control group who received standard care.

Roos et al. (2014) used the 6MWT to measure functional capacity in HIV patients with ischaemic heart disease who participated in an education and home-based pedometer

walking programme. Both the intervention and control group received standard clinic care (consultation with a general practitioner, recorded vitals, and medication collection). The intervention group received pedometers, an activity diary and five contact sessions where body measurements were recorded and education was provided. At completion of the trial, a significant between-group effect was noted as the intervention group's walking distance with 6MWT had improved. The programme had resulted in other positive findings which included improved systolic blood pressure readings, waist-to-hip ratios, high-density lipoprotein levels, and glucose levels.

The 6MWT is used globally in patients with heart disease and chronic pulmonary diseases as it has been proven to be valid, reliable, and easily reproducible (Papathanasiou et al., 2013). In Bulgaria, Papathanasiou et al. (2013) used the 6MWT to measure the efficacy of a high-intensity exercise programme and moderate continuous exercise in two groups of patients with chronic heart failure enrolled in cardiac rehabilitation. The distance covered by participants in the high-intensity exercise programme was 14.3% higher than that of the moderate continuous exercise group. The 6MWT used in their study was valuable in establishing minimal clinically important differences in the chronic heart failure population.

It is encouraging to see that participants of the present study used the 6MWT as this may indicate that the efficacy of exercise and early mobilisation interventions are correctly assessed. Outcome measures such as the 6MWT assist in evaluating the efficacy of interventions and provide an opportunity to adapt treatment plans to meet patient goals when results are unfavorable.

In the present study, the outcome measures that were less frequently used included the BORG rating of perceived exertion scale, MRC sum score, MMRC, NYHA, peak flow, PFIT, SF-36, 1-min STST, and 3-min STST. Most of these require minimal time and equipment to administer. Most participants in the present study indicated that they provided pre-operative and post-operative care to patients with CAD in a hospital setting. When physiotherapy management for a patient is initiated, shortness of breath, muscle strength, and functional capacity should be part of the baseline assessment. Therefore, the BORG, MMRC, and MRC sum score should be utilized more frequently. Patients can be taught to use the BORG rating of perceived exertion scale, which encourages active participation in rehabilitation and helps them learn to monitor symptoms during exercise interventions. The 1-min STST and 3-min STST require less space and time to complete compared to the 6MWT and should be more widely used if such resources are limited. Physiotherapy management should always take a holistic approach. The SF-36 should be utilized more throughout the rehabilitation process, especially since cardiac events and subsequent surgical interventions can affect patients'

motivation to participate in their rehabilitation and later impact their health-related quality of life.

Interestingly, none of the participants indicated using the CPAx, FSS-ICU, ICUMMI, DEMMI or SPPB despite the majority of participants stating that they treat patients post-operatively in the ICU. Since hemodynamic stability of an ICU patient can fluctuate, physiotherapists assess the patient's condition daily. It is uncertain whether barriers exist that prevent physiotherapists from using outcome measures such as the CPAx tool or FSS-ICU since these outcome measures can easily be completed after patient assessment and treatment intervention.

In the present study, physiotherapists treating patients with CAD commonly used outcome measurement tools such as the amount of secretions removed, incentive spirometry, the VAS pain scale, and the 6MWT. This study's results differed from Roos and van Aswegen's 2011 study as well as international practice.

5.6 STRENGTHS AND LIMITATIONS

The strengths of this study are that it was conducted across South Africa, and the reported results are not limited to a specific province. The study provides valuable updated insights into the current management of patients with CAD; however, these results should be interpreted with caution due to the low response rate. The low response rate limits the generalization of results as it does not fully represent the majority of physiotherapy practices in South Africa. This country is densely populated, with most citizens relying on service provision within the public healthcare system. Most responses came from participants working in private healthcare settings, resulting in a lack of data on how patients with CAD are managed in government healthcare facilities. Recruitment of participants should have included physiotherapists who work in tertiary public sector hospitals in the different provinces of South Africa.

The questionnaire should have asked about barriers to CAD patient care that may exist in the hospital setting. It should have asked about surgical and ICU protocols that possibly exist, as well as general clinical information about patients with CAD. The questionnaire should have included open-ended questions for participants to explain reasons why specific treatment interventions and outcome measures were more commonly used than others.

CHAPTER 6

6. CONCLUSION

This study was timely to perform as more than a decade had lapsed since the physiotherapy management of patients with CAD or after CABG surgery in South Africa was first reported on by Roos & Van Aswegen (2011). This survey aimed to establish the number and years of experience of physiotherapists who work in the cardiopulmonary field and are currently involved in the care and rehabilitation of patients with CAD; determine the current physiotherapy interventions and outcome measures used in the management of patients with CAD; identify the referral systems used for referring patients with CAD to physiotherapy rehabilitation within the acute care and out-patient settings; identify the clinical settings (e.g. acute care or outpatient clinic) in which physiotherapy rehabilitation interventions for patients with CAD currently take place, the frequency of these interventions (acute and chronic phase), physiotherapists' involvement in providing structured phase three cardiac rehabilitation programmes in an outpatient setting. A modified survey-based questionnaire was distributed electronically to potential participants throughout South Africa to retrieve relevant information to answer the study objectives.

The findings confirmed that most physiotherapists involved in the care of patients with CAD were treating patients in the hospital, and in contrast to Roos & van Aswegen (2011), in the private sector. Sadly, physiotherapists' involvement in cardiac rehabilitation and the provision of cardiac rehabilitation in the out-patient setting is still limited. Intervention strategies seemed to align with the outcome measures used, however, other evidence-based strategies could be used to provide more comprehensive care.

6.1 RECOMMENDATIONS FOR CLINICAL PRACTICE

- Participants in this survey had on average six years of experience working within the cardiorespiratory field. The findings of this survey could serve as a guide to patient care for inexperienced physiotherapists working in this field.
- The findings of this study could inform private and public working physiotherapy teams about the potential lack of confidence and experience among younger, newly qualified physiotherapists in working with CAD patients. This could create more clinical opportunities for these physiotherapists to interact with patients after CABG surgery.

6.2 RECOMMENDATIONS FOR RESEARCH

- The survey should be conducted among physiotherapists who manage patients with CAD in public healthcare settings to obtain a better understanding of the physiotherapy service provision to this patient population in South Africa.
- The survey should be conducted among physiotherapists who manage patients with CAD to determine the effect of early mobilization post CABG procedure in South Africa.
- Future research should focus on reporting the clinical profiles and outcomes of patients after CABG surgery (e.g. types of complications developed, length of stay, quality of life) in South Africa and the effect that postoperative physiotherapy management has on their outcomes.
- Barriers and facilitators of physiotherapy management of patients with CAD in- and out of hospital need to be explored and strategies developed to overcome the identified barriers.

In conclusion, this study contributes updated information on the physiotherapy management of patients with CAD in South Africa and lays a foundation for future research.

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APPENDIX A

- **REDCap QUESTIONNAIRE**

The current physiotherapy management of patients with coronary artery disease in South Africa

Please complete the survey below. Click on relevant answers and elaborate where necessary. You may withdraw from the study at any time without providing a reason and will not face any consequences.

This study aims to determine the current physiotherapy management of patients with coronary artery disease in South Africa.

Objectives of this study are to:

Establish how many physiotherapists who work in a cardiopulmonary field are currently involved in the care and rehabilitation of patients with CAD and how many have previous experience of working in a cardiopulmonary field.Determine the current physiotherapy interventions and outcome measures used in the management of these patients and draw comparisons to the study published in 2011Identify the referral systems used for referring patients with CAD to physiotherapy rehabilitation within the acute care and out-patient settingIdentify the clinical settings (acute care or outpatient clinic) in which physiotherapy rehabilitation interventions for patients with CAD currently take place, the frequency of these interventions (acute and chronic phase) and how many provide a structured phase three cardiac rehabilitation program in the outpatient setting.

Thank you for taking time out of your schedule to participate in this survey.

What is your current age?	_____
Are you registered with the HPCSA as a physiotherapist?	◯ Yes ◯ No
For how many years have you been practicing as a physiotherapist (general)?	_____
Select the option that best reflects your working environment. Where do you spend the majority of your working time?	◯ Government health care setting ◯ Private health care setting
Do you provide physiotherapy care at your current place of work to patients with coronary artery disease (CAD)?	◯ Yes ◯ No
Do you have any previous experience of working in a cardio-respiratory physiotherapy capacity?	◯ Yes ◯ No
How many years of experience do you have working in a cardio-respiratory physiotherapy capacity?	_____
Clinical settings	
In which of the following in-hospital settings do you currently work?	☐ Cardiothoracic Intensive Care Unit ☐ Cardiac Care Unit ☐ Medical ICU ☐ Surgical ICU ☐ Trauma ICU ☐ Medical Ward ☐ Surgical Ward ☐ Other

You have selected "Other". Please state which in-hospital setting you currently work in.	_____
In which of the following outpatient settings do you currently work? (Maximum two)	☐ Outpatient Government Department ☐ Outpatient Government Community Clinic ☐ Outpatient Private Practice ☐ Nursing Facility ☐ Gymnasium ☐ Other
You have selected "Other". Please state which outpatient setting you currently work in.	_____

Referral systems used for physiotherapy rehabilitation

How are patients with CAD commonly referred for physiotherapy management in your hospital setting?	☐ Specialist/Surgeon ☐ Nurse ☐ Dietician ☐ Occupational therapist ☐ Psychologist ☐ Speech therapist ☐ Self ☐ Other
You have selected "Other". Please state other ways in which patients with CAD are commonly referred to physiotherapy in the hospital setting you work in	_____
How are patients with CAD commonly referred in the outpatient setting that you work in?	☐ Specialist/Surgeon ☐ General practitioner ☐ Dietician ☐ Psychologist ☐ Social worker ☐ Speech therapist ☐ Occupational therapist ☐ Biokineticist ☐ Self ☐ Hospital-based Physiotherapist ☐ Other
You have selected "Other". Please state other ways in which patients with CAD are commonly referred for physiotherapy management in the outpatient setting you currently work in.	_____

Physiotherapy intervention strategies used

A phase three cardiac rehabilitation program is a structured, graded exercise program suited to each patient's needs and goals. Do you provide a structured Phase three cardiac rehabilitation program to patients in the out-patient setting?	○ Yes ○ No

You have selected "Yes". In which of the following out-patient settings do you provide this program?	☐ Out-patient Government department ☐ Out-patient Government Community Clinic ☐ Out-patient Private Practice ☐ Nursing facility ☐ Gymnasium ☐ Telehealth ☐ Home visits ☐ Other
You have selected "Other". Please state other out-patient settings in which you provide this program.	_____
If you are treating patients with CAD, which clinical scenarios are relevant to your physiotherapy practice?	☐ Pre-operative Coronary Artery Bypass Grafting (CABG) ☐ Post CABG (In hospital) ☐ Post CABG (Post hospital discharge: 0-6 weeks) ☐ Post CABG (Structured Phase three cardiac rehabilitation program: after 6 weeks) ☐ Post Angiogram (In hospital) ☐ Post Angiogram (Post hospital discharge) ☐ Post Angioplasty with/without stenting (In hospital) ☐ Post Angioplasty with/without stenting (Post hospital discharge) ☐ Post Myocardial Infarction without invasive medical management (In hospital) ☐ Post Myocardial Infarction without invasive medical management (Post hospital discharge) ☐ Post chest pain/angina without invasive medical management (In hospital) ☐ Post chest pain/angina without invasive medical management (Post hospital discharge)

Which physiotherapy interventions do you currently use in hospital when treating patients with CAD?	☐ Active cycle of breathing techniques ☐ Deep breathing exercises ☐ Incentive Spirometry ☐ Intermittent Positive Pressure Breathing (IPPB: Bird) ☐ Blow bottle/PEP ☐ Suction ☐ Postural Drainage Positions ☐ Manual Techniques (Percussions/Vibrations/Shaking) ☐ Mechanical Vibromat ☐ Inspiratory muscle training with threshold device (powerbreathe) ☐ Circulatory Exercises ☐ Transfer Training ☐ Graded Mobilization ☐ Strengthening Exercises ☐ Shoulder Range of Motion exercises ☐ Home Exercise Program (Specific exercises) ☐ Home Exercises Guidelines (Frequency, intensity, time, type, red flags) ☐ Education regarding post-operative CABG precautions/contraindications (E.g. wound care, physical activity, sternotomy precautions) ☐ Education regarding CAD ☐ Education regarding risk factor modification ☐ Prescribing Sternal-supportive corset ☐ Referral to structured phase three cardiac rehabilitation program ☐ Referral to dietician ☐ Referral to counsellor/ psychologist (if needed) ☐ Other ☐ I do not treat patients with CAD in my hospital setting
You have selected "Other". Please state which interventions (not listed above) you use when treating patients with CAD in the hospital setting?	_____

Which physiotherapy interventions do you currently use when treating patients with CAD out of hospital?	☐ Active cycle of breathing technique ☐ Deep breathing exercises ☐ Incentive Spirometry ☐ Intermittent Positive Pressure Breathing (IPPB: Bird) ☐ Blow bottle/PEP ☐ Suction ☐ Postural Drainage Positions ☐ Manual Techniques (Percussions/Vibrations/Shaking) ☐ Mechanical Vibromat ☐ Inspiratory muscle training with threshold device (powerbreathe) ☐ Circulatory Exercises ☐ Transfer Training ☐ Graded Mobilization ☐ Strengthening Exercises ☐ Shoulder Range of Motion exercises ☐ Home Exercise Program (Specific exercises) ☐ Home Exercises Guidelines (Frequency, intensity, time, type, red flags) ☐ Education regarding post-operative CABG precautions/contraindications (E.g. wound care, physical activity, sternotomy precautions) ☐ Education regarding CAD ☐ Education regarding risk factor modification ☐ Prescribing Sternal-supportive corset ☐ Referral to structured phase three cardiac rehabilitation program ☐ You provide a structured phase three cardiac rehabilitation program ☐ Referral to dietician ☐ Referral to counsellor/ psychologist (if needed) ☐ Other ☐ I do not treat patients with CAD in an out-patient setting
You have selected "Other". Please state which interventions (not listed above) you use when treating patients with CAD in the outpatient setting?	_____

Outcome measurement tools used

Which physiotherapy outcome measures do you currently use when treating patients with CAD (in and out of hospital)?	☐ Secretions (viscosity, amount, colour) ☐ Incentive spirometry ☐ Peak Flow ☐ Visual analogue pain scale (VAS) ☐ BORG rating of perceived exertion questionnaire ☐ New York Heart Association Classification (NYHA) ☐ Modified Medical Research Council Dyspnoea Scale (MMRC) ☐ Nijmegen Questionnaire ☐ Medical Research Council Sum Score (MRC sum) ☐ Chelsea Critical Care Physical Assessment Tool (CPAx) ☐ Functional Status Score for Intensive Care Unit (FSS-ICU) ☐ Intensive Care Unit Mobility Index (ICUMI) ☐ de Morton Mobility Index (DEMMI) ☐ Physical Function in Intensive Care Unit Test (PFIT) ☐ 1 Minute Sit to Stand Test ☐ 3 Minute Sit to Stand Test ☐ 6 Minute Walk Test (6MWT) ☐ Short Physical Performance Battery (SPPB) ☐ 36 Item Short Form Survey (SF-36) ☐ Other
You have selected "Other". Which other outcome measures (not listed above) do you use when treating patient with CAD (in and out of hospital)?	_____

Frequency of physiotherapy service delivery

If you provide physiotherapy interventions to patients with CAD in hospital, what is the common frequency of treatment?	☐ Once daily ☐ Twice daily ☐ Three times daily ☐ More than three times daily ☐ I do not provide physiotherapy interventions to patients in hospital
If you work in a hospital setting and in a cardio-respiratory capacity, and you do not provide treatment to patients with coronary artery disease, please supply reasons for this situation.	_____
If you provide physiotherapy interventions to patients with CAD in an out patient setting, what is the common frequency of treatment?	☐ Two to three times a week ☐ Once a week ☐ Once in two weeks ☐ Once a month ☐ I do not provide physiotherapy interventions to patients in an out patient setting
If you work in an out patient clinical setting in a cardio-respiratory capacity, and you do not provide treatment to patients with coronary artery disease, please supply reasons for this situation.	_____

APPENDIX B

- **PARTICIPANT INFORMATION SHEET**

Physiotherapy management of patients with coronary artery disease: a report on current practice in South Africa

Dear potential participant,

My name is Jamie Reizenberg and I am a Masters student in the department of Physiotherapy at the University of Witwatersrand, Johannesburg. As part of my studies, I have to undertake a research project. I have chosen to research what the current physiotherapy management of patients with coronary artery disease in South Africa is under the supervision of Professor Helena Van Aswegen.

The purpose of the study is to determine how many physiotherapists are currently managing or have managed patients with coronary artery disease in the hospital or outpatient setting, which treatment interventions and outcome measures are being used, the frequency of these interventions, how patients are referred to physiotherapy and reasons why physiotherapists working in the cardio-pulmonary field may not be managing these patients.

Why am I being asked to participate?
You are a physiotherapist registered with the HPCSA and SASP, working in South Africa.

Confidentiality and anonymity
No identifying information will be required. Each questionnaire answered will remain anonymous.

What is the cost?
There will be minimal costs to you if you participate in the project by way of time and data.

What are my rights?
You may withdraw from the project at any time, without any consequences. Reasons for withdrawing will not be asked. Informed consent will be implied with every completed questionnaire.

Contact details
If you have any questions or queries related to the study, feel free to contact me (Jamie Reizenberg) at jamiereizenberg@gmail.com or my supervisor Professor Helena van Aswegen at Helena.VanAswegen@wits.ac.za. Alternatively, you may contact the Human Ethics Research Committee (Medical): Professor Clement Penny at Clement.Penny@wits.ac.za or the Human Ethics Research Committee (Medical) secretariat: Ms Zanele Ndlovu at Zanele.ndlovu@wits.ac.za.

APPENDIX C

- **TREEE MODULE 1 TRAINING CERTIFICATE**

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Ce document atteste que - this document certifies that

Jamie Reizenberg

a complété avec succès - has successfully completed

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[REV : 20170310]

APPENDIX D

- **ETHICAL CLEARANCE CERTIFICATE**

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG	HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

Office of the Deputy Vice-Chancellor (Research and Innovation)

TO: Ms J Reizenberg
School of Therapeutic Sciences
Department of Physiotherapy
Medical School
University

E-mail: jamiereizenberg@gmail.com

CC: Supervisor: Professor H van Aswegen
<Helena.vanAswegen@wits.ac.za>
and <HREC-Medical Research Office@wits.ac.za>

FROM: Mr Iain Burns
Human Research Ethics Committee (Medical)
Tel: 011 717 1252

E-mail: Iain.Burns@wits.ac.za

DATE: 2022/05/10

REF: R14/49

PROTOCOL NO: **M220313** (This is your ethics application reference number. Please quote it in all enquiries, oral or written, relating to this study.)

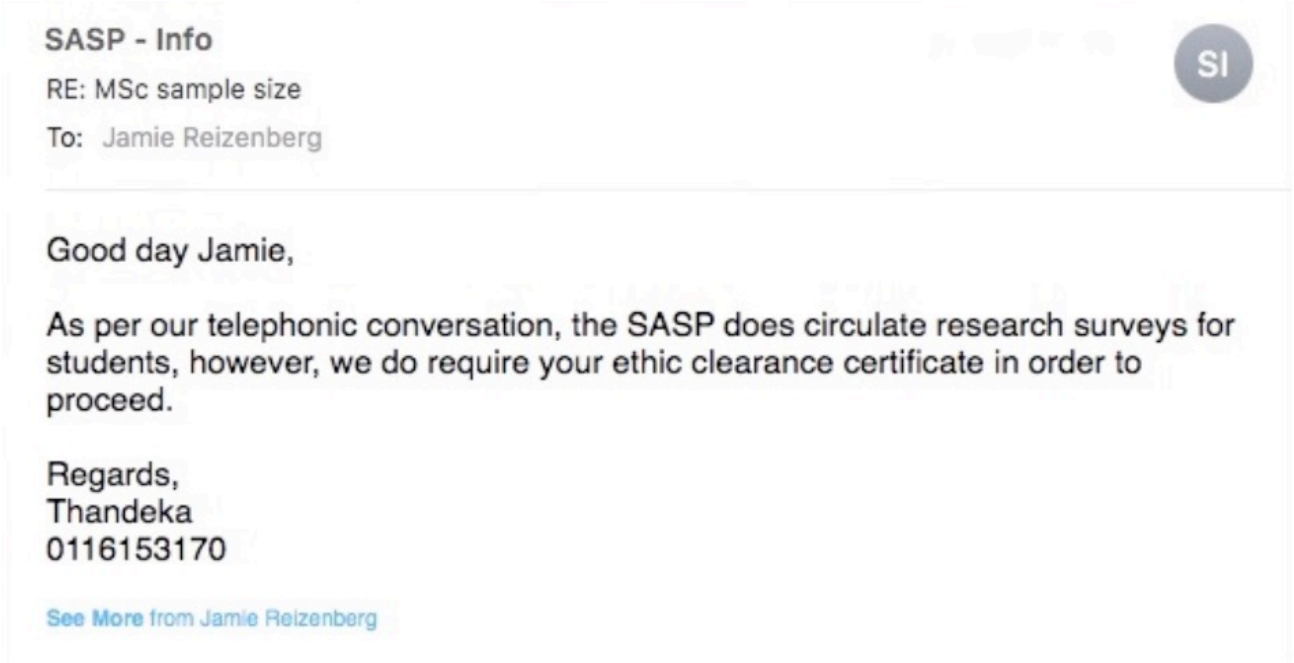
PROJECT TITLE: *Physiotherapy management of patients with coronary artery disease: a report on current practice in South Africa*

Please find attached the Clearance Certificate for the above project. I hope it goes well and that an article in a recognized publication comes out of it. This will reflect well on your professional standing and contribute to Government funding of the University.

MSWorks2000/Iain0007/Clearscan.wps

APPENDIX E

- **SOUTH AFRICAN SOCIETY OF PHYSIOTHERAPY (SASP) PERMISSION E-MAIL**



SASP - Info

RE: MSc sample size

To: Jamie Reizenberg

SI

Good day Jamie,

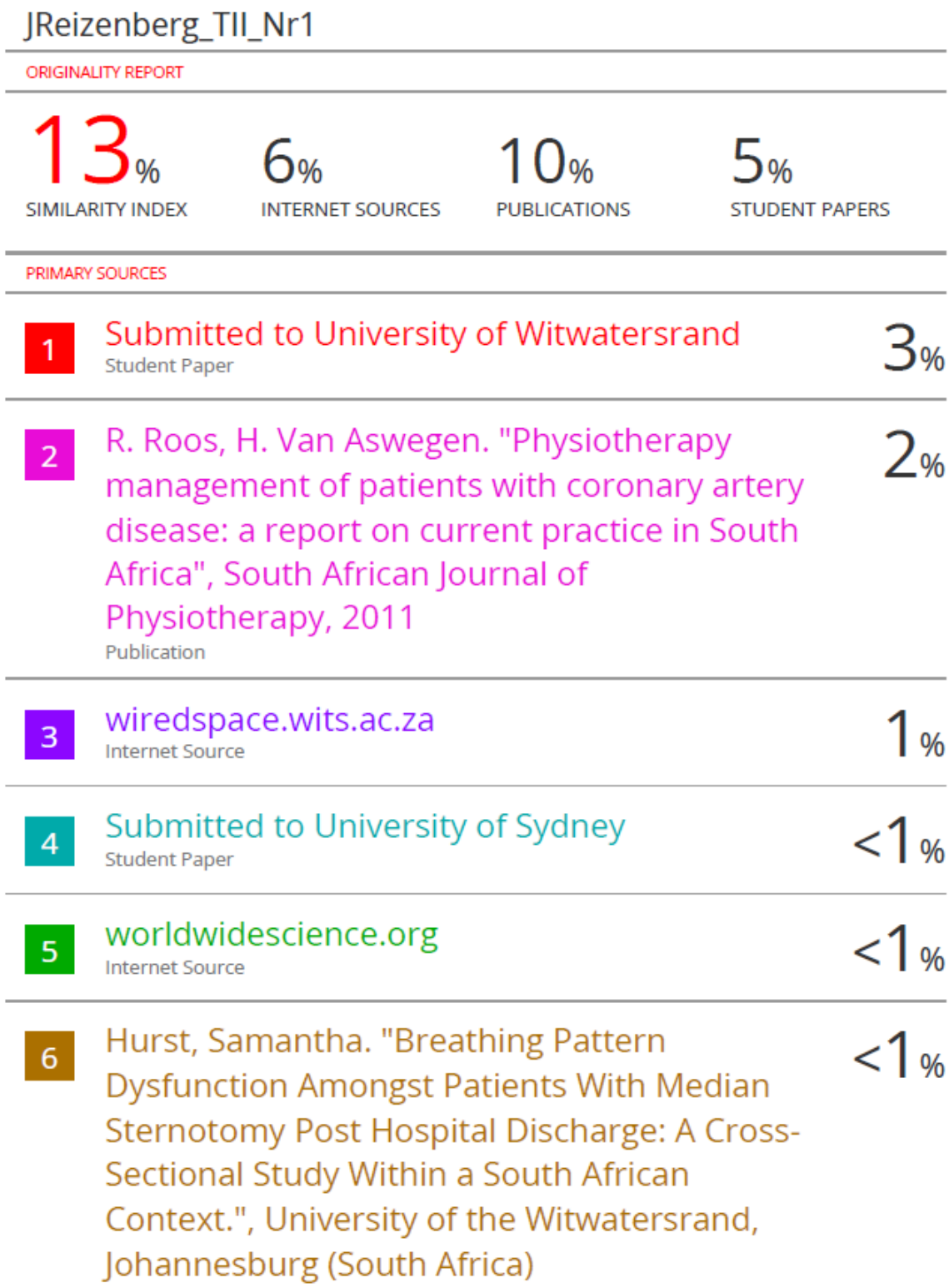
As per our telephonic conversation, the SASP does circulate research surveys for students, however, we do require your ethic clearance certificate in order to proceed.

Regards,
Thandeka
0116153170

See More from Jamie Reizenberg

APPENDIX F

- **TURN-IT-IN REPORT**



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