EXERCISE PRESCRIPTION: KNOWLEDGE, PRACTICE AND ATTITUDES AMONG SOUTH AFRICAN DOCTORS

by

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DECLARATION

I, Dr. Marius Gerhard Roos hereby declare that the work on which this dissertation is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work or any part of it has been, is being, or has to be submitted for another degree in this or any other University.

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ABSTRACT

Background: Physical inactivity is fourth on this list of leading causes of deaths worldwide. South Africans are reported to have low physical activity (PA) levels. Increased levels of PA and aerobic fitness will have a positive influence on morbidity and mortality since sedentary lifestyles are responsible for many of the chronic diseases we face today. Prescriptions from General Practitioners (GPs) represent a well-understood interaction between patient and doctor. An exercise prescription from a GP will remind the patient that PA is part of their treatment plan and should be adhered to with the same diligence with which their mediation is taken. GPs have access to a large proportion of the sedentary population and can play a key role in motivating people to become physically more active. However, very little is known about the exercise prescription practices, knowledge and attitudes towards exercise prescription of South African GPs.

Aims: This study sought firstly to determine the practices, attitudes toward and knowledge on exercise prescription among General Practitioners in South Africa (SA) and secondly to identify possible barriers why South African GPs do not prescribe exercise.

Methods: A self-administered, anonymous electronic questionnaire was developed according to guidelines from literature to assess the practices, attitudes toward and knowledge on exercise prescription among GPs in South Africa. The questionnaire was circulated to a database of GPs via email on three separate occasions, two weeks apart and was completed by a total of 349 GPs. The outcomes measures consisted of the demographic information, training histories, practices of general practitioners regarding exercise prescription, attitudes of doctors towards exercise prescription as well as their attitudes toward the importance of exercise as preventative modality for chronic diseases. Knowledge on benefits, risk factors and contraindications regarding exercise prescription, as well as knowledge of doctors regarding recommendation and formulation of exercise prescriptions were also assessed.

Results:

The response rate from this study was considerably lower compared to the average response rate reported for online questionnaires. Despite the fact that a purposeful attempt was made to draw the participants' attention to the fact that exercise prescription does not involve casual advice such as "you should stop smoking and

exercise more”, substantially higher prescription rates (90.9%) were reported by the participants from this study compared to those from international literature. Possible reasons for these disparities between local and international findings may not only lie in possible self-report bias, but also in the different barriers to exercise prescription reported by the South African doctors compared to the international literature. A minority (18.0%) of the participants felt that exercise prescription will be too time consuming, while almost half (46.0%) of the non-prescribing doctors from this study reported a lack of confidence in their knowledge to be able to prescribe exercise. Approximately 98% of the GPs believed that it should be part of their practice to prescribe exercise to their patients, despite the fact that very few were familiar with the knowledge and safety principles inherent to a safe and effective exercise prescription.
The knowledge of the GPs in this study regarding recommendations for physical activity and the formulation of an exercise prescription was poor.

Conclusion: Although general practitioners reported a fairly high incidence of exercise prescription, insufficient knowledge about not only exercise prescription, but also lifestyle modifications were noticed. Barriers to exercise prescription different from international literature and should be investigated further. A lack in confidence and knowledge to enable safe and effective exercise prescription highlights a need to rethink the undergraduate medical curricula. The good news resulting from this study is the positive attitude from the medical practitioners and their acknowledgement of the ability of physical activity, in the form of exercise training, to prevent the burden of non-communicable diseases.

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ACSM	American College of Sports Medicine
AD	Alzheimer's Disease
BJSM	British Journal of Sports Medicine
BMI	Body Mass Index
BP	Blood Pressure
COPD	Chronic Obstructive Pulmonary Disease
CVD	Cardiovascular Disease
EIM	Exercise is Medicine
FITT	Frequency, Intensity, Time, Type
GP(s)	General Practitioner(s)
HIV/AIDS	Human Immunodeficiency Virus/Acquired Human Deficiency Syndrome
HPCSA	Health Professions Council of South Africa
$HR_{(max)}$	Maximum Heart Rate
IPA	Independent Physician Association
IT	Information Technology
LAL	Look and Learn
LDL	Low Density Lipoprotein
MDD	Major Depressive Disorder
PA	Physical Activity
PAR-Q	Physical Activity Readiness Questionnaire
SA	South Africa
T2DM	Type Two Diabetes Mellitus
UFS	University of the Free State
US	United States
$VO_{2(max)}$	Maximum oxygen consumption
WHO	World Health Organization

NOMENCLATURE

Despite the fact that various papers have tried to clarify the difference between "exercise" and "physical activity" (PA) to ensure uniformity and research quality (Caspersen, Powell and Christenson, 1985; Norton, Norton and Sadgrove, 2010), these terms are still used interchangeably in literature. Exercise is a subcategory of physical activity and is not synonymous with physical activity. However, exercise and PA have shared elements such as involvement of bodily movements produced by skeletal muscles using energy while both are associated with increased physical fitness as the intensity, duration, and frequency of movements increase (Caspersen, et al., 1985).

For this study, PA was defined as athletic, recreational or occupational activities that require physical skills and utilize strength, power, endurance, speed, flexibility, range of motion or agility, while exercise was defined as physical activity that is planned, structured, and repetitive for the purpose of conditioning any part of the body. Therefore, exercise prescription was defined as the formulation of an individualised exercise program based on exercise frequency, intensity, and duration with consideration for the specificity of the training response, specific to the prescribed exercise method.

Every effort was made to stay true to these definitions when referring to exercise or PA, except when the context in which these terms were used interchangeably within literature was unclear; in these situations the term used within the paper was adopted.

INDEX	Page

Page

Page

Chapter 1

INTRODUCTION

1.1 SCOPE OF RESEARCH

The pervasive sedentary lifestyle and accompanying low energy expenditure of modern man are increasingly held responsible for many of the chronic diseases we face today (Sparling and Owen, 2000). Anecdotal beliefs that obesity is an American or European trait no longer holds true, as research exposed low physical activity (PA) levels among South Africans (Joubert, Norman, Lambert et al., 2007; Kruger, Venter, Vorster et al., 2002) which may contribute substantially to excess body mass. Physical inactivity, according to the World Health Organization (WHO), is one of the top ten risk factors for premature death (Kallings, 2008). The leading causes of deaths worldwide are high blood pressure (13%), smoking (9%), high blood glucose (6%), physical inactivity (6%), and obesity (5%). Although physical inactivity is fourth on this list, it can easily be turned around and have an inherently positive effect on almost all the other causes (Khan, Weiler and Blair, 2011). Therefore, an increased level of PA and aerobic fitness will not only reduce the risk for developing various chronic diseases, but also have a positive influence on morbidity and mortality resulting from these chronic diseases (Sørensen, Kragstrup, Kjær et al., 2007).

In spite of the public's knowledge that PA leads to a range of health benefits including improved cardiovascular health, lower risk of obesity, lower risk to develop osteoporosis, and improved psychological well-being (Jones, Harris, Waller et al., 2005), American surveys demonstrate low levels of participation in PA (Armitage, 2005). The Centre for Disease Control reports that approximately 75% of adults in the United States (US) consider themselves to be active, although a mere 22% of these adults are actually active enough to derive health benefits when analysing their reported activity levels. The larger 53% are active but not active enough to derive health benefits, while the remaining 25% of the adult population are completely sedentary (Dauenhauer, Podgorski and Karuza, 2006). This behavioural divide between young adults' lacking participation in exercise despite their apparent knowledge of the benefits associated with PA (Dauenhauer et al., 2006) is of great concern. It is therefore imperative to engage in research which will ultimately contribute to viable avenues encouraging regular PA among the sedentary population.

Non-participation in PA is a complex behavioural issue, influenced by modern physical and social environments. A coordinated approach involving multiple societal, institutional, and departmental collaborations (Khan et al., 2011) will be required, to influence persons' belief systems underpinning their physical behaviour. People are more willing to participate in exercise if they have a positive attitude toward exercise, if they perceive social pressure to exercise, and if they believe they are capable of exercising (Armitage, 2005). Considering that general practitioners (GPs) have access to a large proportion of the sedentary population and are generally a respected source of advice (Swinburn and Walter, 1998) they are key in influencing their patients' belief systems and getting adults to exercise (Phillips and Roy, 2009; Swinburn and Walter, 1998). Receiving a prescription for exercise from a GP represents a concrete and well-understood interaction between patient and doctor in the management of their condition and improvement of their health (Swinburn and Walter, 1998). Such a prescription will not only remind the patient of the exercise goals set by their GP in conjunction with themselves (Swinburn and Walter, 1998), but also highlight the notion that the exercising is part of their treatment plan and should be adhered to with the same diligence with which their mediation is taken.

Recently, it has been suggested that primary care providers agree to the importance of PA counselling and the role they have in promoting PA to their patients (Hébert, Caughy and Shuval, 2012). Despite this reported consensus, a survey among primary care practitioners in the US reported that 47% of primary care providers did not prescribe exercise to their patients at the time of the research (Dauenhauer et al., 2006), once again highlighting the disparity between exercise beliefs and habits.

Previous research exploring possible reasons why GPs do not prescribe exercise identified factors such as time constraints, a lack of confidence in counselling patients on exercise and a lack of reimbursement for their counselling efforts some of the main reasons reported by GPs for not prescribing exercise during their consultations included (Swinburn and Walter, 1998). According to Derman, Patel, Nossel et al. (2008a) only four out of ten doctors (41%) talk to their patients about the importance of exercise (Derman, Patel, Nossel et al., 2008a). Doctors seem to target their advice towards secondary prevention rather than primary prevention (Morrato, Hill, Wyatt et al., 2006).

While some insight have been gained into the practices and attitudes of American doctors towards exercise prescription, very little is known about the exercise prescription practices, knowledge and attitudes towards exercise prescription of South African GPs.

1.2 AIMS OF RESEARCH

The primary aim of this study was to describe the practices, attitudes and knowledge of South African doctors pertaining to exercise prescription. The secondary aim of this study was to identify possible barriers why South African GPs do not prescribe exercise.

1.3 RESEARCH QUESTIONS

In order to achieve the research aims set out above, the following research questions were asked:

1) *Do South African GPs prescribe exercise to their patients as part of a standard consultation?*
2) *What are the attitudes of South African GPs towards exercise prescription?*
3) *Do South African GPs have the basic knowledge needed to compile a safe and effective exercise prescription?*
4) *What are the major barriers for GPs who do not prescribe exercise?*

1.4 DISSERTATION SYNTHESIS

This dissertation consists of seven chapters. Following this introduction and statement of the aims, Chapter 2 provides an overview of the relevant literature and motivation for the research, the methodology and interpretation of the data. Chapter 3 gives an account of the methods followed for participant selection, data collection and data analysis to fulfil the aims of the research project. Chapter 4 reports on the demographic information and results of the research while Chapter 5 discusses the findings drawn from the results, the implication of the findings and the limitations of this study. Chapter 6 concludes the findings and make recommendations for future research to further knowledge in the field of exercise prescription in SA, while the dissertation itself is brought to a close with Chapter 7 which reflects on the lessons learned through the research process.

Chapter 2

LITERATURE REVIEW

"Lack of activity destroys the good condition of every human being, while movement and methodical physical exercise save it and preserve it."

– Plato 380BC

2.1 INTRODUCTION

The World Health Organisation (WHO) states in their constitution that health is "a state of complete physical, mental and social well-being and not merely the absence of disease of infirmity" (WHO, 1989). Risk factors associated with ill health, disability, disease or death often coexists and/or interacts with one another. These risk factors can be categorized into genetic, environmental and behavioural risk factors (Bousquet et al., 2011; Chakravarthy, Joyner and Booth, 2002) which ultimately affects both quality of life and longevity (Sallis, 2009). Approximately one-quarter of the variation in lifespan can be attributed to genetic factors over which we have very little control, as demonstrated by a Scandinavian study on identical twins which reported heritability of average life expectancy to be 20% to 30% (Christensen and Vaupel, 1996). These findings suggest that environmental and behavioural factors account for up to 80% of the variation in age at death, implying that we have substantial influence on our longevity and vitality (Perls and Terry, 2003). It is therefore not surprising that recent literature advocates a focus on modifiable factors such as our environment and behaviour to improve health (Sallis, 2009).

While overwhelming success have been achieved in disease control through environmental interventions such as vaccinations and improved hygiene to increase life expectancy, many authorities in the field of preventative healthcare are of the opinion that too little has been done to target behavioural factors, particularly physical inactivity (Sallis, 2009).

This chapter will provide an overview of the burdens of physical inactivity and its related diseases, the positive effects of exercise on various chronic diseases, evidence to promote the prescription of exercise as medicine and the role of doctors in exercise prescription.

2.2 BURDENS OF INACTIVITY AND DISEASE

It would be impossible to deny the numerous technological advancements which have been part and parcel of this modern day era; cars, televisions, computers, mobile devices and machinery designed to take over manual labour. The driving force behind many of these developments was to increase the productivity of man, unfortunately without any regard for the major cost it would have on the worldwide epidemic of non-communicable diseases stemming from inactivity (Hallal, Andersen, Bull et al., 2012).

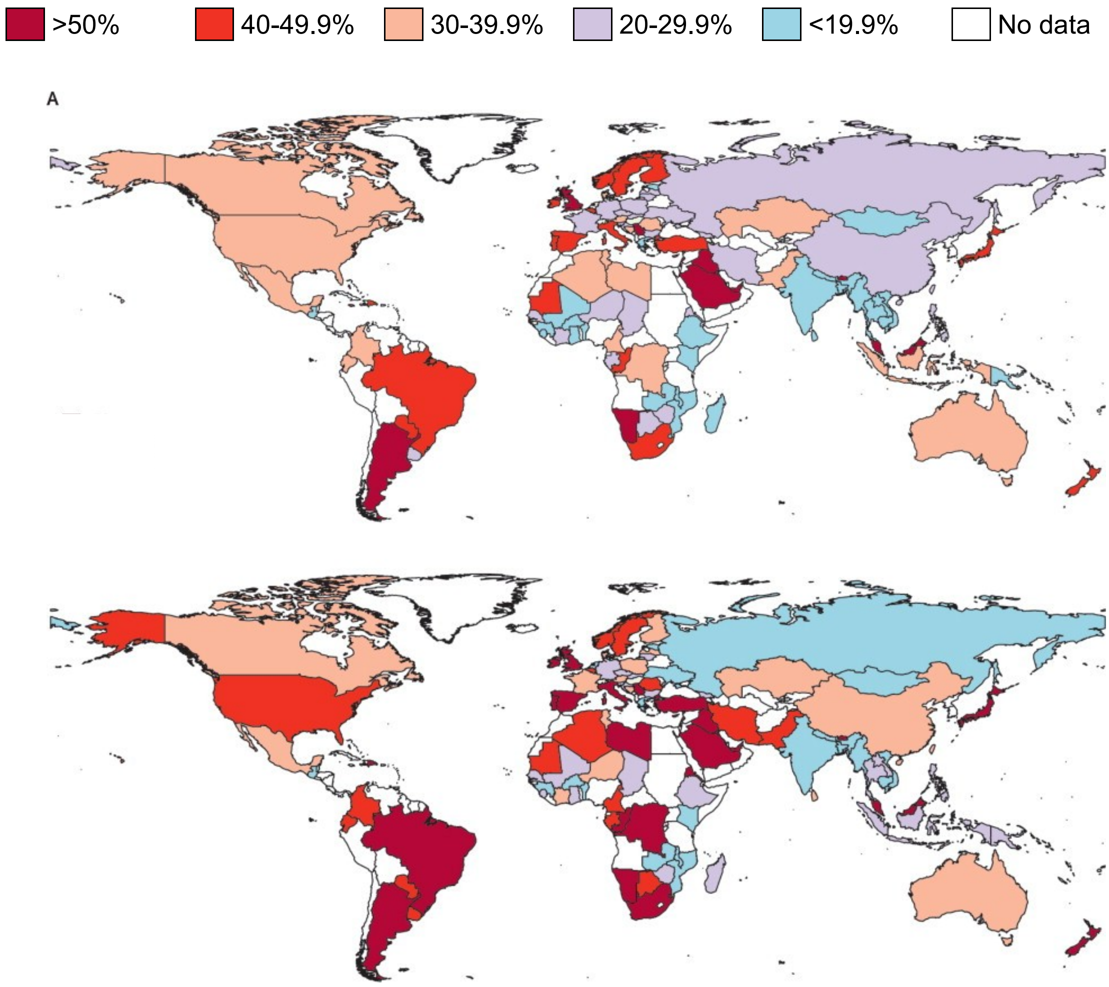

Figure 2.1 Global adult physical activity levels for (a) men and (b) women (Hallal et al., 2012).

The weighted average of adults (aged 15 years or older) from 122 countries represented in the WHO global health observatory data repository (WHO, 2011) who did not meet the minimum requirements for physical activity (PA) accounted to 31.1%

in 2008 (Hallal et al., 2012). Looking at the extensive body of literature describing inactivity levels (Bauman, Bull, Chey et al., 2009; Hallal et al., 2012; Katzmarzyk, Gledhill and Shepard, 2000), low fitness levels (Carnethon, Gulati and Greenland, 2005; Pate, Davis, Robinson et al., 2006) and the Sedentary Death Syndrome (Huber, Knottnerus, Green et al., 2011), physical inactivity is a major public health issue in many countries (Chakravarthy et al., 2002). From Figure 2.1 it is clear that South African adults exhibit high levels of physical inactivity compared to global figures, which is in agreement with local findings from 2000 (Joubert et al., 2007).

A considerable amount of the evidence about non-communicable chronic disease management comes from high-income countries (Beaglehole, Epping-Jordan, Patel, Schofield, Kolt et al., 2008). However, considering that (except for the poorest countries), deaths and disabilities in developing countries resulting from chronic diseases now surpasses those which stems from communicable diseases (Alwan, 2011). Non-communicable diseases also cause death at a younger age in low- and middle-income countries (29% among people under the age of 60), compared to 13% in high-income countries (Alwan, 2011). Therefore, non-communicable diseases likewise have serious consequences for the health and welfare of the people in low and middle income countries (Strong, Mathers and Bonita, 2005). According to Mayosi, Flisher, Lalloo et al. (2009), SA is in the midst of a health transition that is characterised by the simultaneous occurrence of epidemic infectious diseases and a rise in non-communicable diseases (Mayosi, Flisher, Lalloo et al., 2009). With the concomitant increases in obesity and decreases in PA at the population level (Bauman, Phongsavan, Schoeppe et al., 2006), it is not surprising that substantial increases in non-communicable diseases are being observed in both developed and developing countries, reaching epidemic proportions worldwide and causing the greatest global share of death and disability (Daar, Singer, Persad et al., 2007).

The past 16 years of political transition in SA have seen a rise in non-communicable diseases and noteworthy low levels of PA by the South African population (Joubert et al., 2007), posing a serious threat to the health and longevity of people from both developed and developing countries.

The WHO stated that approximately 61% of all deaths over all age groups around the globe during 2005 could be attributed to non-communicable diseases, approximately 30% to communicable diseases and approximately 9% to injuries (WHO, 2005). Mathers and Loncar (2005) predicted that the proportion of deaths due to non-communicable disease will rise from 59% in 2002 to 69% in 2030 (Mathers and Loncar, 2005), while Geneau, Stuckler, Stachenko et al. (2010) painted an even bleaker picture by postulating that non-communicable disease will cause over three quarters of all deaths in 2030 (Geneau, Stuckler, Stachenko et al., 2010). Cardiovascular diseases, chronic respiratory diseases, diabetes and cancers contribute to over 50% of deaths globally (Derman et al., 2008a) and 12% of the overall disease load (Mayosi et al., 2009). These chronic diseases have a shared set of clinical risk factors, namely hypercholesterolemia, hypertension, and obesity - and their closely associated behavioural risk factors - tobacco use, physical inactivity and unhealthy diets (Stuckler, 2008). Even though inactive lifestyles are not the lone cause of non-communicable chronic diseases, is the easiest amendable of all risk factors (Brown and Smith, 2010).

Approximately 3.2 million people die each year due to physical inactivity (Alwan, 2011). The five foremost causes of deaths worldwide can be attributed to hypertension (13%), smoking (9%), high blood glucose (6%), physical inactivity (6%), and obesity (5%) (Kallings, 2008). Although physical inactivity is only fourth on the list of the top ten risk factors for premature death, it plays a role in almost all the other causes (Khan et al., 2011), taking the blame for causing more than 5.3 of the 57 million deaths in 2008 which could have been prevented through PA (Lee, Shiroma, Lobelo et al., 2012). This correlates well with another study which found that physical inactivity were responsible for nearly 1 in 10 deaths in the US during 2005 (Danaei, Ding, Mozaffarian et al., 2009), but higher than the 1.9 million of preventable deaths reported for 2002 (WHO, 2002). Nonetheless, these staggering numbers are disconcerting, and it is therefore not surprising that chronic diseases have been declared the enemy of the new millennium (Booth and Chakravarthy, 2002; Booth, Gordon, Calson et al., 2000) considering the vast number of deaths which could have been prevented if the individuals engaged in a physically active lifestyle.

While the prevalence of non-communicable diseases is not well documented in Africa (Brown and Smith, 2010), literature suggests that non-communicable diseases caused 28% of the total burden of disease measured by disability-adjusted life years (DALYs) in SA during 2004 (Mathers, Fat and Boerma, 2008; Mayosi et al., 2009). And can be attributed to insufficient levels of PA (Joubert et al., 2007).

Even though the negative health effects of physical inactivity are well documented, the economic consequences are often neglected. As the population ages, chronic illnesses have become a common occurrence, putting pressure on the sustainability of healthcare systems as chronic diseases account for most of global healthcare expense (Huber et al., 2011). Physical inactivity was directly responsible for 3% of disability adjusted life years lost in the United Kingdom in 2002, with estimated direct costs to the National Health Service of £1.06 billion (Allender, Foster, Scarborough et al., 2007). In America the annual cost directly attributable to inactivity is an estimated $24 billion–$76 billion (2.4%–5.0% of national healthcare expenditures) (Roux, Pratt, Tengs et al., 2008). In Canada it is estimated that even modest reductions in inactivity levels could result in substantial cost savings. A 10% reduction in the prevalence of physical inactivity has the potential to reduce direct health care expenditures by $150 million a year (Katzmarzyk et al., 2000). It is therefore imperative that research pertaining to avenues for increasing the PA levels of the global population is undertaken as a matter of urgency.

2.3 EXERCISE AND HEALTH

Over the past few decades, extensive knowledge has been accumulated relating to the significant contribution of PA in the prevention and treatment of a number of diseases (Chakravarthy et al., 2002; Leijon, Bendtsen, Nilsen et al., 2008), especially non-communicable chronic diseases. A linear relationship exist between PA levels and overall health status (Sallis, 2009), evidenced by the strong links between increased levels of PA and aerobic fitness with a reduction in the risk for developing various chronic diseases, as well as the morbidity and mortality resulting from these chronic diseases (Oberg, 2007; Pedersen and Saltin, 2006). Increasing PA is now considered to be as important as tobacco control in lessening the burden of non-communicable diseases (Bauman et al., 2006; WHO, 2014).

2.3.1 Exercise and Diabetes

The prevalence of Type 2 Diabetes Mellitus (T2DM) and pre-diabetic conditions such as impaired fasting glucose and impaired glucose tolerance are rapidly on the rise (Hordern, Dunstan, Prins et al., 2012). An estimated one million deaths which occurred during 2002 could be attributed to diabetes (LaMonte, Blair and Church, 2005). In 2009, it was estimated that the world prevalence of diabetes among adults (aged 20–79 years) will be 6.4%, affecting 285 million adults in 2010 and will increase to 7.7% (439 million adults) by 2030 (Shaw, Sicree, and Zimmet, 2010). These figures were revised and a 69% increase in numbers of adults with diabetes in developing countries and a 20% increase in developed countries were postulated for the time period from 2011 to 2030 (Whiting, Guariguata, Weil et al., 2011).

A sedentary lifestyle is directly associated with the development of T2DM (Blair, 1989; Kokkinos and Myers, 2010), while moderate to vigorous PA can reduce onset rates of diabetes by between 6%-48% (Bassuk and Manson, 2005; Helmrich, Ragland, Leung et al., 1991; Sieverdes, Sui, Lee et al., 2010). Exercise plays a leading role in the prevention and control of insulin resistance, pre-diabetes, gestational diabetes mellitus, T2DM, and diabetes-related health complications (Colberg and Sigal, 2010; Hordern et al., 2012). The most important way by which PA decrease the threat for diabetes is by improvement in insulin sensitivity (Roberts and Barnard, 2005). As exercise is an insulin-independent stimulus for increased glucose uptake by the working muscle cells via the Glucose Transporter Type 4 transporter, both aerobic training and resistance training improve insulin action (Colberg and Sigal, 2010), and is considered one of the three cornerstones of treatment for diabetes mellitus (Woodard and Berry, 2001).

According to Colberg and Sigal (2010), an exercise prescription program for persons with diabetes should be individualised according to medication schedule, presence and severity of complications, and goals and expected benefits of the program (Colberg and Sigal, 2010). The majority of patients with T2DM can exercise without taking special precautions. Nonetheless, it is necessary that patients being treated with medication such as sulfonylurea, postprandial regulators or insulin are educated on precautions on how to avoid hypoglycaemia.

Precautions to avoid hypoglycaemia include blood glucose monitoring, adjustment of the insulin dose and dietary modification (Pedersen and Saltin, 2006). Patients with autonomic neuropathy should be carefully monitored since the absence of ischemic symptoms pose a risk for sudden cardiac death (Pedersen and Saltin, 2006) and silent myocardial ischemia (Boulton, Vinik, Arezzo et al., 2005). Similarly, patients with peripheral neuropathy should be educated to monitor for foot blisters or ulcers following exercise since neglect may result in complications leading to amputation (Mayfield, Reiber, Sanders et al., 1998). It is therefore recommended that, due to the high prevalence and incidence of comorbid conditions in diabetic patients, pre-exercise testing should precede training programs (Boulton et al., 2005), and preferably written and managed by individuals with appropriate qualifications and experience (Hordern et al., 2012).

Persons with no significant complications or limitations should follow exercise programs which accumulate to a minimum of 210 min per week of moderate-intensity exercise or 125 min per week of vigorous intensity exercise with no more than two consecutive days without training, as well as two or more resistance training sessions per week (Hordern et al., 2012).

2.3.2 Exercise and hypertension

Results from the South African National Health and Nutrition Examination Survey (SANHANES-1) demonstrated that almost three quarters of South African adults over 50 years are hypertensive (Shisana, Labadarios, Rehle et al., 2013). Hypertension is defined as a systolic blood pressure (BP) above 140mmHg and/or a diastolic BP >90mmHg (Pedersen and Saltin, 2006). It is a risk factor for acute myocardial infarction, cardiac insufficiency and sudden death, while being considered as the single most important risk factor for strokes in SA (Connor, Rheeder, Bryer et al., 2005).

While cardiorespiratory and resistance training has both been shown to be effective in the prevention of hypertension, cardiovascular exercise training is the most effective type of exercise to prevent and treat hypertension (Wallace, 2003). During exercise, systolic BP may rise from baseline, but following 30 to 45 minutes of moderate exercise, a 10 to 20 mmHg decrease in systolic BP are noted which may last for up to ten hours (MacDonald, 2002). Although studies carried out in subjects with cardiovascular diseases or risk factors reported that decreases in cardiovascular risk associated with exercise training are connected to an up-regulation of endothelium-mediated vasodilator function together with an increase in arterial compliance (Green, Spence, Halliwill et al., 2011), further research has shown that the prolonged effect of exercise on the lowering of systolic BP can be attributed to a transient decrease in stroke volume rather than peripheral vasodilatation (Fletcher, Ades, Kligfield et al., 2013).

An increase in exercise capacity is also linked to a lower mortality in hypertensive persons, with a greater risk reduction in younger individuals (18% reduction) compared to older persons (12% reduction) (Kokkinos and Myers, 2010).

2.3.3 Exercise and cancer

Worldwide there is a progressive increase in the prevalence of cancer (Newton and Galvão, 2008). Nearly 40 000 cancer-related deaths are reported annually in SA (Mayosi et al., 2009). With the exception of non-melanoma skin cancers, an estimated 3.45 million new cases of cancer and 1.75 million deaths from cancer were reported in Europe in 2012 (Ferlay, Steliarova-Foucher, Lortet-Tieulent et al., 2013). The most common cancer sites were cancers of the female breast, followed by colorectal, prostate and lung cancer (Ferlay et al., 2013).

An increase in PA has been documented to be associated with reduced risk of developing several forms of cancer (Roberts and Barnard, 2005; Shann, 2000). The mechanism of protection is thought to be due to the favourable effect of PA on a person’s antioxidant capacity (Franzoni, Ghiadoni, Galetta et al., 2005) and consequent ability to scavenge free radicals which have a carcinogenic affect (Dreher and Junod, 1996). This protective effect of PA has been observed over different populations with the potential to reduce the incidence of cancer by 40% (Newton and Galvão, 2008) while being most consistent for breast and colon cancer (Kruk, 2007; Shann, 2000).

PA increases bowel transit time and thus decreasing the duration of contact between faecal carcinogens and colonic mucosa (Shann, 2000) to prevent colon cancer. Furthermore, increased habitual PA modulate the production, metabolism and excretion of sex hormones implicated in the development of breast and endometrial cancer (Shann, 2000) as seen in the significant decrease of salivary estradiol levels with regular PA (Jasienska and Ziomkiewicz, 2006). PA therefore curbs the cancerous effects of certain hormones (Roberts and Barnard, 2005; Shann, 2000) such as estradiol which is a risk factor for developing breast cancer (Kruk, 2007) and testosterone which is a risk factor for developing prostate cancer (Shann, 2000). Even after cancer has been diagnosed, the survival rate of breast and colon cancer increase by 50–60% when engaging in regular PA (Shann, 2000), highlighting not only the preventative but also the therapeutic effect of PA on cancer.

Treatments for cancer include surgery as well as systemic and radiation therapy. However, these treatments compromise the physical function and quality of life of patients (Newton and Galvão, 2008). For many cancer patients chemotherapy or hormone therapy results not only in muscle loss (general cachexia), but also bone mineral loss as a result of reduced PA (Newton and Galvão, 2008) (also refer to Section 2.2.4). Thus there is a growing interest in the use of exercise in the treatment and rehabilitation of patients with cancer (Pedersen and Saltin, 2006; Shann, 2000). Aerobic and resistance exercise programs for cancer patients improve balance and bone remodelling while simultaneously reducing muscle weakness and wasting (Galvão, Taaffe, Spry et al., 2010). This result in reduced levels of fatigue, greater self-confidence, maintenance of body weight, improved mood, less side effect severity, improved aerobic capacity, and a higher quality of life (Pedersen and Saltin, 2006).

2.3.4 Exercise and osteoporosis

Osteoporosis is a disorder characterised by a decrease in bone mineral density caused by inadequate bone development during growth, excessive bone loss, failure to replace bone loss and an imbalance between osteoblast and osteoclast functioning, all of which ultimately lead to microarchitectural deterioration of the skeletal structure (Raisz, 2005). Osteoporosis poses a major risk for sustaining skeletal fractures due to this decrease in bone mineral density and compromised bone architecture (Howe, Shea, Dawson et al., 2011; Kai, Anderson and Lau, 2003; Kruk, 2007). Hip fracture is the most serious complication of osteoporosis resulting in an overall negative impact on the life of patients due to the increased risk for mortality, long term disability and loss of independence (Korpelainen, Keinänen-Kiukaanniemi, Heikkinen, et al., 2006).

The incidence of osteoporosis in the US is estimated to increase to over 14 million people in 2020 (Burge, 2007). During 2005, the direct medical costs due to osteoporosis accumulated to approximately $17 billion in the US. Furthermore, it is estimated that by 2025, annual fractures and costs would have grown by 50% (Burge, 2007). Considering the substantial financial costs together with the fact that osteoporosis affects one out of every four postmenopausal Caucasian women (Siris, Brenneman, Miller et al., 2004), it is imperative that effective prevention and treatment regimes be put in place (Korpelainen et al., 2006).

Osteoporosis is typically treated by using pharmacological agents (Howe et al., 2011) despite the fact that mechanical loading associated with regular aerobic, weight-bearing and resistance exercise are key to stimulate osteogenesis and increase bone mineral density (Howe et al., 2011; Langberg, Skovgaard, Asp, et al., 2000). Despite the fact that high-impact exercise has been suggested to be most effective for the prevention of osteoporosis in premenopausal women (Korpelainen et al., 2006), the evidence of the long-term effect of PA on postmenopausal bone loss is inadequate, mainly due to short follow-up times seen in the core body of literature. However, a meta-analysis concluded that after a year or longer, PA may be effective for slowing bone loss (Korpelainen et al., 2006), deeming exercise a safe and effective modality to avert bone loss in postmenopausal women (Howe et al., 2011). In addition to preventing osteoporosis through mechanical loading, exercise also improves muscle strength, mobility and balance, all of which will aid and protect the elderly against falls and fractures (Buchner, Cress, de Lateur et al., 1997), something dietary supplements and medication are unlikely to accomplish in isolation.

2.3.5 Exercise and cardiovascular disease

Cardiovascular diseases (CVD) include high BP (hypertension), coronary heart disease, stroke, rheumatic heart disease and other forms of heart disease (Kruk, 2007). Physical inactivity, smoking, poor diet and neglect of chronic life-stress play key roles in the pathogenesis of CVD (Derman et al., 2008a). Atherosclerotic CVD is caused by the accumulation of lipids, macrophages, blood-clotting elements, calcium and fibrous connective tissue within the inner layer of arteries, resulting in endothelial dysfunction and vascular inflammation (Pearson, 2003a). These atherosclerotic changes later result in the formation of atheromatous plaques or lesions which may cause obstruction of normal blood flow (Pearson, 2003a). Dyslipidemia or high cholesterol level remains a major cardiovascular risk factor in SA, as familial hypercholesterolaemia occurs in one out of every 200 Afrikaners which may cause early CVD in affected individuals (Mayosi et al., 2009). From the SANHANES-1 project, it was found that one out of five males 15–65 years of age and older had abnormally high serum total- and low density lipoprotein (LDL) cholesterol. In the South African females the figures were even worse, where abnormal lipid concentrations were found in almost one out of three females 15–65 years of age (Shisana et al., 2013). Regular PA results in beneficial changes in persons with normal lipid and lipoprotein concentrations as well as in most persons with dyslipidemia (Kelley and Kelley, 2008; Kelley, Kelley, Roberts et al., 2011; Murphy, Blair and Murtagh, 2009). Regular PA and exercise not only plays a substantial role in the primary prevention of CVD, but also in the secondary prevention and rehabilitation of patients with known CVD (Thompson, 2005; Thompson, Franklin, Balady et al., 2007).

The purpose of PA in the form ofexercise training is to reduce physiological limitations and increase exercise capacity through specific exercise therapy (Derman, Whitesman, Dreyer et al., 2008b). Health benefits associated with regular exercise and increased exercise capacities include, among others, the following (Derman et al., 2008a; Giannuzzi, Saner, Björnstad et al., 2003; Leon, Franklin, Costa et al., 2005; Miles, 2007; Mora, Cook, Buring et al., 2007; Thompson et al., 2007):

- Reduced number of cardiovascular events
- Improvement in blood lipid concentrations
- Reduced systolic and diastolic BP
- Increased fibrinolysis
- Reduced thrombocyte aggregation
- Reduced endothelial dysfunction of the coronary arteries
- Increased autonomic tone and heart rate variability
- Decreased cardiac arrhythmias
- Improvement of insulin resistance and glucose intolerance
- Improved psychosocial factors
- Improved lifestyle choices
- Reduced obesity
- Reduced smoking habit
- Improved functional (exercise and work) capacity
- reduced hospitalization
- and decreased morbidity and total mortality.

Notwithstanding these benefits, exercise training is hardly ever prescribed for patients with CVD (Thompson, 2005). Some authors hypothesize that the complexity of prescribing exercise for patients with chronic disease may be a contributing factor to this tendency since the patient should not only be advised which exercise therapies to use, but the exercise goals should be defined, a suitable training intensity, duration and frequency chosen for the appropriate stage of the medical condition (Derman et al., 2008b).

Preceding regular exercise training all patients should be assessed by a cardiologist or medical practitioner skilled in exercise testing and prescription to have a baseline symptom-limited exercise test and exclude any contraindications before an exercise programme is initiated (Derman et al., 2008b). This will also detect important clinical signs such as a cardiac murmur, ischemia symptoms or arrhythmia that would alter the therapeutic approach, gallop sounds, pulmonary “wheezing,” or pulmonary crepitation (Thompson, 2005). Patients with a history of worsening unstable angina or decompensated heart failure should not undergo exercise testing until their condition stabilizes (Fletcher, Balady, Amsterdam et al., 2001).

After an exercise stress test, the patient should be classified as either a high, moderate or low risk patients. For high and moderate risk patients (for example those with exercise-induced myocardial ischaemia with possible ST-segment depression and/or angina pectoris and those with left ventricular ejection fraction <30%, arrhythmia, clinical depression, low exercise tolerance or those patients unaccustomed to exercise) there should be medical supervision, as these patients should be monitored more closely and frequently than low- risk patients. Risk stratification should be repeated at 3 month intervals (Derman et al., 2008b; Thompson, 2005).

Family doctors have a key role as the central coordinating figures in promoting cardiovascular wellness through routine provision of and/or information on primary and secondary preventive services; identifying patients who would gain from a structured cardiac rehabilitation program and helping them to engage in these programmes, encouraging existing patients to complete the program and providing longitudinal follow-up for patients after program completion (Stephens, 2009). If a local cardiac rehabilitation program is not available, doctors should refer patients to physical therapy or fitness facilities or should advise the patient on how to start an exercise program. This necessitates doctors to design an exercise program for the patient (Thompson, 2005). When developing an individualized exercise prescription for aerobic and resistance training, take into consideration evaluation of exercise stress test findings, risk stratification, comorbidities (e.g., peripheral arterial disease and musculoskeletal conditions), in addition to patient and program goals (Balady, Williams, Ades et al., 2007). Besides PA, cardiac rehabilitation programs must also address diet, emotional, medication, and smoking cessation issues (Giannuzzi et al., 2003; Thompson, 2005).

2.3.6 Exercise and obesity

Thirty years ago the world were fixed on juvenile malnutrition, the ‘protein gap’ and how to feed the world’s rapidly increasing population (James and Leach, 2001; Prentice, 2006). At present the WHO finds itself needing to deal with a different pandemic, namely obesity and its associated non-communicable diseases (Caballero, 2007; James and Leach, 2001). Meanwhile the challenge of juvenile malnutrition has not disappeared, thus creating a ‘double burden’ of disease that threatens to overwhelm the health services of many resource-poor countries (Prentice, 2006). According to the

WHO, the criteria for obesity is defined as a body mass index (BMI) of >30 kg/m^2 and overweight a BMI of 25 – 29.9 (Alwan, 2011). Cardiovascular risks increase with higher degrees of obesity (Apovian, 2010). Physical inactivity is considered to be an important underlying reason for obesity (Kokkinos and Myers, 2010), while obesity in turn intensifies cardiovascular disease risk stratification through its indirect adverse effects on numerous recognised risk factors such as insulin resistance and hypertension (Khan, 2008; Lee, Sui and Blair, 2009). Furthermore, there is a strong correlation between high BMI and the development of several other non-communicable diseases, including site-specific cancers such as colon and prostate cancer in men, and breast, endometrial, cervical, and ovarian cancer in women (Kruk, 2007).

Historically, obesity has been regarded as a 'Western' problem associated with prosperity, but is of rising significance in low income countries (Hawkes, 2006; Zimmet, 2000). Unfortunately, the same holds true for the South African population. Globalisation is causing the increase in consumption of foods high in fats and sweeteners throughout the developing world. This "nutrition transition" as well as physical inactivity are considered to be important underlying reasons for obesity (Kokkinos and Myers, 2010) and is associated with the rapid rise of obesity and diet-related chronic diseases worldwide (Hawkes, 2006). In the 1998 SA Demographic and Health Survey high levels of excess body mass were observed among South Africans, particularly women. It was found that more than 29% of men and 56% of women were classified as overweight (BMI >25) or obese (BMI >30) (Joubert et al., 2007). The South African National Health and Nutrition Examination Survey (Shisana et al., 2013) showed a deterioration of the nutritional status of adult males and predominantly females based on various anthropometric measures. It was also found that major changes across all BMI groups occurred; the percentage of persons regarded as being underweight or normal weight decreased, while individuals considered being overweight or obese increased (Shisana et al., 2013). Overall, Mean BMI increased across all age categories, provinces, and race groups, but specifically among females (Shisana et al., 2013). It is suspected that the low levels of PA among South African adults reported in the past (Joubert et al., 2007; Kruger et al., 2002) contributed to the reported excess body mass, although education status also has to be taken into consideration since research has shown a sharp rise in the incidence of obesity among people who seem to be better educated and financially more privileged than the general South African population (Senekal, Steyn and Nel, 2003).

Table 2.1 Benefits of regular exercise in the treatment of obesity

Risk factor being influenced	Benefit
Cardiovascular and all-cause mortality	Significant reductions in cardiovascular morbidity and mortality in patients who are overweight but attain even a moderate level of cardiorespiratory fitness versus those who are overweight and remain unfit.
Cardiovascular risk factors	Hypertension, insulin resistance, elevated blood glucose levels, and dyslipidaemia improve as a result of greater physical PA and increased fitness level in adults who are overweight or obese, even in the absence of weight loss.
Fat and muscle during weight loss	As much as 50 percent or more of the weight loss achieved through dieting can occur at the expense of lean body mass, causing a loss of muscular strength that is amplified by feelings of fatigue and reduced basal metabolic rate - all of which can have a detrimental effect on long-term, successful weight management. There are also favourable changes in body composition associated with exercise during caloric restriction.
Physical and psychological well-being	Increased cardiorespiratory fitness and greater muscular strength to perform activities of everyday life may improve the mobility, functional abilities, and quality of life in obese persons. Moreover, an enhanced sense of psychological well-being, including reduced feelings of stress, anxiety, and depression, and improved sleep patterns are associated with enhanced levels of PA and improved fitness.
Long-term weight maintenance	Successful weight maintenance in persons who have lost weight is highly dependent on the level of PA they sustain.

Adopted from (McInnis, Franklin and Rippe, 2003)

Research has shown that a high-volume-high-intensity exercise regimen had the greater beneficial effects on body weight, fat mass and central obesity than a low amount of exercise (Slentz, 2004). This approach will also aid in the preservation or increase of lean muscle mass which will alter body shape, even in the absence of dieting. Contrary to traditional beliefs, exercise on its own has a limited effect on weight loss (Franz, VanWormer, Crain et al., 2007; Macfarlane and Thomas, 2010). Instead, it has been shown that exercise in combination with a nutritional plan is the most effective approach for sustainable weight loss (Macfarlane and Thomas, 2010) due to the combined effect to create a positive caloric imbalance needed for weight loss. Although exercise is most effective for weight loss when used in conjunction with a nutritional plan, it is still more effective than diet on its own (Macfarlane and Thomas, 2010) and a key component for avoiding primary weight gain (Pedersen and Saltin, 2006). Probably the most noteworthy effect that an obese person engaging in regular PA will benefit from, is the decrease in risk factors for comorbidity problems such as diabetes (Pan, Li, Hu et al., 1997), together with the positive psychological effects associated with regular PA (King, Hopkins, Caudwell et al., 2009; Lee et al., 2009).

In Africa and SA the fight against obesity is complicated. An overweight body type very often has positive connotations within the black South African community, symbolising wealth and status (Mvo, Dick and Seyn, 1999). Obesity is therefore widely accepted and an avenue to a high level of body satisfaction among many middle-aged South African women (Prentice, 2006; Van der Merwe and Pepper, 2006). In contrast, being "thin" or of normal body weight according to WHO standards (Alwan, 2011) often has a negative associated with HIV/AIDS (Human Immunodeficiency Virus/Acquired Human Deficiency Syndrome) status which further accentuate the positive attitudes noted towards obesity among Africans (Clark, Niccolai, Kissinger et al., 1999; Prentice, 2006).

2.3.7 Exercise and chronic respiratory disease

One of the major chronic respiratory diseases in SA is chronic obstructive pulmonary disease (COPD) (Mayosi et al., 2009). COPD is characterised by a poorly reversible airflow limitation that is usually progressive and associated with an abnormal inflammatory response of the lungs to noxious particles or gases, particularly cigarette smoke (Fabbri and Rabe, 2007; Pauwels, Buist, Calverley, et al. 2001). While COPD affects the lungs, it also causes substantial systemic consequences such as weight loss, nutritional abnormalities and skeletal muscle dysfunction (Celli, 2008). Data released by Statistics SA showed that premature adult deaths caused by COPD increased by 24% from 1999-2003 (Mayosi et al., 2009). Unfortunately research suggests that COPD is often under diagnosed (Garcia-Aymerich, Barreiro, Farrero et al., 2000; Rutschmann, Janssens, Vermeuen et al., 2004), raising concerns that the prevalence of COPD may be even higher than documented.

For persons with COPD, strong linear associations exist between their exercise capacity and their health-related quality of life (Puhan, Siebeling, Zoller et al., 2013). Furthermore, exercise capacity is one of the strongest predictors of mortality and showed reliably stronger associations than either lung function or dyspnoea (Puhan et al., 2013). As the disease progress, gas exchange becomes compromised and patients may develop respiratory failure (Puhan et al., 2013). As soon as dyspnoea develops, it occurs at even lower levels of exercise (Celli, 2008). In fact, the BODE index (body mass index, forced expiratory volume in one second (FEV1), dyspnoea and 6-minute walk distance) includes exercise capacity to predict mortality (Puhan, Mador, Held et al., 2008; Puhan et al., 2013). However, COPD is a multidimensional disease. Many patients with COPD may have decreased fat-free mass, impaired systemic muscle function, anaemia, osteoporosis, depression, pulmonary hypertension, and cor pulmonale, all of which are important elements of the effect COPD may have on patients (Celli, 2008). The objectives of management of COPD are prevention of further deterioration in lung function, improvement of symptoms (coughing, sputum production and dyspnoea) and quality of life, treatment of complications, and to prolong a meaningful life (Celli, 2008).

One of the most important advances in the therapy of COPD is the capability to influence the disease without having to automatically modify lung function. Pulmonary rehabilitation and oxygen therapy are established forms of treatment for COPD (Celli, 2008). Pulmonary rehabilitation comprises of a combination of holistic interventions on the respiratory system such as smoking cessation, psychological support to help with coping strategies, and physical activity in the form of exercise training (Spruit, Troosters, Trappenberg et al., 2004). Physical exercise improves exercise capacity and health related quality of life and is a cost effective intervention (Puhan, Schünemann, Frey et al., 2005; Reardon, Mckenna and Riddoch, 2005). Although exercise training does not improve lung function, it does ease other symptoms of COPD such as dyspnea, fatigue and anxiety (Casaburi and ZuWallack, 2009; Spruit et al., 2004). Because of increasing skeletal muscle dysfunction in advanced stages of COPD (Franssen, Broekhuizen, Janssen et al., 2004), exercise training has become the core component of pulmonary rehabilitation (Lacasse and Goldstein, 2006; Reardon et al., 2005; Spruit, Singh, Garvey et al., 2013).

Table 2.2 Benefits of exercise for patients with chronic respiratory diseases

Factor being influenced	Benefit
Increased muscle strength	Exercise training improves aerobic function of the muscles of ambulation.
Improved ventilatory efficiency and reduced hyperinflation	Exercise training reduces the ventilatory requirement and respiratory rate during heavy exercise, prolonging the time allowed for expiration and reducing dynamic hyperinflation
Desensitisation to dyspnea	Desensitization to dyspnea occurs centrally as a result of exercise training; the underlying mechanism is uncertain.
Decreased anxiety and depression	Decreased anxiety and depression are thought to result from increased exercise capacity and consequent increases in activities of daily living, coupled with feelings of mastery.

(Casaburi and ZuWallack, 2009)

The type of exercise training for pulmonary rehabilitation follows the FITT (frequency, intensity, type, time) principle and includes: High-intensity regimens which are generally the preferred type of exercise, although lower-intensity exercise is also beneficial (Gosselink, 2002; Puhan, Büsching, Schünemann et al., 2006), with exercise of the leg muscles as the focal point of endurance exercise (such as walking, stationary cycling, and treadmill exercise). Under the observation of rehabilitation staff the intensity of the exercise may be increased as tolerated by the patients. Resistance training that includes the upper arms aids the ability to carry out the activities of daily living and because some of the upper-arm muscles also function as auxiliary muscles of respiration, it is often advised (Casaburi & ZuWallack, 2009; Puhan et al., 2005; Spruit et al., 2013).

Commonly contraindications for pulmonary exercise rehabilitation includes the inability to walk, either due to orthopaedic or neurological disorders, unstable cardiac disease including unstable angina or recent myocardial infarction and psychiatric or cognitive problems that would prevent the patient from understanding what is required or cooperating with the exercise prescription plan (Casaburi and ZuWallack, 2009; Spruit et al., 2013). Mild to moderate cases of COPD can be managed by a GP (Chavannes, Vollenberg, van Schayck et al., 2002) with specific attention given to the PA habits of persons with COPD who visit their general practice (Chavannes et al., 2002).

2.3.8 Exercise and Depression

According to the Global Burden of Disease study (Mathers and Loncar, 2005), mild to moderate Major Depressive Disorder (MDD) is one of the most pronounced causes for years of life lost due to premature death or disability, ranking second behind ischemic heart disease (Dunn, Trivedi, Kampert et al., 2005). It is estimated that approximately one in five adults experience MDD at some stage of their lives (Blumenthal et al., 2005). Depression is twice as likely to occur in women compared to men (Blumenthal et al., 2005) and often co-occurs with medical conditions such as obesity, diabetes, and cardiovascular disease (Blumenthal et al., 2005). In SA, the prevalence of MDD accounts to approximately 9.7% of adults with significantly higher numbers of MDD diagnoses seen among females compared to males, and those with a low level of education compared to those with a higher level of education (Tomlinson, Grimsrud, Stein et al., 2009).

There is scientific evidence to suggest that physical exercise is just as effective in the treatment of mild to moderate MDD as pharmacotherapy and psychotherapy (Dunn et al., 2005), and those who do participate in regular leisure-time exercise are less likely to experience depressive symptoms, irrespective of the intensity of the exercise they engage in (Harvey, Hotopf, Øverland et al., 2010). Positive changes in the psychological profile with exercise may include (Warburton, Katzmarzyk, Rhodes et al., 2007):

- Improved mood
- Improved self-concept
- Improved work behaviour
- Decreased depression and anxiety
- Improved social networks.

The amount of exercise needed for persons suffering from depression is equivalent to the recommendations for healthy subjects since the effect of lower amounts of exercise is similar to that of placebo controls (Dunn et al., 2005). According to the American College of Sports Medicine (ACSM) guidelines (ACSM, 2010), the recommended exercise dose is at least 30 minutes a day, five days per week of moderate intensity, or 50 minutes three times per week of high intensity exercise, accumulating to 150 minutes of exercise per week (ACSM, 2010). Although most studies to date have focused on aerobic exercise, some studies found evidence that resistance training may also be effective (Blumenthal et al., 2005).

2.3.9 Exercise and Dementia

Alzheimer's disease (AD) is a progressive neurodegenerative disorder that is characterized by the presence of amyloid deposition and neurofibrillary tangles in the brain, coupled with a loss of cortical neurons and synapses (Nestor, Scheltens and Hodges, 2004; Terry, Masliah, Salmon et al., 1991). It is considered not only the most common cause of dementia (Nestor et al., 2004), but also the most widespread kind of dementia throughout the world with rates increasing exponentially with age (Kawas and Corrada, 2006). The prevalence rose from 3% among the 65-75 years age group to a staggering 50% among those 85 years and older (Zhu and Sano, 2006). In 2006, the worldwide incidence of Alzheimer's disease accounted to 26.6 million cases. It is furthermore estimated that by 2050, the incidence of Alzheimer's disease will quadruple to 1 in 85 persons worldwide who will be living with the disease (Brookmeyer, Johnson, Ziegler-Graham et al., 2007).

Alzheimer's disease, other dementias and alcohol-use disorders are projected to be among the top four causes of burden of disease in high-income countries in 2030 (Mathers and Loncar, 2005). Not only does AD pose a future problem for the world, but SA will also be affected as an estimate 7.7% of the population (3.7 million people) in SA were over the age of 60 years in 2006 (Statistics SA, 2006), and rising. Globally, around 13% (nearly 4.3 million) AD cases may be attributed to physical inactivity (Barnes and Yaffe, 2011).

Presently there is no cure for AD (Zhu and Sano, 2006). However, substantial evidence exists that PA have an important role in moderating dementia such as AD (Hillman, Erickson and Kramer, 2008; Larson and Wang, 2006; Scarmeas, Luchsinger, Schupf et al., 2009; Verdelho, Madureira, Ferro et al., 2012). By increasing PA by 25%, an estimated million cases of dementia can be prevented (Nagamatsu, Flicker, Kramer et al., 2014). Positive findings on the exercise response in AD include a slower decline in mental status (Arcoverde, Deslandes, Rangel et al., 2008), improved cognitive function (Guiney and Machado, 2013; Kramer, Colcombe and McAuley, 2005), improved health and an improvement in quality of life (Deslandes, Moraes, Ferreira et al., 2009; Lawlor and Hopker, 2001; Pedersen and Saltin, 2006).

2.3.10 Exercise and Stroke

Early definitions of a stroke stated it to be an event characterised by rapidly developing clinical symptoms and signs of focal, and at times global, loss of cerebral function lasting more than 24 hours or leading to death, with no apparent cause other than that of vascular origin (Hatano, 1976). More recently, a statement by the American Stroke Association (Sacco, Kasner, Broderick et al., 2013) placed emphasis on the fact that a stroke is, in fact, a central nervous system infarction and defined it as an infarction of the brain, spinal cord, or retinal cell death attributable to ischemia, based on:

1. pathological, imaging, or other objective evidence of cerebral, spinal cord, or retinal focal ischemic injury in a defined vascular distribution; or
2. clinical evidence of cerebral, spinal cord, or retinal focal ischemic injury based on symptoms persisting ≥24 hours or until death, and other aetiologies excluded.

This include ischemic stroke, silent central nervous system infarction, stroke caused by intracerebral haemorrhage, silent cerebral haemorrhage, subarachnoid haemorrhage, stroke caused by cerebral venous thrombosis, and a stroke not otherwise specified (Sacco et al., 2013).

In addition to the high mortality associated with strokes (the second most common cause of death worldwide; Mathers and Loncar, 2005), strokes also have a high morbidity, leaving up to 50% of survivors chronically disabled (Lloyd-Jones, Adams , Brown et al., 2010). The cornerstone of the prevention of recurrent stroke and acute cardiac events in stroke survivors is the modification of multiple risk factors through a combination of comprehensive lifestyle interventions and appropriate pharmacological therapy (Gordon, Gulanick, Costa et al., 2004). Therefore, regular PA is recommended for both primary and secondary prevention of stroke (Lloyd-Jones et al., 2010) evidenced by the fact that moderately to highly active individuals have a lower risk of both ischemic and hemorrhagic strokes compared to individuals with inadequate PA levels (Lee, Folsom and Blair, 2003). The goals for exercise training in stroke survivors are (Gordon et al., 2004):

- Increased independence in ADLs
- Increased walking speed/efficiency
- Improved tolerance for prolonged PA
- Reduced risk of cardiovascular disease
- Improved level of safety during ADLs
- Increase range of motion (ROM) of involved extremities
- Preventing contractures.

2.4 EXERCISE AS MEDICINE

Globally we are treating more people for chronic disease of lifestyle with biomedical means. Although the importance of these treatment options cannot be underestimated, it has to be acknowledged that they are, in fact, secondary and tertiary treatment options for chronic disease of lifestyle. Ideally, primary prevention should be implemented before a chronic disease is clinically manifested. A popular example of effective primary prevention is the polio vaccine which had virtually eliminated this infectious disease (Booth et al., 2000). To the same effect, PA and exercise can be viewed as a primary prevention "vaccine" against numerous chronic diseases of lifestyle (Sallis, 2009), evidenced by the literature described in Section 2.3. Promotion of PA is a priority for health agencies (Heath, Parra, Sarmiento et al., 2012), evidenced by the shift in focus from monitoring, protecting and promoting general health, to injury prevention and control, chronic disease prevention and management, health-promoting public policies and environmental support for behavioural change to increase PA in a whole population (Alwan, 2011; Davis, Verhagen, Bryan et al., 2014; Geneau et al., 2010; Matheson, Klügl, Dvorak et al., 2011; Tremblay, Warburton, Janssen et al., 2011).

2.4.1 Exercise promotion and behavioural change

Health education efforts in everyday settings such as schools, the workplace and health services are important pieces in a jigsaw of factors affecting levels of activity. Policies and interventions in areas such as community safety, transport, pollution control, urban and rural planning, as well as access to facilities are fundamental in the feasibility and successful integration of PA into everyday life (Bousquet, Anto, Sterk et al., 2011; Geneau et al., 2010; King and Sallis, 2009; Sallis, Frank, Saelens et al., 2004; Yancey, Fielding, Flores et al., 2007).

2.4.1.1 Promotion and intervention strategies

Intervention strategies can be classified into (1) campaigns and informational approaches, (2) environmental/ policy approaches (3) and behavioural and social approaches (Yancey et al., 2007). Campaigns and informational approaches include strategies to change knowledge, attitudes, and behaviour within a specific community (Heath et al., 2012). Community-wide campaigns often use television, radio, newspapers and other media to raise large-scale, high-intensity and high visibility programs to target specific segments of the population (middle to high income) with health messages (Heath et al., 2012).

Mass media campaigns target young people between the ages of 9 -13 to increase and maintain PA (Heath et al., 2012). In SA, the National Department of Health initiated the “Move for Health Day” in 2002, followed by the “Healthy Lifestyle” campaign in 2004 (Kolbe-Alexander, Bull and Lambert, 2012). In 2005 the campaign “Vuka SA – Move for your health” was launched as part of the National Department of Health’s Healthy Lifestyles initiative (Kolbe-Alexander et al., 2012); Vuka is the Nguni word for “wake up”.

Another practice in this domain is to deliver short informational, instructional, and motivational messages about PA at key community sites (Heath et al., 2012). This differs from mass media campaigns because the messaging is site-specific (workplaces, centres for senior citizens, schools) and is often delivered by a health educator or communicator (Heath et al., 2012). A different approach that’s been successful is to deliver “Point-of-decision” prompts. This includes single-component interventions designed to remind and motivate people to use stairs in buildings instead of the lift, or to park further away and walk to your destination (Heath et al., 2012; Kahn, Ramsey, Brownson et al., 2002). Kahn et al. (2002) found prompts to use staircases instead of lifts effective as informational approach as well as community-wide campaign. In addition, school-based physical education, social support in community settings, and creation of or enhanced access to places for PA combined with informational outreach activities have also enjoyed a certain measure of success (Kahn et al., 2002). However, there is insufficient evidence that these community-wide interventions are effective, especially in communities in countries in low to middle income (Heath et al., 2012). The launch of Exercise is Medicine® (EIM) is currently in progress in most countries throughout the world, with specific targeted campaigns running at universities (EIM, 2012).

Environmental and policies should be designed to structure physical and organisational environments so that people have accessible, safe, attractive, and convenient places to be physically active (Marcus, Williams, Dubbert et al., 2006).

2.4.1.2 Behavioural and social approaches

Behavioural and social approaches to promote PA aim not only to change and maintain behaviour regarding PA, but also create organisational and social environments that enable and enhance change (Heath et al., 2012). Factors affecting PA behaviours are broadly perceived as personal, social and environmental (Seefeldt, Malina and Clark, 2002).

Despite insight gained into behavioural change, literature reports a drop-out rate of approximately 50% within the first six months after individuals engage in PA in the form of exercise training (Wilson and Brookfield, 2009), highlighting the importance of taking multidimensional models of behavioural change into consideration when approaching exercise promotion. For this study specifically, behavioural change are discussed from the perspective of not only the patients who should start to exercise, but also the doctors who have to start prescribing exercise. One of the most popular behavioural change models with wide applications in health care practices is the Transtheoretical Model of change (DiClemente and Prochaska, 1982; Prochaska and Marcus, 1994; Prochaska and Velicer, 1997) which explains how to change a problematic or adopt a positive behaviour. Persons attempting to change their PA behaviour typically move through a series of five stages (Figure 2.2), each with a temporal dimension of readiness (Prochaska and Marcus, 1994).

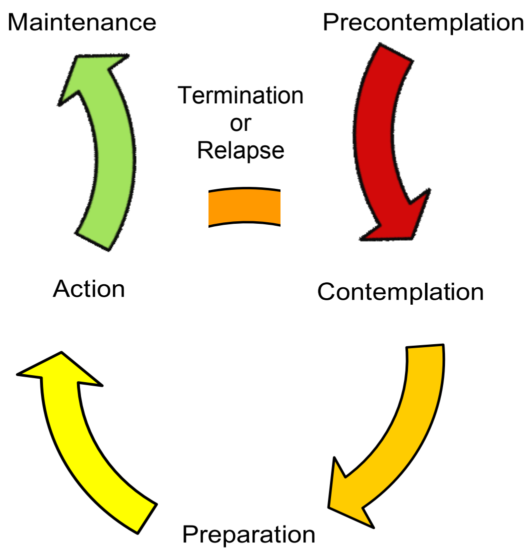

Figure 2.2 *Stages of Transtheoretical Model of behaviour change (Adapted from Prochaska and Marcus, 1994).*

Although original formulation suggested a linear engagement through the stages (DiClemente and Prochaska, 1982), behavioural change is more likely to take on a cyclical pattern of progression and regression through the stages (Prochaska and Marcus, 1994) and should be facilitated accordingly. As far as could be established, no literature could be found to provide evidence based guidelines for the role of the clinician within each stage of the Transtheoretical Model specifically related to exercise. However, the Transtheoretical Model consists not only of the different stages of change, but also identify processes of change which represents cognitive and behavioural constructs (Prochaska, Velicer, DiClemente et al., 1988). Applied to PA, change occurs within the experiential and behavioural domain of cognitive function (Table 2.3):

Table 2.3 Processes of behavioural change

	Process	Definition
Experiential	Conscious raising	Undertaking by the individual to find out more about PA
	Dramatic relief	Emotional experiences associated with change
	Environmental re-evaluation	Understanding how physical inactivity affects physical/social environments
	Self-re-evaluation	Emotional and cognitive reappraisal of values by the individual with respect to inactivity
	Social liberation	Awareness and acceptance of social changes encouraging active lifestyles
Behavioural	Counter-conditioning	Substitution of PA for sedentary behaviour
	Helping relationships	Seeking out social support to help initiate and maintain activity
	Reinforcement management	Using awards to encourage or maintain behaviour changes
	Self-liberation	Choosing and making a commitment to change, believing in one's ability to change / control behaviours
	Stimulus control	Avoiding or controlling stimuli and other causes that support inactivity

(Woods, Mutrie and Scott , 2002)

Other clinical settings such as weight loss programmes for diabetic patients have drawn their guidelines for the role of the clinicians to facilitate and support the patient through the stages of change from Coleman and Pasternak (2012). Applied to PA, the patient characteristics and role of the clinician within each stage of change looks as follows (Table 2.4):

Table 2.4 Stages of behavioural change: characteristics and clinician roles

TTM stage	Patient characteristics	Clinician's role
Precontemplation	There is no indication that the patient intends to change his PA behaviour within the next six months.	Provide information on the effects of inactivity and allow the patient to express his/her emotions. Re-assess their intention periodically.
Contemplation	There is a strong indication that the patient is inclined to change his/her PA behaviour within the next six months.	Discuss barriers to change and emphasise the expected benefits of PA. Increase the patient's confidence by pointing out his/her abilities.
Preparation	The patient shows signs that a decision to change his/her PA behaviour has been made and he/she intends to act on this decision in the near future, usually within the next month.	Discuss the practical aspects of the exercise programme and set specific goals. Develop an action plan which works towards the goals and encourage the patient to tell others about his/her decision.
Action	PA behaviour has changed and exercise incorporated into daily living for less than six months.	Provide training pertaining to the exercise programme and suggest social support. Provide tips or techniques to help meet his/her goals.
Maintenance	The patient has been engaging in regular PA for more than six months, adopting a habitual PA behaviour. The likelihood to revert back to prior PA behaviour is minimal.	Monitor, support and encourage the patient. Discuss possible stumbling stones to sustained success and suggest realistic solutions.
Termination or Relapse	Patient reverts back to a previous stage of the TTM.	Remind the patient that he/she is not a failure. Emphasise the progress made thus far and encourage a recommitment to the goals.

(Coleman and Pasternak, 2012)

2.4.2 Role of doctors to promote exercise as medicine

As physical inactivity remains a pressing public health issue (Grandes, Sanchez, Sanchez-Pinilla et al., 2009), a great need exists to increase activity in the general population. A pillar of the WHO's global PA plan (2010) is advice on PA in the primary care sector (Khan et al., 2011). GPs have access to a large proportion of the sedentary population (Swinburn and Walter, 1998), evidenced by the fact that 70% of the Swedish population will consult a GP at least once during a 12 month period (Kallings, Leijon, Hellénius el al., 2008). In addition, doctors are in the perfect clinical setting to promote PA (Phillips and Roy, 2009). All of these factors considered, doctors are considered to be well positioned to champion the cause of prevention of chronic diseases by promoting PA (Matheson et al., 2011) since they can take advantage of the on-going care they provide to a large sector of the population and be influential in changing patients' behaviours (Brotons, Björkelund and Bulc, 2005; Olesen, Dickinson, and Hjortdahl, 2000).

When patients received physician advice regarding exercise they were more likely to engage in exercise (76.5%) compared to those who did not receive such advice (38.8%) (Greenlund, 2002) since patients respect their advice and as a result are more likely to change their behaviours (Grandez et al., 2009). Almost two-thirds of patients (65%) would be more interested in exercise and PA to stay healthy if advised by their doctor and given additional resources (Derman, et al., 2008a), while 24% of patients turn to fitness and health web sites for advice on exercise and PA after turning to their doctor first (25%) (Derman et al., 2008a).

Exercise prescription may involve either a verbal or written recommendation for PA. However, in comparing verbal advice from a GP with a written exercise prescription, it was found that the latter approach led to greater effectiveness of the consultation room intervention (Marcus et al., 2006; Smith, 2000). A prescription symbolizes a well-understood interaction between patient and doctor (Swinburn and Walter, 1998) which will constantly remind the patient of the health-related exercise goals (Shephard, 1978; Swinburn and Walter, 1998). In addition, a physical prescription for exercise from a GP is a credible way to communicate changes in lifestyle to patients which focuses on empowerment of the patient to take control of his/her preventative healthcare instead of just removing symptoms by using drugs (Huber et al., 2011).

In order to affect change, it is important that doctors and other health care professionals include exercise and PA counselling as part of routine health maintenance. As doctors we often evaluate risk factors for cardio vascular disease during routine visits. Considering the direct relationship between a person's health status, longevity and PA levels, PA status should be assessed on a regular basis similar to the other major modifiable cardiovascular risk factors (diabetes mellitus, hypertension, hypercholesterolemia, obesity, and smoking) which are assessed routinely (Sallis, 2011). PA assessment should therefore be considered a vital health measure that is tracked regularly over time (Sallis, 2011; Strath, Kaminsky, Ainsworth et al., 2013). Even though an exercise test may not always be feasible during a clinical examination, enquiring about a patient's PA habits takes very little time yet gives the opportunity to include PA on the patient's agenda (Blair, 2009). Examples of consultation room interventions include the Green Prescription of New Zealand, which is a short assessment and an exercise prescription written by the GP during a normal appointment, frequently with a referral to a community sports trust for follow-up and linkages to community programs (Katz, Shuval, Comerford, 2008; Petrella and Lattanzio, 2002). The Active Script program in Australia is based on a similar model (Swinburn and Sager, 2003), while the Physician-based Assessment and Counselling for Exercise-model was developed within the US and consists of a self-completed questionnaire to elicit a PA history and provide consequent advice on the principles of exercise. Specific exercise objectives are then developed with the help of the nurse or receptionist and are checked by the physician (Fletcher and Trejo, 2005; Van Sluijs, van Poppel, Stalman et al., 2004; Van Sluijs, van Poppel, Twisk et al., 2005). In the United Kingdom, the schemes largely comprise of a GP's recommendation to a recreation centre where an exercise prescription consist of a free or subsidized attendance to the facility over a period of weeks or months. While all of these consultation room tools are considered to minimal interventions, studies show increases in the amount of PA (mainly walking) over four to six weeks in those patients who do receive some form of exercise prescription (Fletcher and Trejo, 2005).

Even without the use of standardised consultation room intervention tools such as those mentioned above, cost-and time-effective PA strategies can be prescribed by the doctor, include the following (Wallace, 2003):

- Emphasizing the link between reduced disease risk and PA.
- Pointing out the role of PA in weight control.
- Providing a written prescription for exercise.
- Emphasizing those 30 minutes of daily PA can make a substantial difference in long-term health outcomes.
- Encouraging patients to select activities they enjoy.
- Encouraging patients to find someone with whom to exercise.
- Encouraging patients to keep a diary to monitor their behavior.

Referring back to Section 2.4.1.2 and Table 2.4 physician understanding and discussion of potential social barriers (e.g., feeling uncomfortable while exercising in public), barriers caused by unsubstantiated expectations (e.g., the idea that exercise has to be painful or extremely vigorous to be beneficial) and developing an individualized PA program in the form of exercise can lead to greater patient compliance (Miles, 2007; Seefeldt et al., 2002). In considering the importance of taking patient preferences into account when designing an exercise prescription, it is still important to explain the benefits of different forms of exercise (Katz, 2012; Seefeldt et al., 2002).

2.4.3 Barriers to prescribing exercise

Literature pertaining to the exercise prescription rates of doctors give widespread numbers, but with similar implications. In a study on health promotion services in Sefton, England, GP ranking of health promotion services that are most utilised are smoking cessation (67%), dietary advice (48%), only then follows physical activity (35%) (Gormley and Hussey, 2009). Similar trends were reported in the USA where about half of smokers (52%) reported receiving advice to quit, 25% of patients reported receiving dietary, and 24% reported receiving advice to get more exercise (Kreuter, Chheda and Bull, 2000). A population-based survey in New Zealand reported that General Practitioners give physical activity advice to only 13%, and exercise prescription to only 3% of their patients (Patel et al., 2011). A random sample of US adults showed that only 28% have been advised by their physicians to engage in regular exercise, while only 11% reported assistance from their physicians in planning an exercise routine or follow-up support regarding their exercise patterns (Glasgow, Eakin, Fisher et al., 2001). Furthermore, literature seems to suggest that only four out of ten physicians (41%) talk to their patients about the importance of exercise (Derman et al., 2008a) and focus mostly on secondary rather than primary prevention, despite their awareness that exercise will benefit their patients' health on various levels (Morrato, et al., 2006).

The playing field regarding physical activity counselling and exercise prescription is not level. Doctors tend to suggest counsel only to those they judge would benefit from being more active (Glasgow et al., 2001). Doctors are also more likely to counsel patients to be more active as a form of secondary prevention (Wee, McCarthy, Davis et al., 1999). Kreuter et al. (2000), found that patients who have existing problems with obesity, hypertension or hypercholesterolaemia were more likely to be counselled about physical activity (Kreuter et al., 2000). It is therefore of critical importance that doctors that do give advice on exercise and physical activity are aware of the current guidelines for exercise prescription as well as the indications and contraindications for exercise (Section 2.4.4.3). If GPs are cognisant of these risks they can make sure that strategies are in place to diminish risks, spot early signs of any problems and can educate patients fully before they decide to start on an exercise program. However, there is paucity on interventions that have specifically examined the effectiveness of a physician providing advice to patients with a known health risk factor (Marshall, Booth and Bauman, 2005).

Looking into the possible reasons or barriers which withhold doctors from prescribing exercise to their patients, a couple of themes seem to emerge from literature. Time, skills, reimbursement, and evidence supporting outcomes remain recurrent barriers to physical activity and exercise counselling in family practice (Petrella and Lattanzio, 2002; Ribera, Mckenna and Riddoch, 2005). The foremost barriers to exercise prescription were firstly inadequate time for patient education and counselling to encourage physical activity, secondly lack of necessary skills for providing such counselling, and thirdly lack of reimbursement from health insurance and managed care plans for physical activity related preventive health maintenance and treatment programs.

According to McKenna, Naylor and McDowell (1998) barriers to change include attitudinal and system barriers. Attitudinal barriers consist of beliefs about the effectiveness, or even the status, of physical activity promotion within general practice (McKenna, Naylor and McDowell, 1998). Doctors' perceptions that counselling may be ineffective may be one of the causes for the low rate of exercise prescription (Wee et al., 1999). Although there is robust evidence that physical activity is beneficial for the prevention and treatment of non-communicable diseases, limited data exist on the long-term effectiveness of exercise counselling. Physician advice about exercise has been shown to be effective (Bull Kreuter and Scharff, 1999; Eaton and Menard, 1998; Petrella and Lattanzio, 2002; Van Sluijs et al., 2005). However randomized trials have shown conflicting results on the efficacy of exercise counselling (Eden and Orleans, 2002; Swinburn and Walter, 1998).

Another obstacle that prevents doctors from prescribing physical activity to their patients is the physician's own exercise regimen (Phillips and Roy, 2009). Being involved a healthy behaviour is the most reliable and powerful predictor of doctors advising patients about related prevention issues (Frank and Rothenberg, 2000; Shahar, Henken, Rozen et al., 2009). Health care providers should personally partake in an active lifestyle to familiarise themselves with the issues involved and model active behaviour for patients and the public. Doctors who embrace physically active lifestyles themselves are often vocal promoters of exercise and translate their beliefs, attitudes, and behaviours to their patients (McKenna et al., 1998; Phillips and Roy, 2009). Reasons why physically active doctors may council their patients more often on healthy lifestyles than their counterparts are that the active physicians could be more interested in prevention and may therefore extend their personal interests into the clinical context. They might be more familiar with the physiological and other effects of behavioural change. They also might feel more comfortable talking about barriers to, benefits of, and costs of behaviour change (Frank and Rothenberg, 2000). Patients also respond more positively to PA promotion when they perceive that the doctors practise what they preach and stated that this would help their inclination to comply with the doctor's recommendation to be physically active and exercise more (McKenna et al., 1998).

System barriers include time constraints, lack of standard protocols, lack of success in the counselling role, the lack of appropriate training and the lack of reimbursement (McKenna et al., 1998). Doctors continue to blame time constraints for not advising patients on the benefits of physical activity (Petrella and Lattanzio, 2002; Rogers, Bailey, Gutin et al., 2002) as the time needed to meet preventive, chronic and acute care requirements significantly exceeds the time physicians have available for patient care (Østbye and Yarnall, 2005). However, study results show that discussing the benefits of and barriers to physical activity, and patient preferences and practices need not take more than three to five minutes during an office visit and can play a critical role in patient implementation (Albright, Cohen, Gibbons, Balady, Bricker et al., 2000).

Since sporadic counselling during routine office visits are not an effective means of producing sustained increases in PA (Lawlor and Hanratty, 2001), doctors should rather incorporate PA monitoring and counselling as a standard procedure during consultations.

Literature suggest that doctors sometimes think they were inadequately trained or experienced in prescribing physical activity (Persson, Brorsson, Hansson et al., 2013) and felt that undergraduate training relating to non-pharmacological treatment methods is inadequate (Steptoe, Doherty, Kendrick, et al., 1999). This also included knowledge on how to write an effective exercise prescription, and counselling strategies that will promote behavioural change (McKenna et al., 1998). GPs are often aware that PA is mentioned as first-line treatment in guidelines for several diagnoses yet training in exercise prescription is lacking all over the world (Connaughton, Weiler and Connaughton, 2001; Dunlop and Murray, 2013; Matheson et al., 2011; Persson et al., 2013; Rogers et al., 2002; Weiler, Chew, Coombs et al., 2012a). This correlates to most studies which have found that GPs' knowledge of PA guidelines is very low (Dunlop and Murray, 2013; Lawlor, Keen and Neal, 1999; McKenna et al., 1998). Although Buffart (2009) reported that Australian doctors' knowledge improved over the past decade and that they felt more confident to give physical activity advice (Buffart, van der Ploeg, Smith et al., 2009), a study among final year medical students in Scottish Universities reported that only 52% were confident about giving physical activity advice (Dunlop and Murray, 2013). Considering that doctors who do not feel comfortable or competent to prescribe PA in the form of exercise are less likely to do so (Johansson, Stenlund, Lundström et al., 2010; Persson et al., 2013), the trend of not prescribing exercise may partially be attributed to a foundational flaw in undergraduate medical curricula.

Uncertainty about recommendations for physical activity, for example the benefits of continuous versus intermittent activity and aerobic versus resistance exercise may have contributed to doctors' negative perceptions of the usefulness of an exercise prescription (Andersen, Blair, Cheskin et al., 1997). The importance of physical activity is often undervalued and underappreciated in clinical medicine (Blair, 2009) as a result of the seeming lack of education in exercise physiology which often conceal the value of exercise for health care problems (Singh, 2002). It is therefore important for each GP to understand the different physiologic effects and benefits of different forms of exercise to be able to guide each patient to the best regime (Katz, 2012).

A mainly curative medical culture was also cited as a barrier (Bize Comuz and Martin, 2007) as pharmacological treatment is traditionally touted for treating for lifestyle-related diseases (Persson et al., 2013). Patients expect quick treatment and doctors found that even when they recommend treatment with physical activity, the patient every so often asks for medicine (Persson et al., 2013). On the other hand, Leijon, Stark-Ekman, Nilsen et al (2010) found that three out of four (76%) patients thought that doctors have a responsibility to encourage PA levels among patients (Leijon, Stark-Ekman, Nilsen et al., 2010), indicating a possible misperception from the doctors on their patients' expectations.

According to a study by Johansson et al. (2010) doctors are the professional group with the least positive attitude to doing preventative work in health care (Johansson et al., 2010), and many do not see PA promotion to be a priority in practice or relevant to the consultation (Hébert et al., 2012). Despite the fact that family physicians are effective for increasing PA of primary care patients (Grandez et al., 2009), a large proportion of doctors reported feelings of failure at getting their patients to start exercising (Rogers et al., 2002), which explains why a lack of success in the counselling role is also cited as a barrier for prescribing exercise (Leijon et al., 2010).

Health schemes often do not compensate doctors for patient education or counselling on lifestyle management such as advice on physical activity and exercise prescriptions that is provided primarily for prevention (Joy, Blair, Mc Bride et al., 2012). A WHO questionnaire survey of over 2300 GPs in 16 countries identified the lack of payment by health schemes for preventive medicine one of the main barriers against practising preventive medicine (McAvoy, 2000). Doctors indicated that reimbursement should be more specifically linked to health promotion counselling (Bize et al., 2007).

GPs are receptive to the concept of PA promotion in the clinical setting and most doctors are in the contemplation stage for PA promotion (Ribera et al., 2005). To succeed, doctors need clinical tools and processes that back PA assessment and counselling (Joy et al., 2012). However, the above mentioned barriers need to be addressed to incorporate PA counselling and exercise prescription into primary care effectively. Doctors' barriers for promoting PA can be negated by establishing multidisciplinary networks between doctors and PA professionals such as Biokineticists as this would be time- and resource effective (Ribera et al., 2005).

2.4.4 Knowledge needed to prescribe exercise

To the same extent which a doctor should know the indication, contraindications and dosages of medicines, so also should they know these same principles pertaining to exercise as a therapeutic (whether preventative or treatment) modality. While exercise has many health benefits, risks are inherent to certain population groups with chronic diseases (ACSM, 2010) and can sometimes be an intricate art. It is imperative that doctors possess the necessary knowledge, skills and abilities to clear a patient for exercise and to compile a safe exercise prescription for patients (ACSM, 2010). Each patient should be evaluated and receive individualized "prescriptions" for aerobic activity, resistance (strength) training, and daily lifestyle activities (McInnis et al., 2003).

2.4.4.1 Exercise prescription principles

Exercises can basically be classified into three groups: aerobic exercise (walking, jogging, bicycling and swimming), resistance training (weights), and flexibility exercises (Katz, 2012). The biggest quandary in prescribing exercise is not which therapies to use but in outlining the objectives and incorporating the correct components in the compilation of the exercise programme for the specific patient (Sumchai, 2013). Exercise programmes should be designed and described in terms of the FITT principle which is based on the following four components (Oberg, 2007; Sumchai, 2013; Warburton, Nicol and Bredin, 2006):

Frequency - How often should a person exercise?
Intensity - How hard should a person exercise?
Time - How long should an exercise session last?
Type - What is the modality of the exercise the person should engage in?

During 2013, the ACSM added two additional components (volume and progression) to accommodate both the principle of the cumulative volume of exercise which should be incorporated within the exercise programme and the physiological adaptations associated with regular PA which will call for progression within the exercise prescription. However, at time of data collection for this research project these guidelines have not yet been released and consequently have been omitted from the questionnaire.

It is important to note that every person's exercise programme should not necessarily follow the same type or dose of exercise as programmes required for treatment of overt or advanced disease differ from the exercise programmes required for disease prevention and general health promotion (Singh, 2002). As a general guideline, the ACSM recommends a weekly program to consist of the following for a healthy non-pregnant adult aged 18 to 65 (ACSM, 2010):

- Moderate-intensity aerobic PA for a minimum of 30 minutes, five days per week.
- Vigorous activity three days per week for a minimum of 20 minutes.
- Combinations of moderate and vigorous aerobic exercises three to five days per week
- Resistance training two to three days per week.

To incorporate the FITT principle into aerobic and resistance training respectively, the recommendations in Table 2.5 apply. The intensity of the aerobic exercises is deliberately lower than that of supervised cardiac rehabilitation programs (70% to 85%) (Fletcher et al., 2001) to lessen the probability of ischemia in an unsupervised setting (Thompson, 2005). It is interesting to note that the new Canadian PA guidelines, specific guidelines for flexibility have been removed. However flexibility exercises are not discouraged (Tremblay et al., 2011).

Table 2.5 Exercise prescription guidelines for aerobic and resistance exercises

Component	Aerobic exercises	Resistance exercises
Frequency	3-5 days per week	2-3 days per week
Intensity	60% to 75% of predicted maximal heart rate	10-15 repetitions per set to being moderately fatigued
Time	20-60 minutes per session	1-3 sets of 8-10 different upper and lower body exercises
Type	Walking, treadmill, cycling, rowing, stair climbing, arm/leg ergometry, and others using continuous or interval training as appropriate.	Calisthenics, elastic bands, cuff/hand weights, dumbbells, free weights, wall pulleys, or weight machines.

(Balady et al., 2007)

2.4.4.2 Exercise screening

Although exercise is beneficial to all for the reasons stated in Section 2.3, there are certain populations which are at risk when they exercise. It is therefore imperative that patients get expert advice before starting with an exercise program, increase their exercise intensity suddenly, or have existing diseases or musculoskeletal problems. Sedentary patients should undergo a pre-participation screening, regular history taking and physical examinations respectively which focus on coronary heart disease risk factors or indications of existing cardiac conditions (Metkus, Baughman, and Thompson, 2010). The purpose of medical screening is to exclude individuals with unstable medical conditions who are at an increased risk for cardiovascular events and to prevent unnecessary, potentially costly medical evaluations (Thompson et al., 2007). The risk for sudden death should also be evaluated, even though the risk for sudden death attributed to exercise in middle aged males is a mere 1 in 1.5 million exercise hours and even smaller in females and children.

A comprehensive health and fitness evaluation for each patient is necessary. This starts with a pre-screening and risk stratification. Pre-screening makes use of screening questionnaires such as the Physical Activity Readiness Questionnaire (PAR-Q) or American Heart Association/American College of Sports Medicine Pre-participation Screening Questionnaire (Fletcher et al., 2013). Greenland, Alpert, Beller et al. (2010) suggests that patients undergo a pre-screening global risk assessment based on the Framingham Risk Score (Greenland, Alpert, Beller et al., 2010). Patients who are believed to be at low risk for a cardiac event (<0.6% per year) do not need further evaluation, while those believed to be at high risk for such events (>2% per year) need further assessment and aggressive treatment. Patients who are at intermediate risk of events (0.6% to 2.0% per year) should be considered for screening (Greenland et al., 2010). Risk stratification is done on the basis of age and cardiac risk factor characteristics and is used to determine the individual's need for subsequent supervision and the level of monitoring required for exercise training (Fletcher et al., 2013). Resting BP, height, mass, body mass index (BMI), Electro Cardio Gram (exercise testing as indicated by risk stratification (see Table 2.6) or a resting Electro Cardio Gram may be considered for cardiovascular risk assessment in asymptomatic adults without hypertension or diabetes (Greenland et al., 2010). Health-related physical fitness comprises of those components of physical fitness are linked to good health and include the following (Corbin, Pangrazi and Franks, 2000):

Body composition

This the only non-performance measure among the health-related physical fitness components. Body composition is measured in the laboratory using underwater weighing and in the field using skinfold calipers (Corbin et al., 2000).

Cardio-respiratory fitness (CRF)

The best measure of cardiovascular fitness and exercise capacity is maximal oxygen uptake ($VO_{2(max)}$). Accurate assessment of cardio-respiratory fitness is obtained by ventilatory gas analysis at maximal exertion during a graded exercise test (Fletcher et al., 2013; Jurca, Jackson, LaMonte et al., 2005). Indirect ways estimate $VO_{2(max)}$ from maximal exercise duration, the peak workload and/or heart rate responses achieved during submaximal or maximal exercise ergometry (Jurca et al., 2005). Frequently used field tests include the mile run, the 12 minute run, the 1 mile run, the mile walk, the PACER run for children and various bicycle, step, and treadmill tests (Corbin et al., 2000).

Muscular strength

Muscular strength is the amount of external force that a muscle can exert. Testing strength includes the assessment of one repetition maximum (the maximum amount of resistance you can overcome one time). One repetition maximum tests are usually conducted on resistance machines. Strength can also be evaluated by using dynamometers. Strength can be measured isometrically (static contractions) or isotonically (dynamic contractions) (Caspersen et al., 1985; Corbin et al., 2000).

Muscular endurance

This is the muscle's ability to continue to perform without fatigue. Tests of muscular endurance are based on the number of repetitions that can be performed by the specific muscle group being tested (example: repetitions of push-ups or abdominal curls. Muscular endurance can be measured isometrically (static contractions) or isotonically (dynamic contractions) (Corbin et al., 2000).

Flexibility

Flexibility relates to the range of motion available at a joint and is specific to each joint of the body. Flexibility is usually measured by using measurement devices such as a goniometer, flexometer and the sit and reach test (Corbin et al., 2000).

The ACSM and American Heart Association recommend graded exercise testing for asymptomatic patients with DM, men > 45 years and women > 55 years of age before undertaking vigorous exercise (Fletcher et al., 2013). It is important to educate patients to identify symptoms of possible cardiac events, including chest pain, arm or jaw discomfort, syncope or pre-syncope, palpitations and dyspnea (Fletcher et al., 2013). These patients should stop exercising immediately, and be evaluated before continuing their program (Metkus et al., 2010).

Physically active patients should also undergo pre-participation screenings and regular follow-ups since the risk of musculoskeletal injuries increases as the intensity and amount of the activity increases (Haskell et al., 2007).

2.4.4.3 Exercise risks and contraindications

In deciding whether a patient has risks or contraindications for exercise testing, good clinical judgment is of utmost importance (Gibbons and Balady, 2002). Even though exercise testing is considered a safe procedure, adverse cardiovascular events are possible and have been reported. Estimates of sudden cardiac death during exercise testing range from zero to 5 per 100 000 tests (0.005%) (Myers, Arena, Franklin et al., 2009). Therefore certain safety measures should be in place. In general these are (Myers et al., 2009):

1. Risk stratification of patients. This will determine the appropriate level of medical supervision needed during testing (refer to Tables 2.6.a to 2.6.c);
2. A written emergency plan that is rehearsed regularly. Evacuation plans for unstable patients by a specified route for rapid transfer to hospital emergency facilities should be in place;
3. An automated external defibrillator must be available; and
4. Trained staff that is familiar with abnormal hemodynamic responses and/or signs and symptoms of ischemic heart disease.

Table 2.6.a Risk Classification for Exercise Training (Class A)

Class A	Characteristics	Activity guidelines	Supervision required
A-1	Children, adolescents, men <45 years of age, and premenopausal women who have no symptoms or known presence of heart disease or major coronary risk factors	No restrictions other than basic guidelines	None
A-2	Men ≥45 years of age and post menopausal women who have no symptoms or known presence of heart disease and with <2 major cardiovascular risk factors	No restrictions other than basic guidelines	Should undergo a medical examination and possibly a medically supervised exercise test before engaging in vigorous exercise.
A-3	Men ≥45 years of age and post menopausal women who have no symptoms or known presence of heart disease and with ≥2 major cardiovascular risk factors	No restrictions other than basic guidelines	Should undergo a medical examination and possibly a medically supervised exercise test before engaging in vigorous exercise.

*** Class A: Apparently Healthy Individuals** (Fletcher et al., 2013).

Table 2.6.b Risk Classification for Exercise Training (Class B)

Characteristics/diagnoses	Activity guidelines	Supervision required
1. CAD (MI, coronary artery bypass graft, percutaneous transluminal coronary angioplasty, angina pectoris, abnormal exercise test, and abnormal coronary angiograms); includes patients whose condition is stable 2. Valvular heart disease, excluding severe valvular stenosis or regurgitation 3. Congenital heart disease; risk stratification for patients with congenital heart disease should be guided by the 27th Bethesda Conference recommendations 4. Cardiomyopathy: ejection fraction ≤30%; includes stable patients with heart failure but not hypertrophic cardiomyopathy or recent myocarditis 5. Exercise test abnormalities that do not meet any of the high-risk criteria outlined in Class C	Activity should be individualized, with exercise prescription provided by qualified individuals and approved by primary healthcare provider	Medical supervision during initial prescription session is beneficial. Supervision by appropriate trained non-medical personnel for other exercise sessions should occur until the individual understands how to monitor his or her activity. Medical personnel should be trained and certified in Advanced Cardiac Life Support. Non-medical personnel should be trained and certified in Basic Life Support (which includes cardiopulmonary resuscitation). Electrocardiographic and BP monitoring are useful during the early prescription phase of training

*** Class B: Presence of Known, Stable CVD with Low Risk for Complications with Vigorous Exercise, But Slightly Greater Than for Apparently Healthy Individuals** (Fletcher et al., 2013).

Table 2.6.c Risk Classification for Exercise Training (Class C)

Characteristics/diagnoses	Activity guidelines	Supervision required
1. CAD 2. Valvular heart disease, excluding severe valvular stenosis or regurgitation 3. Congenital heart disease; risk stratification for patients with congenital heart disease should be guided by the 27th Bethesda Conference recommendations 4. Cardiomyopathy: ejection fraction ≤30%; includes stable patients with heart failure but not hypertrophic cardiomyopathy or recent myocarditis 5. Complex ventricular arrhythmias not well controlled	Activity should be individualized, with exercise prescription provided by qualified individuals and approved by primary healthcare provider	Medical supervision during all exercise sessions until safety is established Electrocardiographic and blood pressure monitoring: Continuous during exercise sessions until safety is established

*** Class C: Those at Moderate to High Risk for Cardiac Complications During Exercise or Unable to Self-Regulate Activity or to Understand Recommended Activity Level** (Fletcher et al., 2013).

Table 2.7 Absolute and relative contraindications to exercise testing

Absolute contraindications	Relative contraindications
• Acute myocardial infarction (within 2 days) • High-risk unstable angina • Uncontrolled cardiac arrhythmias causing symptoms of hemodynamic compromise • Active endocarditis • Symptomatic severe aortic stenosis • Decompensated symptomatic heart failure • Acute pulmonary embolus or pulmonary infarction • Acute noncardiac disorder that may affect exercise performance or be aggravated by exercise (e.g., infection, renal failure, thyrotoxicosis) • Acute myocarditis or pericarditis • Physical disability that would preclude safe and adequate test performance • Inability to give consent	• Left main coronary stenosis or its equivalent • Moderate stenotic valvular heart disease • Electrolyte abnormalities • Tachyarrhythmias or bradyarrhythmias • Atrial fibrillation with uncontrolled ventricular rate • Hypertrophic cardiomyopathy • Mental impairment leading to inability to cooperate • High-degree AV block

(Fletcher et al., 2001; Fletcher et al., 2013)

It should be taken into account that relative contraindications can be superseded if the benefits of exercise outweigh the risks associated with exercise. Although the above mentioned contraindications mentioned in Table 2.7 is intended to govern exercise testing, exercise participation also has a set of contraindications which should be adhered to ensure the safety of the patient. These include the following (Fletcher et al., 2013; Thompson et al., 2009):

- Unstable angina
- Resting systolic BP > 200 mmHg
- Resting diastolic BP > 110 mmHg
- Orthostatic BP drop of > 20 mmHg with symptoms
- Critical aortic stenosis
- Acute systemic illness or fever
- Uncontrolled atrial or ventricular arrythmias
- Uncontrolled sinus tachycardia > 120 beats per minute
- Uncompensated cardiac failure
- 3rd degree heart block without a pacemaker
- Active pericarditis or myocarditis
- Recent embolism
- Thrombophlebitis
- Resting ST-segment depression > 2 mm
- Uncontrolled diabetes
- Severe orthopaedic conditions that would prohibit exercise
- Other metabolic conditions including acute thyroiditis, hypokalaemia, hyperkalaemia, hypovolaemia etc.

Considering the fact that a doctor could be held responsible for a major adverse event resulting from participation in an exercise programme prescribed by the doctor (Rolfe and Boyce, 2011; Weiler et al., 2012a), it is the doctor's responsibility to be informed and updated on the guidelines for exercise testing and prescription (Fletcher et al., 2001; Fletcher et al., 2013). As previously mentioned, GPs have time constraints and this may limit their ability to effectively advice patients on the benefits of PA, exercise, exercise prescription and comprehensive lifestyle risk factor modification. With more evidence that exercise is medicine for both prevention and management of non-communicable diseases, doctor should be informed and make use of a multidisciplinary team including Biokineticists as rehabilitation specialists who are trained in exercise testing and supervision for special population groups (Czerniewicz and Nicholson, 2004; Franklin, Fern, Fowler et al., 2009; Nied and Franklin, 2002; Nolte et al., 2013). Making use of a referral system also increases adherence to an exercise program (Duda, Williams, Ntoumanis et al., 2014), implying that South Africa should theoretically be more geared to utilize such approaches considering that we have trained PA professionals such as Biokineticists.

2.5 SUMMARY

Even though being physically active for health and well-being is accepted by much of the general population, the majority of people in developed countries fail to meet even minimal requirements (Lee et al., 2012). Considering the numerous preventative and therapeutic health benefits associated with a physically active lifestyle, the effectiveness of exercise to treat various chronic diseases, the limited side effects associated with exercise in comparison to pharmaceutical therapies and the role doctors can play in the promotion of physically active lifestyles, it can almost be regarded as unethical if they choose not to take an active role in exercise prescription for the patient's sake (Weiler, Feldschreiber, and Stamatakis, 2012b). To reinforce our capability to manage modern non-communicable chronic diseases, doctors should have a fundamental understanding of the benefits of PA, how to successfully encourage our patients to be physically active and combat sedentary behaviour for different age groups. It is therefore of utmost importance to engage in research which would lay the foundations for sustained interventions aimed at getting doctors to prescribe exercise to their patients.

Chapter 3

METHODOLOGY

3.1 INTRODUCTION

This chapter describes the formulation of the questionnaire and methods used to achieve the aims of the study.

3.2 STUDY DESIGN

This study was an observational descriptive study to assess the knowledge, practices and attitudes of South African doctors regarding exercise prescription to their patients, by using a self-reported, anonymous online questionnaire. Once the study was approved by the Ethics Committee of the Faculty of Health Sciences, UFS, the questionnaire was forwarded to HealthMan®. HealthMan® (Pty) Ltd is a privately owned healthcare consultancy for the management and administration of specialist and healthcare networks. The Director of HealthMan® gave the researcher permission to use their database of GPs as compiled by HealthMan®, to conduct this electronic survey with the use of E2 Solutions (Appendix F). E2 Solutions (Pty) Ltd was established in 1999 as a niche electronic-business software development house that designs, builds, manages, supports and hosts a range of value adding online commercial applications. HealthMan® employ the services of E2 Solutions (Pty) Ltd. on a contractual basis to advise on and manage all routine operational tasks, as well as provide them with additional services such as online questionnaires.

This self-administered, anonymous survey was conducted from May 2011 to June 2011. During this time the questionnaire was posted on the internet two weeks apart on three separate occasions. General practitioners (GPs) who completed the questionnaire (Appendix C) on the internet, once they have read through the information sheet (Appendix B), automatically sent the questionnaire back to a secured HealthMan® computer via E2 Solutions with the click of a button. The database of GPs compiled by HealthMan® consisted of 4657 GPs at the time of data collection. E2 Solutions collected the raw data and sent it to the researcher. The researcher grouped the data into different assessment areas after which the data were analysed with help of the Department of Biostatistics, Faculty of Health Sciences, University of the Free State (UFS).

3.3 STUDY PARTICIPANTS

The target population for this study was GPs across SA. The researcher obtained e-mail addresses of medical doctors within the HealthMan® system via E2 Solutions, who has registered members in every province of SA. At the time of data collection there were 15 000 health care providers in the HealthMan® system, of which E2 Solutions managed the data base of 4657 GPs. The questionnaire was sent out to the 4657 e-mail addresses of GPs across SA, via HealthMan® of which 18 returned as invalid e-mail addresses. Of the 4639 potential respondents, only 349 GPs responded to the questionnaire after duplicates were removed (response rate = 7.5%). Due to the low response rate, uncompleted questionnaires were not discarded, but each question was handled individually according to the number of respondents instead.

3.3.1 Inclusion criteria

Participants had to meet the following criteria to be included in the study:

- A qualified medical doctor
- Male or female
- Working primarily as a GP.

3.3.2 Exclusion criteria

Participants who met the following criteria were excluded from the study:

- Doctors still busy with their community service
- Working primarily in another sector other than a GP.

3.4 MEASUREMENT

To ensure reliability, the work of Connaughton et al., (2001) formed the basis of the questionnaire with specific inferences from the American College of Sports Medicine (ACSM) Guidelines for Exercise Testing and Prescription (ACSM, 2010). The questionnaire consisted of single (choose the most appropriate) answer questions, as well as multiple (choose all the appropriate) answer questions. Survey questions included basic demographic information, knowledge questions, provider attitudes regarding self-efficacy in dealing with exercise prescription, and provider behaviours, including screening practices. Questions within the questionnaire were sorted under different exercise prescription-related topic areas namely;

- Demographics and training information
- Practices of GPs regarding exercise program
- Attitudes of general practitioners towards exercise prescription
- Knowledge of exercise prescription (Appendix E).

The questionnaires were available in English only. The researcher collected and saved all data securely on a password-protected computer. The raw data was sent to the Department of Biostatistics, Faculty of Health Sciences, UFS for statistical analysis.

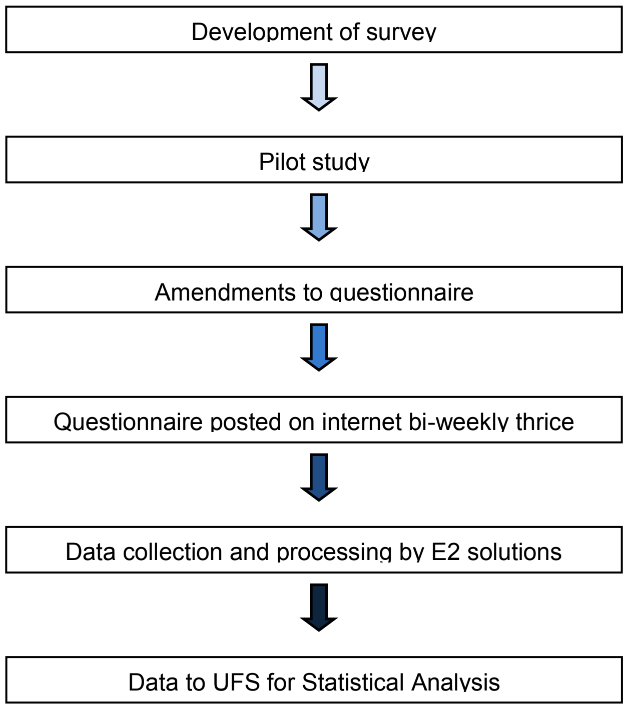

Figure 3.1 Schematic representation of the research process

3.5 METHODOLOGICAL AND MEASUREMENT ERRORS

Certain weaknesses are inherent to questionnaires. It is acknowledged that the subjects may have responded to the questions in a way that they think were most appropriate or socially desirable and not what they actually practice. In an attempt to minimize this weakness, the questions have been formulated in such a way that it was not apparent what the wrong or undesirable answers were. In order to minimize non-responder bias, the questionnaire was sent out over the internet on three separate occasions, two weeks apart.

The survey generated a low overall response rate (7.5%), as it is seen that response rates to surveys have dropped over time (Sax, Gilmartin, and Bryant, 2003). Self-selection bias is another limitation of online survey research. There is a tendency of some persons to respond to an invitation to participate in an online survey, while others ignore it. This may lead to a systematic bias (Wright, 2005). Doctors may also tend to answer surveys that are of personal interest to them (Casebeer, Bennett, Kristofco et al., 2002). To try to counter this, a prize was awarded through a lucky draw to one of the doctors that completed the survey.

3.6 PILOT STUDY

A pilot study was conducted to trial the questionnaire, expose any possible confusions or ambiguities arising during completion thereof and ultimately determine the validity of the questionnaire. After acceptance of the protocol, five general practitioners in the Klerksdorp region were identified to complete the questionnaire and comment on the time required for completion, understanding and clarity of the questions. Amendments were then made accordingly. The participants from the pilot study were not excluded from the study.

3.7 ANALYSIS OF THE DATA

E2 Solutions collected the raw data. The researcher grouped the data into different assessment areas. Data were analysed with help of the Department of Biostatistics, Faculty of Health Sciences, UFS. Due to the exploratory nature of the project, descriptive statistics was mainly used to analyse and discuss the data. The low response rate made it difficult, and at times impossible to conduct further statistical analyses to investigate possible differences between demographic groups or relationships between different variables. All data were stored securely on password-protected computers with restricted access to the data by authorized personnel involved with the research project.

3.8 IMPLEMENTATION OF FINDINGS

The findings will be submitted to appropriate peer-reviewed journals namely the British Journal of Sports Medicine and the South African Journal of Sports Medicine for possible publishing. The findings from this research project will lay a foundation for future research relating to the implementation of the Exercise is Medicine campaign in SA and possible interventions at an undergraduate level.

3.9 ETHICS

3.9.1 Ethical approval

The study was approved by the Ethics Committee of the Faculty Health Sciences, University of the Free State (UFS) (ECUFS 190/2010) (Appendix A).

3.9.2 Information to consent and participation

Before entering the website and questionnaire the participant were instructed to read through the information sheet (Appendix B). The information sheet briefly informed the participant what the purpose of the study was, and approximately how much of their time the survey would take. Participation in the study was completely voluntarily, and by completing the questionnaires, consent to be included in the study was automatically given. Refusal or discontinuation to participate involved no penalty. Participants were informed of the anonymity and confidentiality associated with their participation and the handling of data.

3.9.3 Confidentiality

The study was completely anonymous and participants could not be connected to any of the data, and nothing that could reveal anyone's participation in the study was disclosed. Although the participants were asked to give their MP-numbers (registration number with the South African Health Professions Council for General Practitioners), it was only used to ensure that they were indeed registered medical practitioners and avoid more than one entry by a single person for the incentive price draw (Section 3.9.4).

3.9.4 Remuneration

One doctor, by completing the questionnaire received a price worth R3000, which was awarded through a lucky draw. The price money was sponsored by the researcher, while HealthMan® handled the draw. One MP number was chosen randomly by a computer as the winner of the lucky draw.

Chapter 4

RESULTS

4.1 INTRODUCTION

This chapter reports on the demographic information and exercise prescription habits of the participating general practitioners (GPs), as well as their knowledge on exercise prescription. While figures summarise the demographic and exercise prescription habits of the participants, tables were deemed more appropriate to provide insight into possible misperceptions regarding exercise prescription. Tables report not only the percentage of participants who chose the correct or desirable answers for each question, but also highlight the incorrect or undesirable answers chosen by the participants in response to the multiple choice questions.

4.2. DEMOGRAPHIC INFORMATION OF PARTICIPANTS

In this section, results on the participants' primary employment, years since graduation, location at the time of data collection and their postgraduate qualification status in Sports Medicine are given.

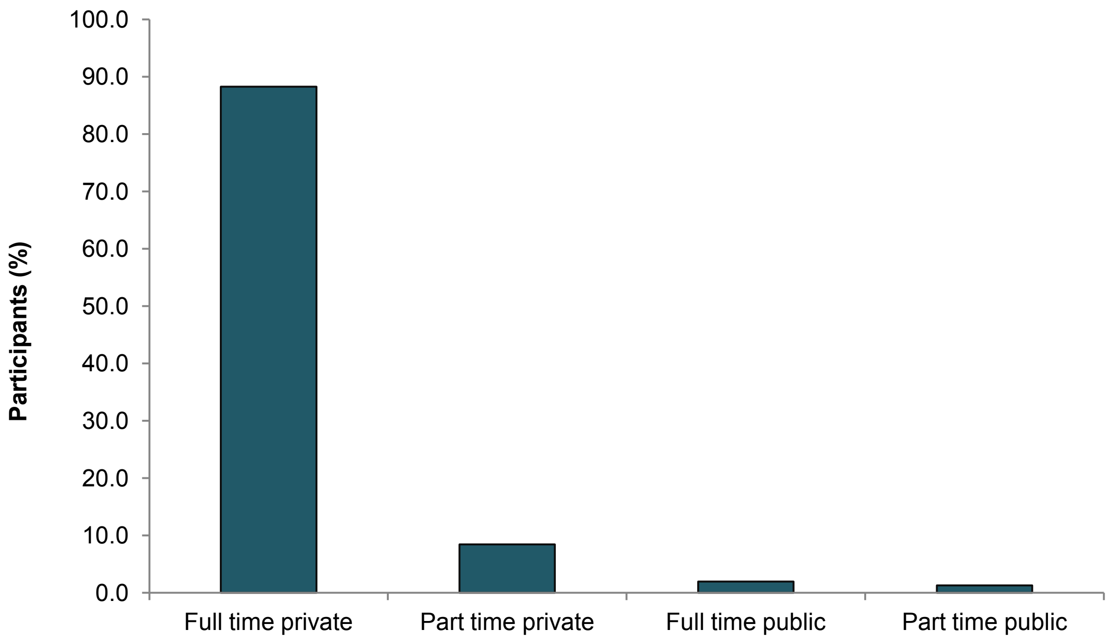

Figure 4.2.1 Participants' sector of primary employment and practice (n = 307)

At the time of data collection, 88.3% (n=271) of the participants were primarily employed in the private sector on a full time basis. While there was a substantial difference in the percentage of participants practicing in the private sector on a full time and part time (8.5%, n=26) basis, both the full time and part time public sector general practitioners were scarcely represented in this study. Only 2.0% (n=6) of the participants were primarily employed in the public sector on a full time basis, while 1.3% (n=4) were employed on a part-time basis (Figure 4.2.1).

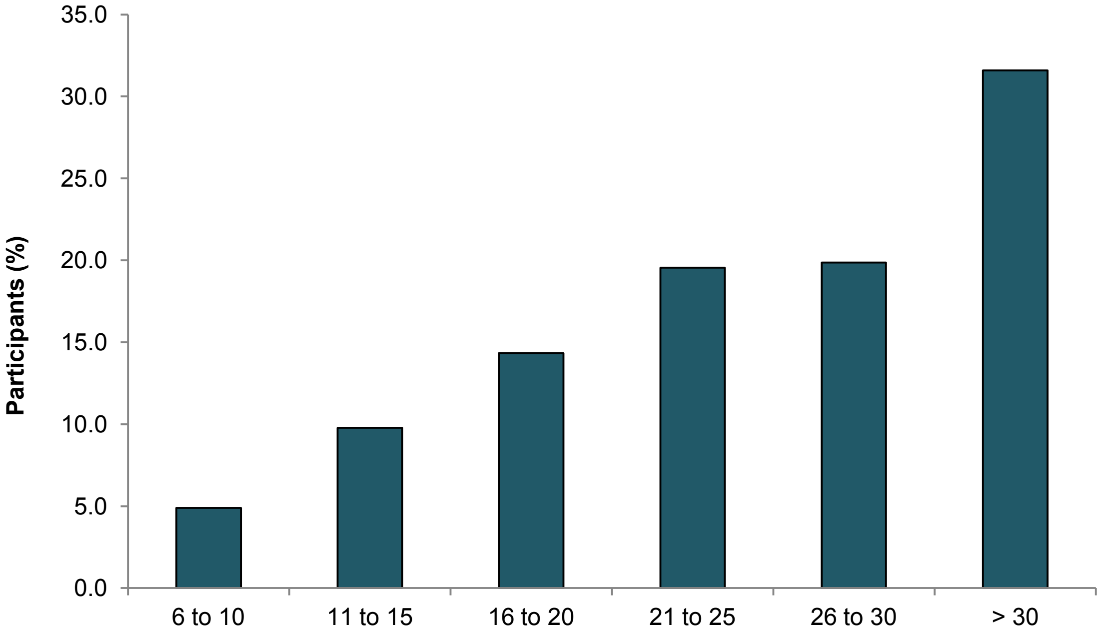

Figure 4.2.2 Number of years since graduation (n = 307)

To explore how many years the participants had been practicing medicine and whether undergraduate curricular input was a possible influential factor in their knowledge or attitudes towards exercise prescription, the participants were asked to declare the year in which they obtained their medical degree (Figure 4.2.2). Of the doctors that completed the survey, a mere 4.9% (n=15) obtained their degree within the 10 years preceding the data collection. A further 9.8% (n=30) obtained their degree 11-15 years ago, 14.3% (n=44) obtained their degree 16-20 years ago, 19.5% (n=60) obtained their degree 21-25 years ago and 19.9% (n=61) obtained their degree 26-30 years ago. This accumulates to 63.5% (n=195) participants who had between 11 and 30 years' experience in practicing medicine. A substantial 31.6% (n=97) completed medical school more than thirty years ago.

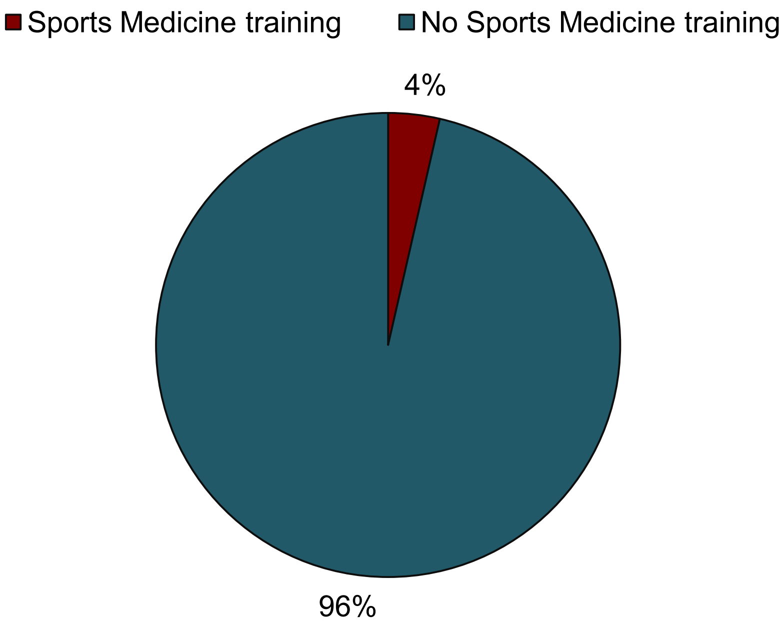

Figure 4.2.3 Postgraduate training in Sports Medicine (n = 307)

Of the 307 doctors who provided their demographic information, only 3.6% (n=11) obtained postgraduate training in Sport and Exercise Medicine (Figure 4.2.3).

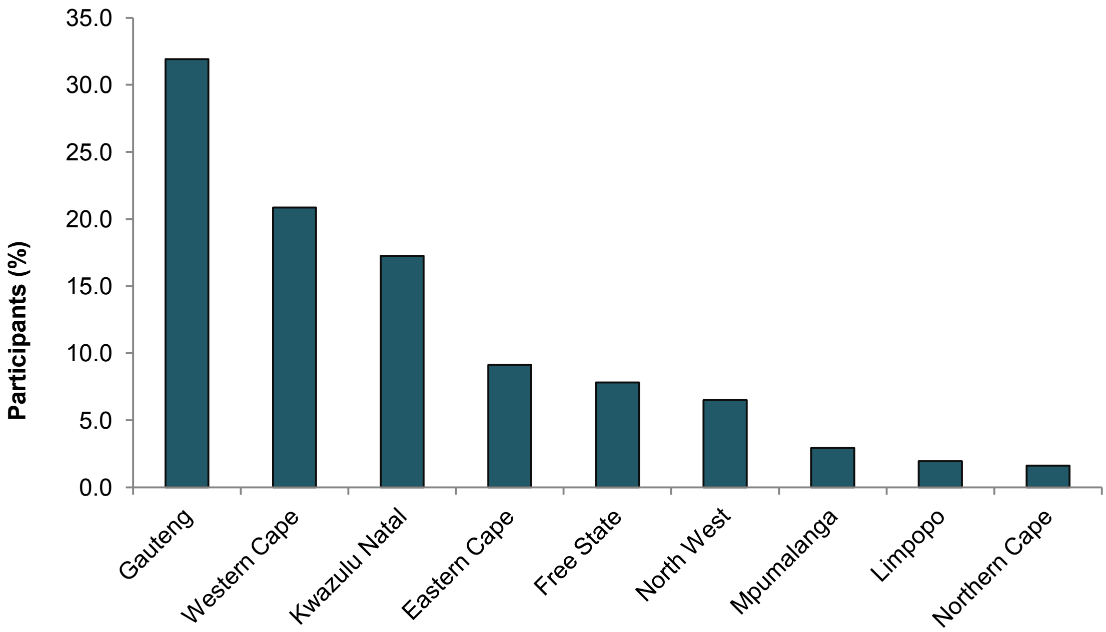

Figure 4.2.4 Provincial distribution of participants (n = 307)

When looking at the provincial distribution portrayed in Figure 4.2.4, it is clear that the largest proportion of participating doctors were based in Gauteng (31.9%, n=98). In descending order, the remaining participants practiced medicine in the following provinces: 20.9% (n=64) in the Western Cape, 17.3% (n=53) in KwaZulu Natal, 9.1% (n=28) in the Eastern Cape, 7.8% (n=24) in the Free State, 6.5% (n=20) in the North West, 2.9% (n=9) in Mpumalanga, 2.0% (n=6) in Limpopo and 1.6% (n=5) in the Northern Cape.

4.3 PRACTICES OF GENERAL PRACTITIONERS REGARDING EXERCISE PRESCRIPTION

In this section the exercise prescription practices of general practitioners are explored, with specific focus on whether they prescribe exercise or not, the advising frequency to their patients, the primary method of exercise prescription used and possible reasons for not prescribing exercise if applicable.

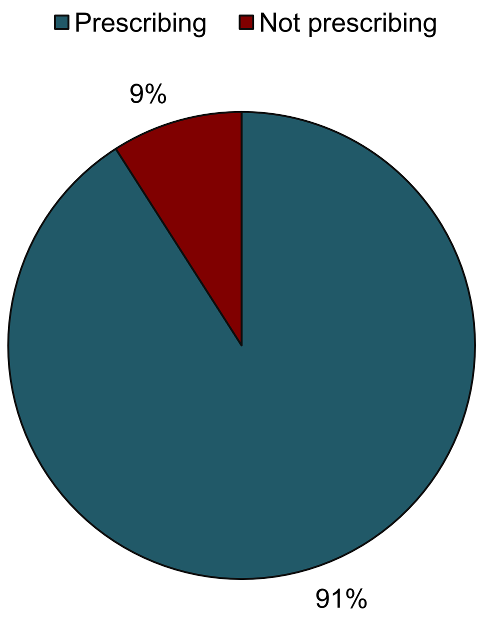

Figure 4.3.1 Participants' (n = 309) use of exercise as therapeutic modality during consultations

From Figure 4.3.1 it can be seen that 90.9% (n=281) of the participants claimed to prescribe exercise to their patients as a therapeutic modality during consultations, while the remaining 9.1% (n=28) of the doctors did not prescribe exercise during consultations. Even though the vast majority claimed that they do, in fact, prescribe exercise during their consultations, it was important to investigate the frequency and modality of prescribing exercise to their patients (Figures 4.3.2 and 4.3.3).

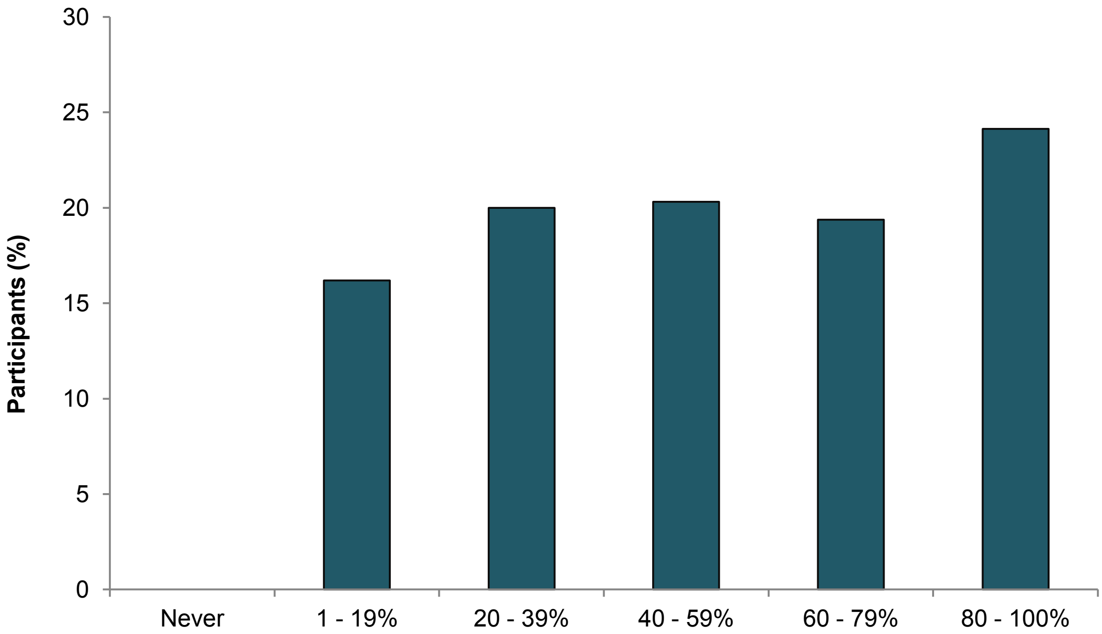

Figure 4.3.2 Exercise prescription or advising frequency (n = 315)

This question was used to determine to what extent the participants prescribed exercise to their patients. In spite of the fact that 28 doctors who originally admitted to not prescribing exercise (Figure 4.3.1), none of the doctors admitted it here (Figure 4.3.2). Of the 315 doctors who completed this question, 16.2% (n=51) claimed to prescribe exercise to 1-19% of their patients while a fifth (20.0%, n=63) of the doctors prescribed exercise to 20-39% of their patients on a daily basis. Furthermore, 20.3% (n=64) of the doctors prescribed exercise to 40-59% of their patients, 19.4% (n=61) prescribed exercise to 60-79% of their patients and almost a quarter (24.1%, n=76) prescribed exercise to 80-100% of the patients they see every day.

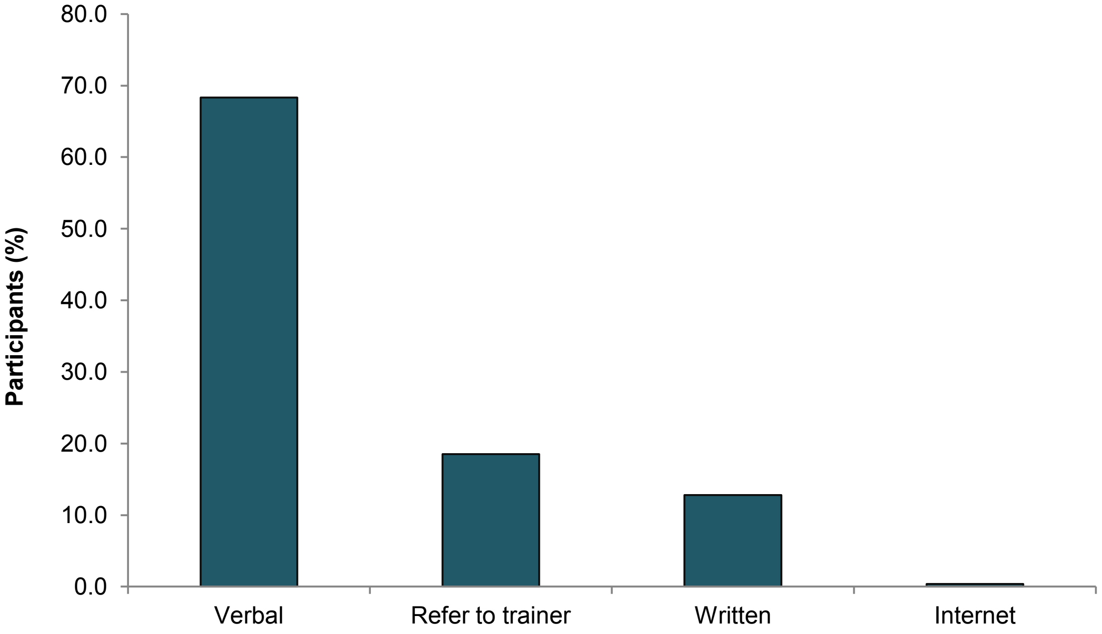

Figure 4.3.3 Exercise prescription methods (n=281)

Of the 281 participants who prescribed exercise to their patients, 68.3% (n=192) gave verbal exercise advice while 18.5% (n=52) preferred to refer their patients to a trainer. Only 12.8% (n=36) gave a written exercise prescription to their patients to take home while a single doctor (0.4%) made use of the internet as exercise prescription modality for his/her patients.

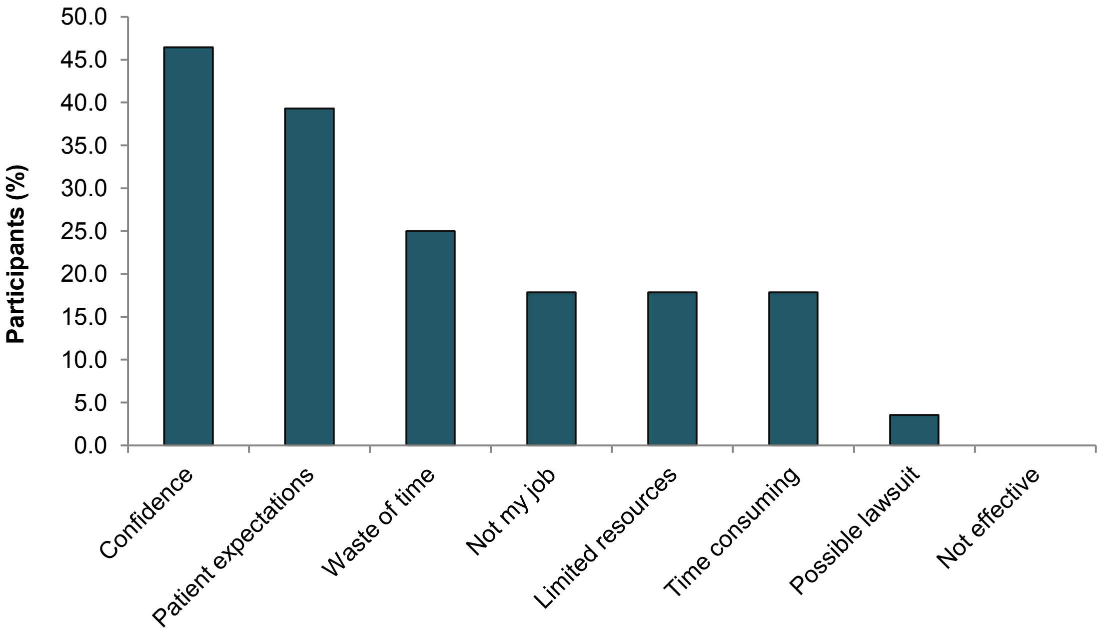

Figure 4.3.4 Non-prescribers' reported reasons for not prescribing exercise (n = 28)

The participants who did not prescribe exercise (Figure 4.3.1) were instructed to choose as many of the given options they felt applied to the reasons why they did not prescribe exercise to their patients. The barriers to prescribing exercise were reported as follow:

Almost half (46%, n=13) of the non-prescribing GPs did not feel confident enough to prescribe exercise to their patients. Thirty nine percent (n=11) of these doctors felt that their patient had an expectation for receiving medication instead of exercise which had to be met. A quarter (25%, n=7) considered exercise prescription a waste of time while 18% (n=5) of these doctors believed it was not their job to prescribe exercise to their patients. Eighteen percent (n=5) felt they had a lack in resources while 18% (n=5) believed that prescribing exercise to their patients will be overly time consuming. Only one doctor felt that a possible medical law suit was a barrier to prescribing exercise to his/her patients. None of the doctors considered exercise ineffective and therefore a reason for not prescribing exercise.

It is important to mention that the participants were also given the opportunity to respond to an option labelled “other” and elaborate freely to accommodate the possibility that barriers beyond that envisaged were keeping them from prescribing exercise. However, all the reasons encompassed within these responses were synonymous with the reasons already given and reported in Figure 4.3.4.

4.4 ATTITUDES OF GENERAL PRACTITIONERS TOWARDS EXERCISE PRESCRIPTION

In this section the attitudes of GPs towards exercise prescription and the importance of exercise as a preventative modality for chronic diseases are reported.

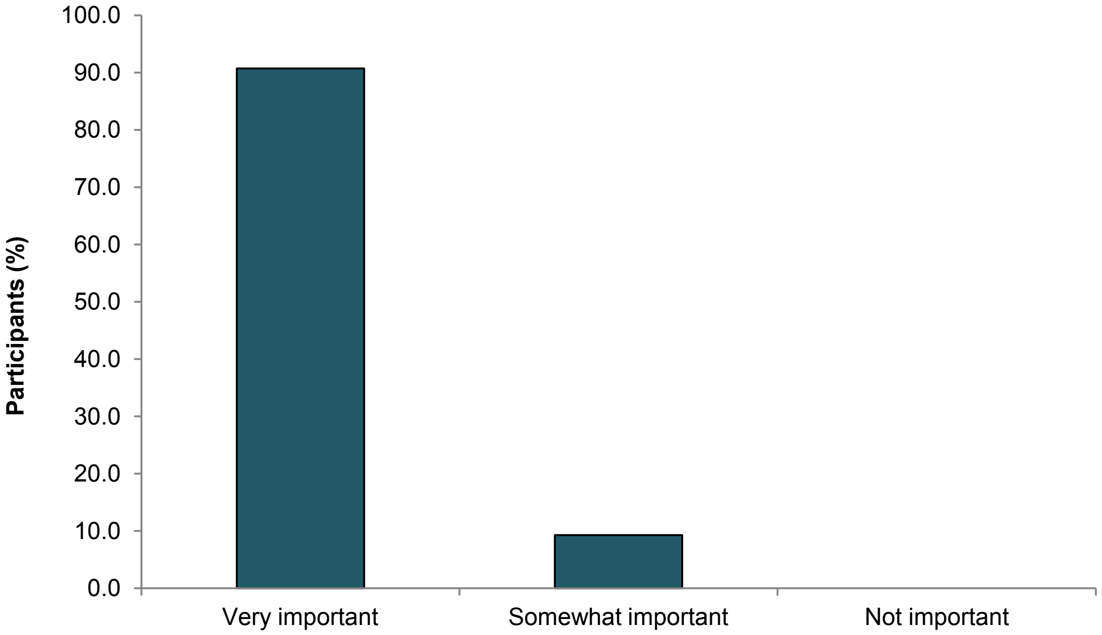

Figure 4.4.1 Attitude towards importance of exercise as preventative modality for chronic disease (n = 312)

All the GPs (100%, n=312) agreed to the importance of exercise to prevent chronic diseases to a greater or lesser extent (Figure 4.4.1). The majority (90.7%, n=283) believed that exercise is very important, while 9.3% (n=29) believed exercise is somewhat important in the prevention of chronic disease.

Table 4.4.1 Agreement with statements regarding exercise prescription

	Statement	% (n = 315)
Desirable	Physical activity yields benefits for individuals of any age	95.6
	Exercise is beneficial in preventing chronic disease	92.4
	Primary care practitioners should be proactive in prescribing exercise for all patients	87.0
	Ascertaining information on preventative health behaviours, including exercise is an important part of patients history taking	85.7
Undesirable	Exercise promotion is not within the scope of a GP practice	2.2
	None of the above	0.3

The participants were asked to choose as many options as they felt were applicable regarding statements on exercise prescription (Table 4.4.1). Of the doctors that completed this specific question of the survey (n=315), 85.7% (n=270) felt that preventative health behaviours, including exercise were an important part of history taking. Eighty seven percent (n=274) of the GPs were of the opinion that primary care practitioners should be pro-active in prescribing exercise to all patients, while 92.4% (n=291) believed that exercise can be beneficial in preventing chronic diseases. The majority (95.6%, n=301) of the GPs felt that physical activity is beneficial for all patients. However, there were still a small number of GPs (2.2%, n=7) who felt that exercise prescription were not within the scope of a GP practice.

4.5 KNOWLEDGE OF EXERCISE PRESCRIPTION

This section report on the knowledge of doctors relating to the benefits, risk factors and contra-indications associated with exercise, as well as knowledge fundamental for recommendations and formulation of a typical exercise prescription. In addition to the percentage of GPs who agreed with each individual option as an answer to the stated question, the percentage of participants who provided all the correct answers for each respective question as a whole are also reported.

Table 4.5.1 Agreement with statements regarding the benefits of regular exercise

	Statement	% (n = 315)
Correct	Decreased resting blood pressure	90.2
	Effective therapy for many chronic diseases in older adults	83.5
	Decreased heart rate	80.3
	Increased threshold for the onset of disease signs or symptoms	58.1
	Decreased myocardial oxygen cost	46.0
	Decreased serum high-density lipoprotein as well as serum triglycerides	45.4
	Reduced platelet adhesiveness and aggregation	42.5
Incorrect	Increased minute ventilation	61.0
	Weight reduction due to decrease in muscle mass	21.3
	Increased insulin needs	11.4
	None of the above	0.3

The participants were asked to choose all the benefits of regular exercise. From Table 4.5.1 it can be seen that this question comprised of seven correct and four incorrect options. The majority of doctors correctly identified a decrease in resting blood pressure (90.2%, n=284), the fact that exercise is effective therapy for many chronic diseases in older adults (83.5%, n=263) and a decreased heart rate (80.3%, n=253) as benefits of regular exercise. In increased threshold for the onset of disease signs and symptoms were correctly identified as a benefit of regular exercise by 58.1% (n=183) of the doctors. However, other benefits such as a decreased myocardial oxygen cost (46.0%, n=145), decreased serum high-density lipoprotein as well as serum triglycerides (45.4%, n=143) and reduced platelet adhesiveness and aggregation (42.5%, n=134) were less familiar to the participants. Instead, more participants (61.0%, n=192) wrongly chose an increased minute ventilation as a benefit of regular exercise. A small number of participants also indicated that they were of the impression that a decrease in muscle mass leading to weight loss (21.3%, n=67) and increased insulin needs (11.4%, n=36) were associated benefits of regular exercise, although this is not the case. As a whole, none of the GPs chose all the correct options.

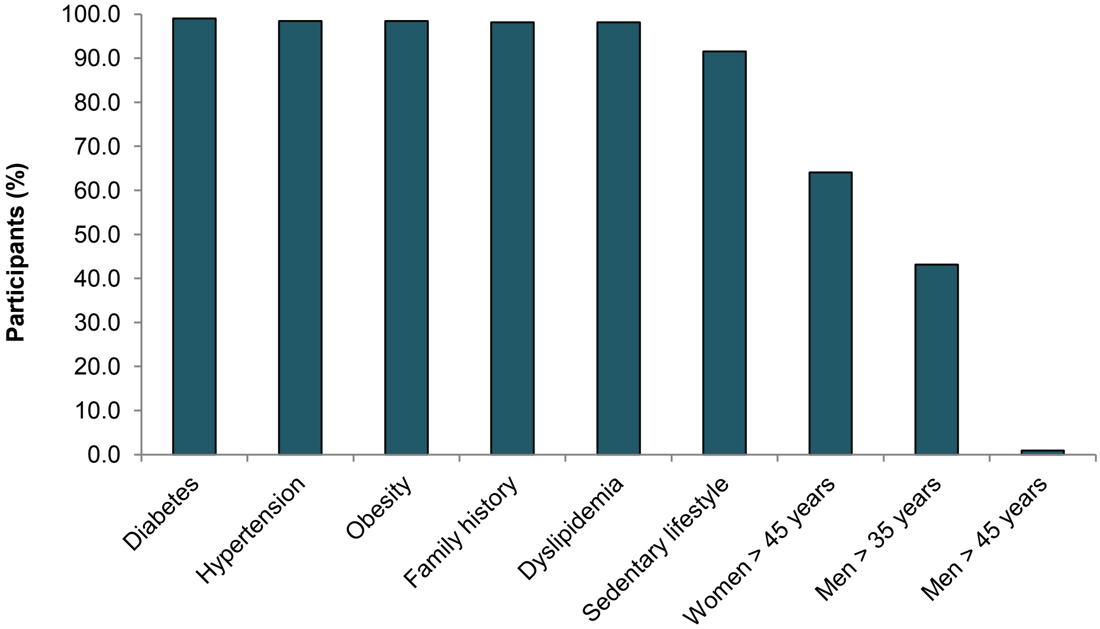

Figure 4.5.1 Identification of risk factors for cardiovascular disease (n = 320)

The participants were asked to identify all the cardiovascular risk factors for exercise. All the options provided are risk factors for cardiovascular disease although none of the doctors chose all the options. A resounding number of participants (91.6% to 99.1%, Figure 4.5.1) correctly identified diabetes, hypertension, obesity, a family history of myocardial infarction and a sedentary lifestyle as risk factors for cardiovascular disease. While still in the majority, a decrease in the number of doctors identifying women above 45 years of age (64.1%, n=205) and men above 35 years of age (57.2%, n=183) as cardiovascular risk factors is clearly noted. A mere 0.9% (n=3) of the participants correctly identified men above 45 years of age to be at risk for developing cardiovascular disease. As a whole, a total of 98.4% (n=315) of the doctors chose at least five correct options while 50.9% (n=163) chose eight out of the nine correct options.

Table 4.5.2 Identification of contraindications for exercise

	Contraindication	% (n = 320)
Correct	Acute systemic illness or fever	95.6
	Unstable angina	88.1
	Active pericarditis or myocarditis	85.9
	Uncompensated congestive heart failure	84.1
	Resting systolic blood pressure > 200 mm Hg	78.1
	Sinus tachycardia 110 beats per minute	67.8
	Resting diastolic blood pressure > 110 mm Hg	63.1
	Uncontrolled diabetes mellitus	54.1
	Thrombophlebitis	52.8
Incorrect	Obese patients	4.69
	None of the above	1.25

The participants were asked to identify the contraindications for exercise. Out of a possible eleven options, only nine truly were contraindications according to the ACSM guidelines for exercise prescription (ACSM, 2009). Acute systemic illness or fever were seemingly the most familiar contraindication as chosen by 95.6% (n=308) of the participants, closely followed by unstable angina (88.1%, n=284), active pericarditis or myocarditis (85.9%, n=276) and uncompensated congestive heart failure (84.1%, n=271). A resting systolic blood pressure above 200 mmHg were correctly identified as a contraindications by 78.1% (n=252) of the participants, while 67.8% (n=219) of the participants correctly identified a sinus tachycardia of 110 beats per minute or more as a contraindication for exercise. Sixty three percent (n=202) of the doctors correctly identified a resting diastolic blood pressure above 110 mmHg as a contraindication. Furthermore, approximately half of the participants correctly identified uncontrolled diabetes and thrombophlebitis as contraindications (54.1% and 52.8% respectively). Interestingly 4.69% (n=15) were of the impression that obesity is a contraindication while 1.25% (n=4) of the participants could not identify even a single contraindication correctly, by choosing none of the above. A total of 15.9% (n=51) of the participants chose all the correct answers.

Table 4.5.3 Agreement with statements regarding recommendations for physical activity according to the ACSM

	Statement	% (n = 315)
Correct	Every adult should perform activities to maintain or increase muscular strength and endurance a minimum of 2 days per week	54.6
	Combination of moderate and vigorous intensity exercise	43.2
	Vigorous exercise, 20 min, 3 days per week	22.5
Incorrect	Moderate aerobic exercise for 20 min. 5 days per week	59.7
	None of the above	1.6

The participants were asked to choose the correct options relating to recommendations for PA in a non-pregnant healthy adult. Five options were given of which three were correct (Table 4.5.3). Only 54.6% (n=172) of the participants knew that an adult should engage in PA at least twice a week. Less than halve (43.2%, n=136) knew that the weekly exercise should entail a combination of both moderate and vigorous exercise, while a mere 22.5% (n=71) knew that ideally a person should engage in vigorous exercise three times a week for 20 minutes each. The majority participants wrongly believed that a non-pregnant healthy adult should engage only in moderate aerobic exercise five days a week for 20 minutes each while in fact, each session should last at least 30 minutes each (ACSM, 2009). Interestingly, 1.6% (n=5) of the participants chose not to identify any of the given options as a recommendation for PA. Only 0.63% (n=2) of the doctors chose all the right options.

Table 4.5.4 Components for an exercise program

	Component	% (n = 320)
Correct	Frequency	97.8
	Intensity	88.8
	Time	85.0
	Mode of exercise	84.4
Incorrect	Total health	72.5
	Injury prevention	71.6
	Targeted training	59.4
	Fat loss	57.2
	None of the above	0.3

The respondents were asked to identify the key components which should be addressed within an exercise programme. The four key components of an exercise programme are the **f**requency of the exercise, the **i**ntensity at which one should exercise, the **t**ype or mode of exercise which should be specified and the **t**ime or duration of each exercise session (FITT). These FITT principles are very common foundational knowledge in exercise prescription and should be familiar to anyone who has ever engaged in exercise prescription. Frequency was correctly identified by 97.8% (n=313) of the participants. Intensity was correctly identified by 88.8% (n=284) of the participants. Time was correctly identified by 85.0% (n=272) of the participants, while mode was correctly identified by 84.4% (n=270) of the participants. More than halve of the participants incorrectly chose total health (72.5%, n=232), injury prevention (71.6%, n=229), targeted training (59.4%, n=190) and fat loss (57.2%, n=183) as key components of a standard exercise programme. A single participant (0.3%, n=1) chose the option 'none of the above'. Only 4.7% (n=15) of the GPs answered the question correctly.

Table 4.5.5 Identification of means for estimating exercise intensity

	Estimation means	% (n = 333)
Correct	Percentage of estimated $HR_{(max)}$	88.6
	Heart rate reserve	55.3
	Percentage of estimated $VO_{2(max)}$	44.1
	Rate of perceived exertion	32.1
Incorrect	Respiratory rate	45.4
	None of the above	1.8

Exercise intensity may be estimated using the percentage of the age-predicted maximum heart rate ($HR_{(max)}$), the heart rate reserve, the percentage estimated $VO_{2(max)}$ or the rate of perceived exertion which is usually measure on a visual analogue scale. The respondents were asked to choose all the correct options. The percentage of $HR_{(max)}$ was chosen by most of the doctors (88.6%, n=295). Heart rate reserve was chosen by 55.3% (n=184), percentage estimated $VO_{2(max)}$ by 44.1% (n=147) and the rate of perceived exertion was chosen by 32.1% (n=107) of the participants. Of the incorrect options, respiratory rate was chosen by 45.4% (n=151) of the doctors while 1.8% (n=6) answered that none of the mentioned options were correct. Of the 333 responders only 1.5% (n=5) doctors answered this question correctly.

Table 4.5.6 Identification of means for estimating maximum heart rate

	Estimation means	% (n = 333)
Correct	220 minus age	52.3
Incorrect	Admit to not knowing	24.0
	200 minus age	19.2
	230 minus age	0.9
	None of the above	3.6

The participants were asked to choose the correct option regarding the means of estimating $HR_{(max)}$. Just over half of the doctors (52.3%, n=174) answered correctly that age predicted $HR_{(max)}$ can be determined by subtracting age from 220. Almost a quarter (24.0%, n=80) of the doctors admitted they do not know the answer to this question while 19.2% (n=64) of the doctors erroneously chose 200 minus age as the correct answer. The incorrect option of 230 minus age were chosen by 0.9% (n=3) of the doctors and 3.6% (n=12) said that not one of the options were correct.

Table 4.5.7 Identification of minimum exercise requirements according to the ACSM

	Minimum exercise requirements	% (n = 333)
Correct	30 minutes per day	56.8
Correct	150 minutes per week	42.9
Correct	3000 to 4000 steps per day	7.8
Correct	1000 kcal per week	6.9
Incorrect	1000 to 2000 steps per day	9.3
Incorrect	None of the above	5.4

The participants were asked to choose the all the possible correct options for identifying the minimum requirements for exercise. This question consisted of six options of which four were correct (Table 4.5.7). According to the ACSM (2009), the minimum quantity of physical activity is either 1000kcal per week, 150 min per week, 30 min per day, or 3000-4000 steps per day. Almost a tenth (9.3%, n=31) of the doctors chose the incorrect option that the recommended minimum quantity of physical activity required is 1000-2000 steps per day and 5.4% (n=18) of the doctors chose the incorrect option that none of the options were correct. Six point nine percent 6.9% (n=23) believed correctly that it is 1000kcal per week, 42.9% (n=143) said 150 min per week, 56.8% (n=189) said 30 min per day, and 7.8% (n=26) of the doctors believed that it is 3000-4000 steps per day. Only 0.9 % (n=3) of the doctors chose all the correct answers.

Chapter 5

DISCUSSION

5.1 INTRODUCTION

The pervasive sedentary lifestyle and accompanying low energy expenditure of modern man are increasingly held responsible for many of the chronic diseases we face today (Sparling and Owen, 2000). Anecdotal beliefs that obesity is an American or European trait no longer holds true, as research exposed low physical activity (PA) levels among South Africans (Joubert et al., 2007; Kruger, Venter, Vorster, et al., 2002) which may contribute substantially to excess body mass. Considering that general practitioners (GPs) have access to a large proportion of the sedentary population and are generally a respected source of advice (Swinburn and Walter, 1998) they are key in getting adults to exercise (Phillips and Roy, 2009; Swinburn and Walter, 1998). Receiving a prescription for exercise from a GP highlights the notion that the exercising is part of their treatment plan and should be adhered to with the same diligence with which their mediation is taken. While some insight have been gained into the practices and attitudes of American doctors towards exercise prescription, very little is known about the exercise prescription practices, knowledge and attitudes towards exercise prescription of South African GPs. This study examined the prevalence of exercise prescription among South African General Practitioners (GPs), their attitudes towards exercise prescription, reasons why they do not prescribe exercise to their patients, as well as their knowledge pertaining to exercise prescription (Section 1.2).

5.2 DEMOGRAPHICS

At the time of the research, 38236 medical practitioners were on the registration roll of the Health Professions Council of SA (HPCSA, 2012), although specifics on the number of general practitioners versus medical specialists in the country at the time of the research cannot be confirmed. From the potential 4639 registered GPs from the HealthMan® database, only 349 completed questionnaires were included, yielding an overall response rate of 7.5%. However, it has to be mentioned that two of the GPs who responded to the survey did not meet the inclusion criteria (Section 3.3.1) since they were primarily employed in the educational and managerial sector respectively, raising questions how many of the registered GPs are actually practicing as GPs.

Nonetheless, the response rate from this study was considerably lower compared to the average response rate reported for online questionnaires (12.95%) (Scott, Jeon, Joyce, et al., 2011), highlighting the fact that the results had to be interpreted with caution. The low response rate may possibly be explained, in part, by the general trend of declining response rates seen for all types of surveys over time (Sax et al., 2003), especially e-mail surveys since 1986 (Sheehan, 2001). In addition, doctors often feel they are swamped with questionnaires (MacPherson and Bisset, 1995) with too little time to complete lengthy questionnaires (Hummers-Pradier et al., 2008; McAvoy and Kaner, 1996; Scott et al., 2011). Although this was not within the scope of this study, it would have been interesting to follow up on the non-responders to explore whether the reasons given by South African doctors for not partaking in research corresponds to that of literature from international studies. Considering the importance of health care related research ultimately leading to the welfare of patients and the role doctors play in these types of research, it is recommended that future research investigate the barriers to participation in health care related research among South African doctors.

The majority of responding doctors were from Gauteng (31.9%), the Western Cape (20.9%) and KwaZulu Natal (17.3%). It was not possible to retrieve data from the Independent Practitioners Association on the provincial distribution of the GPs from the database at the time of the research to determine whether the proportional distribution of the participants corresponded to that of the database. However, looking at the population of SA across the nine provinces (Appendix D), the responses were approximately representative and proportionate to the provincial population sizes, with the exception of the Western Cape where more doctors responded to the survey, and Limpopo and Mpumalanga where fewer doctors responded to the survey. It is unclear why these provinces did not follow the same pattern as the other provinces, but it is suspected that the low response rate may have had an influence in the misrepresentation.

Most of the GPs were in full time private practice (88.3%) with no postgraduate training in Sport and Exercise Medicine (96.4%). Interestingly, the vast majority of doctors graduated more than 20 years ago (71.0% in total) at the time of the research. While being cautious to interpret this finding, it would appear that the GP population is ageing. This is in agreement with a reported shift in mean age of the South African GP population (approximately 46 years of age) (Moosa, 2014). Findings from the United Kingdom reported a decline in GP numbers as older GPs retire without a proportionate influx of young GPs (Deloite, 2012) resulting from fewer young doctors choosing a career as general practitioners (House of Commons, 2012). If this is indeed the situation in SA, it may have severe implications for the already struggling primary health care sector. Therefore, despite not flowing directly from the aims of this study, it is recommended that future research investigate the demographics of our general practitioners to form a basis to assist proactive interventions aimed towards the survival of our GP population, especially when considering the envisaged role GPs will have to play in the planned National Health Insurance strategy (Moosa, 2014).

5.3 PRACTICES OF GENERAL PRACTITIONERS REGARDING EXERCISE PRESCRIPTION

For this study a clear distinction was made between exercise prescription which comprise of a written or verbal plan according to the FITT principles (see section 2.4.4.1), and exercise advise which is not structured clearly. In this study 90.9% (282) of the participants claimed to prescribe exercise to their patients (Figure 4.3.1). Despite the fact that a purposeful attempt was made to draw the participants' attention to the fact that exercise prescription does not involve casual advise such as "you should stop smoking and exercise more" (Appendix C), substantially higher prescription rates were reported by the participants from this study compared to those from international literature (Eley and Eley, 2009; Elley, Kerse, Arroll et al., 2003; Barry Gribben, Goodyear-Smith, Grobbelaar et al., 2000; Persson et al., 2013). It is interesting to note that a similar study among South African GPs found similar results to this research project (approximately 93% prescribed exercise) (Watson, Khan and Crear, 2013). Possible reasons for these disparities between local and international findings may not only lie in possible self-report bias (Casebeer et al., 2002), but also in the different barriers to exercise prescription reported by the South African doctors and will be discussed further in Section 5.4.

When ask how many patients they advise to exercise, 84% of the participants reported to give advice to at least two out of every ten of their patients. Despite the fact that 9.1% of the doctors admitted to not prescribing exercise, none reported that they do not advice any of their patients to exercise (Figure 4.3.1 and Figure 4.3.2). This may point to the possibility that the participants understand the difference between exercise advice and exercise prescription. However, looking at the reported exercise prescription methods, it was clear that their understanding of exercise prescription mostly entails verbal instruction instead of a written prescription (Figure 4.3.3), evidenced by the 68.3% of participants who gave verbal instruction while only 12.8% gave a written prescription for the patient to take home. Although a very small percentage of the doctors provided the patient with a written exercise prescription, this is still higher compared to the 3% of written prescriptions by doctors reported in literature (Sørensen et al., 2007). However, comparing these findings to the study from Watson et al. (2013) where 65% of the 21% of doctors who provided written material gave it in the form of their own instruction (accounting to 13.7%), comparable written exercise rates were found between these two studies among South African doctors. While being higher than the reported international literature, the written prescription rates are still very low, indicating that the South African doctors were unaware (or ignorant) of the fact that written prescriptions provided in addition to verbal advice may enhance the effectiveness of interventions (Marcus et al., 2006; Smith, 2000). Receiving a prescription for exercise from your general practitioner (GP) represents a well-understood interaction between the patient and the doctor (Swinburn and Walter, 1998) and will constantly remind of the exercise goals set by the GP and the patient (Swinburn and Walter, 1998). In addition, a physical prescription for exercise from a general practitioner is a credible way to communicate changes in lifestyle to patients which focuses on empowerment of the patient to take control of his/her preventative healthcare instead of just removing symptoms by using drugs (Huber et al., 2011). It is therefore recommended that research leading up to doctor education regarding effective exercise prescription methods are undertaken

Through these findings the first research question (Section 1.3) was answered.

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5.4 ATTITUDES OF GENERAL PRACTITIONERS TOWARDS EXERCISE PRESCRIPTION

From this study it seems that the participating GPs took on a positive attitude towards exercise prescription, evidenced by the fact that the vast majority (85.7 to 95.6%) of participants agreed with positive statements regarding exercise prescription (Table 4.4.1). In addition, only 2.2% of the participants indicated that exercise promotion should not be within the scope of a GP practice, implying that approximately 98% believed that it should be part of their practice to prescribe exercise to their patients, echoing the views of Sallis (2009) and Matheson et al. (2011). This finding is encouraging, but also highlights the fact that fewer doctors actually do what they believe they should do (which is to prescribe exercise). A possible explanation for the disparity between their self-reported scope of practice and their self-reported exercise prescription habits may potentially be found in literature which claims that doctors who exercise themselves are more likely to prescribe exercise to their patients (Lobelo et al., 2009). Future research incorporating the Transtheoretical Model of change (Prochaska and Velicer, 1997) should include exploration of exercise patterns of doctors to shed light onto their exercise prescription habits.

Through these findings the second research question (Section 1.3) was answered.

5.5 BARRIERS TO EXERCISE PRESCRIPTION

While literature has reported time constraints to be the main reason for doctors not prescribing exercise to their patients (B Gribben et al., 2000; Patel et al., 2011), a minority (18.0%) of the participants felt that exercise prescription will be too time consuming (Figure 4.3.4). This is a positive finding which implies that the doctors from this study did not have a misconception of the time involved with evaluation of activity level and exercise prescription, which needs not to take more than three to five minutes of your consultation time (McInnis et al., 2003).

Almost half (46.0%) of the non-prescribing doctors from this study reported a lack of confidence in their knowledge to be able to prescribe exercise. Although this figure is in agreement with previous literature (Phillips and Roy, 2009), SA is in an unique situation of being the only country to have healthcare professionals (Biokineticists) specialised in exercise prescription and promotion of physical activity (PA) for healthy, chronically ill or special needs population groups. Although the relationship between the participants' reported lack in confidence and their opinion of their responsibility to prescribe exercise was not investigated, it was interesting to note that 18% of the non-prescribing doctors reported that it was not their job to prescribe exercise (Figure 4.3.4). However, it can still be argued that doctors are very often the first point of contact for patients who could benefit from an exercise prescription. Taken this, together with the numerous health benefits associated with PA which will be in the best interest of their patient into account, one can argue that it would be almost unethical not to prescribe exercise, be it by prescribing it themselves or referring their patients to a Biokineticist. Unfortunately this research project did not explore the opinions of the doctors on whose responsibility it is to prescribe exercise which should be investigated by future research.

Thirty eight percent of the non-prescribing doctors reported a perceived expectation from the patients to receive medication, not exercise. Although patients do have expectations regarding the prescription of medication (Cockburn and Pit, 1997), doctors are seemingly unaware of the fact that their patients consider them to be a respected source of information (Phillips and Roy, 2009; Worsley, 1989). Theoretically, the doctor's opinion of what is needed by the patient should override their perception of what the patients think they should receive. However, literature has shown that doctors' perceptions about their patients' expectations proved to be the greatest determinant for prescribing medication, and that when the GP were of the impression that the patient expected to receive medication, the patient was indeed 10 times more likely to receive a prescription for medication (Cockburn and Pit, 1997). This disparity between doctors' medical opinions and actions is eloquently demonstrated by Butler et al. (1998) who found that doctors tend to prescribe antibiotics to patients complaining of sore throats in an attempt not to jeopardise the doctor-patient relationship, despite the fact that the doctors knew that antibiotics will be ineffective in treating their patients' sore throats. Furthermore, patient expectations were seldom explicit (Butler, Rollnock, Pill et al., 1998), highlighting the fact that the patient expectations are often, in fact, nothing more than a perception on the doctor's behalf. Since these (sometimes unreal) patient expectations seemingly play such an influential role in the practices of doctors, the negative role of perceived patient expectations to receive pharmaceutical treatment rather than exercise, albeit the proven effectiveness of exercise in the treatment and prevention of various chronic diseases, should be researched further.

The fact that 24% of the non-prescribing doctors believed that exercise prescription would be a waste of time since the patients will not adhere to the exercise prescription elicit the fact that they were clearly uninformed and unaware of the fact that patients who received physician advice regarding exercise were more likely to engage in exercise (76.5%) compared to those who did not receive such advice (38.8%) (Greenlund, 2002). Furthermore, considering that 65% of patients would exercise to stay healthy, if advised by their doctor, and 25% would seek advice from their doctor first (ACSM, 2005), their perception of their patients' likelihood to adhere to their exercise prescription may be inaccurate. Since patients respect their advice and as a result are more likely to change their behaviours (Grandez et al., 2009), this reported barrier should not prohibit doctors from prescribing exercise.

A lack in resources was reported as a barrier to prescribing exercise by 18% of the non-prescribing doctors. Considering that materials such as the resources from the Exercise is Medicine® website or the Green Prescription from New Zeeland's Ministry of Health are freely available at no cost, this reported barrier should not carry any weight. Although Biokineticists can also be considered a resource, it is acknowledged that Biokineticists are mostly concentrated around cities and scarce in smaller towns as seen in the Northern Cape for example (BASA, 2014).

Through these findings the fourth research question (Section 1.3) was answered.

5.6 KNOWLEDGE ABOUT EXERCISE PRESCRIPTION

The questions to examine the knowledge of the doctors regarding exercise prescription were divided into five sections; (1) benefits of exercise, (2) identification of risk factors, (3) contraindications to exercise, (4) recommendations for physical activity and (5) formulation of an exercise prescription.

As previously mentioned, 90.9% (282) of the participants in this study claimed to prescribe exercise to their patients (Figure 4.3.1) and by implication, felt confident and knowledgeable enough to do so. Almost half (46.0%) of the non-prescribing doctors from this study reported a lack of confidence in their knowledge to be able to prescribe exercise. In other studies researchers found that between 48.2% and 92% of providers agreed that they felt confident or very confident in their abilities to provide PA counselling (Buffart et al., 2009; Douglas, Torrance, van Teijlingen et al., 2006; Lawlor et al., 1999; Steptoe et al., 1999).

5.6.1 Benefits of exercise

It is reassuring that 83% of the doctors that participated in this study knew that exercise is effective therapy for many chronic diseases in older adults (Table 4.5.1) as exercise has a beneficial effect, even when begun later in life, on postponement of disability in the elderly (Berk, Hubert and Fries et al., 2006). This stands in direct contrast in what was found in a study by Rogers (2002) where only 18% of doctors felt that exercise was important for a 75 year old.

Given that visits to GPs present a unique window of opportunity for preventive services, such PA counselling, exercise counselling are given in less than 30% of ambulatory care visits by American adults with hyperlipidemia, hypertension, obesity, or diabetes mellitus (Ma, Urizar Jr, Alehegn et al., 2004). In South Africa the opposite seems to be the case as 90% of the doctors in this study recognized that exercise is an important modality in the treatment of hypertension and will reduce resting blood pressure. This is supported by the findings of Watson et al. (2013) which reported that 72% of GPs will always give advice to patients with hypertension (Watson et al., 2013).

As previously mentioned, medical students and doctors from international universities lack education on the benefits of PA (McKenna et al., 1998). In this study it seemed to be the case among South African doctors as well as less than half of the doctors knew that exercise can decrease myocardial oxygen cost, decrease serum high-density lipoprotein and serum triglycerides, and reduce platelet adhesiveness and aggregation (Table 4.5.1). While an urgent rethink of our medical curricula is clearly indicated, sports physicians are ideally trained to fill this gap. Sport and exercise medicine physicians are not only skilled in maintaining and promoting health, restoring function, increasing physical capacity and vitality and preventing and treating disease, but also understand the importance of lifestyle changes (including PA and exercise) (Matheson et al., 2011). Exercise medicine is defined by the Faculty of Sport and Exercise Medicine (FSEM; UK) as the use of physical activity and exercise as a health tool for primary and secondary disease prevention (Jones, Brooks and Wylie, 2013). In their study O'Halloran, Brown, Morgan et al. (2009) found that 64% of doctors felt that their practice could make use of help from a sport and exercise medicine physician in the use of exercise to treat diseases in the clinical setting (O'Halloran, Brown, Morgan et al., 2009). As holistic, multidisciplinary doctors, sport and exercise medicine physicians could rapidly develop the field of preventative medicine (Matheson et al., 2011).

5.6.2 Identification of risk factors for cardiovascular disease

A resounding number of participants in this study (91.6% to 99.1%, Figure 4.5.1) correctly identified diabetes, hypertension, obesity, a family history of myocardial infarction and a sedentary lifestyle as risk factors for cardiovascular disease. This echoes that doctors know and are taught clinical guidelines for chronic diseases such as those for cardiovascular disease (Weiler et al., 2012a). Even though PA promotion is one of the first treatment and management recommendations in a large number of ever-increasing evidence based clinical guidelines for many chronic conditions (Weiler et al., 2012a; Weiler et al., 2012b) (e.g. cardiovascular disease (Pearson, 2002; Pearson, 2003b), medical students did not know the PA guidelines as well as other health promotion guidelines (Dunlop and Murray, 2013). Understanding how to effectively promote PA will reinforce the ability of future doctors to manage non-communicable chronic diseases and follow clinical guidelines (Weiler et al., 2012a). Still PA teaching in medical schools across the world is sparse or non-existent (Connaughton et al., 2001; Matheson et al., 2011; Persson et al., 2013; Rogers et al., 2002; Weiler et al., 2012a). The consequences of this omission could be dire as seen in Section 5.4.3

5.6.3 Contra-indications for cardiac patients to exercise

Bize et al. (2007) found that doctors were more likely to provide counselling if the patient had cardiovascular disease symptoms (Bize, Comuz and Martin, 2007). Although the specific patient population being counselled were not investigated in this study, a similar study among South African GPs found that 72% reported that they always give advice to their patients regarding PA with hypertension, 73% always give advice on PA to their Type 1 DM patients and 84% always give advice on PA to their type 2 DM patients (Watson et al., 2013). Although most of the respondents to our study correctly identified unstable angina (88%); active pericarditis or myocarditis (86%); uncompensated congestive heart failure (84%) and resting systolic blood pressure more than 200 mmHg (78%) as contra-indications for cardiac patients that would prevent a patient form exercising (Table 4.5.2), it is extremely worrying that they missed sinus tachycardia of 110 beats per minute (68%), uncontrolled diabetes mellitus (54%) and thrombophlebitis (53%), as this can be detrimental for the health of patients.

5.6.4 Knowledge of recommendations for physical activity

This study found that South African GPs did not know the PA recommendations as just 54.6% of the participants knew that an adult should engage in physical activity at least twice a week; only 43.2% knew that the weekly exercise should entail a combination of both moderate and vigorous exercise, while a mere 22.5% knew that ideally a person should engage in vigorous exercise three times a week for 20 minutes each (Table 4.5.3), which is similar to the findings of Douglas et al. (2006). Furthermore, 18% of GPs were of the impression that 20 minutes of PA three times a week were sufficient (Douglas et al., 2006) where in the current study, 59% of the GPs stated incorrectly 20 minutes PA three times a week were sufficient.

5.6.5 Formulation of an exercise prescription

The trend on the low levels of knowledge on PA continued when the participants were asked about the recommended minimum quantity of PA (Table 4.5.7). Forty three, and 56% percent doctors answered 150 minutes per week and 30 minutes per day correct respectively. But only seven percent knew that 1000kcal per week are also correct. A mere 8% of the doctors knew that 3000 – 4000 steps per day will also qualify as sufficient daily exercise. The relatively low levels of knowledge and accuracy in describing the current PA guidelines were surprising, since the recommendations for sedentary adults are currently present in several guidelines on the management of chronic diseases such as prevention of coronary heart disease, particularly given that most of the GPs in this study (91.6% to 99.1%, Figure 4.5.1) correctly identified diabetes, hypertension, obesity, a family history of myocardial infarction and a sedentary lifestyle as risk factors for cardiovascular disease.

Exercise prescription is not a case of one size fits all. The prescription must be individually tailored to the needs and goals of each patient. To effectively prescribe exercise to patients the exercise dose or FITT (frequency, intensity, type and time) needs to be quantified (Cléroux, Feldman and Petrella, 1999; Oberg, 2007; Singh, 2002). As mentioned previously these FITT principles are very common foundational knowledge in exercise prescription and should be familiar to anyone who has ever engaged in exercise prescription. However, only fifteen (4.66%) GPs in this study answered the question correctly (Table 4.5.4). Exercise intensity can be estimated using heart rate reserve (HRR), percentage estimated $VO_{2(max)}$, percentage of age-predicted maximum heart rate ($HR_{(max)}$), and rate of perceived exertion (RPE). Just 1% of the GPs that participated in this study knew this and answered this question correctly (Table 4.5.5). To further obtain information on whether knowledge on estimating the intensity of exercise was sufficient, the participants were asked about the means of estimating $HR_{(max)}$ (Table 4.5.6). Just over half of the doctors (52.3%), answered correctly that age predicted $HR_{(max)}$ can be determined by subtracting age from 220. Conversely almost a quarter (24.0%) of the doctors admitted they do not know the answer to this question and 48% of doctors do not know how to determine age predicted heart rate, which is important to estimate exercise intensity when prescribing exercise.

Taking the abovementioned into consideration the doctors in this study, although indicating that they give advice on physical activity and prescribe exercise to their patients, were clearly not knowledgeable on fundamental exercise prescription principles. Therefore it is imperative to train doctors in the prescription of exercise as there are sufficient data from both epidemiological studies and experimental trials available to warrant the training of all physicians in the basics of exercise prescription for health-related and quality-of-life benefits. Sport and exercise medicine physicians should play a cardinal role in this process, as they are skilled in preventing and treating disease by using PA and exercise in addition to prescribing exercise to their patients.

Through these findings the third research question (Section 1.3) was answered.

5.7 LIMITATIONS

The greatest limitation from this study is the low response rate which complicated statistical analyses reaching beyond descriptiveness. The structure of the questionnaire also had some weaknesses which contributed further to the limitation of the data analyses. Given the high exercise prescription rates from this study in comparison to literature, the effect of self-report bias cannot be excluded. While limited conclusions could be drawn from the results, useful findings laid a foundation for future research and hence the value of the research was not compromised.

Chapter 6

CONCLUSIONS AND RECOMMENDATIONS

Within the limitations of this research, it can be concluded that a greater proportion of South African doctors seemingly prescribe exercise to their patients compared to their international counterpart. These exercise prescriptions are mainly verbal advice with only a few doctors who provided their patients with a written instruction to take home with them, implying that the participants were unaware of the increased efficacy associated with written exercise prescriptions compared to verbal advice. It was also noted that very few doctors refer their patients for an exercise programme. Considering that South Africa is in a unique situation of having exercise prescription specialists (Biokineticists), this avenue for increasing the physical activity (PA) levels of the South African population should be propagated among the South African doctors. Furthermore, the advising or prescription frequency was fairly equally distributed between anything from 1% to 100% of patients receiving exercise instruction from the participants. This highlights that even though a large proportion of the doctors claimed to prescribe exercise, it may, in fact, be a very limited number of patients who actually receive exercise prescriptions. It is recommended that future research investigate the actual proportion of patients who receive exercise prescriptions from their doctor to gain a clearer picture of the exercise prescription trends within our country. It is also recommended that future interventions pertaining to exercise prescriptions among doctors incorporate education on the efficacy of a written exercise prescription.

In general the participants displayed positive attitudes towards exercise prescription, evidenced by the fact that approximately 90% of the participants acknowledged that they regard exercise as an important modality in the prevention of chronic disease. When asked more specifically to agree or disagree with statements regarding exercise, the vast majority concurred that PA yields benefits to patients of all ages, that information on health behaviours including exercise habits should form part of patient history taking and that primary care givers should be proactive in prescribing exercise to all their patients. Only a few participants regarded exercise prescription not to be within the scope of their practice. It is recommended that future research investigate the opinions of doctors pertaining to where the responsibility to prescribe exercise ultimately lies to explore possible additional barriers to exercise prescription not previously reported in literature.

The fact that the majority doctors incorrectly believed that regular exercise leads to increased minute ventilation, together with the minority who correctly identified decreased myocardial oxygen cost, decreased serum lipids and reduced platelet adhesiveness as benefits of regular exercise highlighted the fact that the doctors had a lacking knowledge of the physiological responses and benefits associated with regular exercise. Considering that insight into the reasons why exercise is therefore important to their patients may potentially stimulate a higher exercise prescription rate among doctors, it is recommended that more attention is given to exercise physiology and the role exercise can play in various disease managements. Although anecdotal experience negates this notion, it has to be acknowledged that the doctors possibly did receive this information during their undergraduate training but did not retain this information. To explore whether this gap in knowledge stems from undergraduate training, it is recommended that future research investigate the knowledge and experiences of final year medical students related to the role of exercise within medicine.

While the vast majority of participants were able to correctly identify most of the cardiovascular risk factors, many of the participants were less cognisant of the contraindications to exercise. Contraindications which were less familiar to the doctors included sinus tachycardia, resting diastolic blood pressure above 110 mmHg, uncontrolled diabetes and thrombophlebitis. Considering the high exercise prescriptions rates reported by the participants, it is concerning that the majority of the doctors could not identify halve of the contraindications to exercise, drawing the safety of their patients into question.

Various findings confirmed that the participating doctors had an inadequate foundational knowledge for the compilation of a safe and effective exercise prescription. The fact that the doctors could not distinguish the true from the concealed definitions for the FITT (frequency, intensity, type and time) principle which is fundamental to exercise prescription imply that the doctors are unlikely to prescribe adequate volumes of exercise which is in line with the ACSM recommendations for physical activity. Furthermore, the majority had no knowledge of alternative methods of estimating exercise intensity other than using the maximum heart rate, and even so, only half of the participants knew how to correctly calculate the estimated maximum heart rate. This indicates that the doctors prescribe exercise without any insight into the contents of their exercise prescription, which raises further questions whether their exercise prescriptions or advice actually include any guidelines reaching beyond a simple instruction or casual advice to their patients that they should exercise. As inadequate exercise volumes limit the health benefits associated with PA, it is recommended that further research investigate the contents of their exercise prescriptions to draw conclusions on the efficacy of the exercise prescriptions of South African doctors, especially considering the high prescription rates reported by the participants from this study.

The three main barriers for not prescribing exercise were lack of confidence in knowledge (which agrees with the findings on exercise knowledge), concerns that it is a waste of time since patients were unlikely to follow advice, and the expectations of the patients to receive medication instead of an exercise prescription. Considering that the latter two of these barriers are essentially unsubstantiated in light of literature, it is recommended that interventions among general practitioners to rectify these misperceptions regarding their patients be rectified.

In summary, the South African doctors from this study displayed high self-reported exercise prescription rates although the actual amount of patients receiving exercise prescriptions are questioned. The quality of the exercise prescriptions are also questioned since the participants displayed a lack in knowledge on the components and contraindications which should inherently be part of a safe and effective exercise prescription. It is suspected that many of the seeming shortcomings in the knowledge of the doctors could possibly stem from a lack in their undergraduate training. If future research confirms this to be the case, medical curricula should be revised considering the extensive preventative and curative health benefits associated with PA which will be in the best interest of both patients and the current economic burden facing our country.

Chapter 7

Lessons learned: Reflecting on the research process

"If we knew what it was we were doing, it would not be called research, would it?"
– Albert Einstein

7.1 INTRODUCTION

The word research comes from the late 16thcentury - from the obsolete French recerche (noun), recercher (verb), from Old French re- (expressing intensive force) + cerchier "to search". The Webster Dictionary define research as "the diligent inquiry or examination in seeking facts or principles; laborious or continued search after truth; investigation".

For me, however, having been through this process, research is not only the cold, scientific definition given by the Webster Dictionary. Instead, research is like a journey across uncharted waters and at times stormy seas. This journey, as any other, needs preparation and planning, an enquiring mind, an adventurous spirit, knowing what your final destination should be, and most of all perseverance. On occasion it can be exhilarating. Every so often it can be infuriating and frustrating, especially when you hit a dead end, or in this case a very low response rate! For me it also leads to a journey of introspection and redefining my motivation for becoming a doctor and pursuing further education into the field of Sport and Exercise Medicine. The research process taught me valuable lessons, not only about conducting research, but also about life and the lessons we can learn through listening to other people's stories.

This chapter is the last in my journal on this journey, concluding the research process, reflecting back on something that started out as a perilous mountain, ended as a personal achievement, and the many obstacles faced in-between. Below are the major lessons I learned.

7.2 IN THE BEGINNING, THERE WAS A RESEARCH TOPIC

When starting on the Master's degree in Sport and Exercise Medicine, my focus was primarily on sports injuries and all it entails. I came here to become a Sports Physician after all, and as a consequence I toiled with many research topics relating to the epidemiology of various sports injuries. Yet, somewhere into the program I realised that Sport and EXERCISE Medicine makes a difference in the health of not only athletes, but also in that of the rest of the population. This revelation awakened the realization that I am first and foremost a family doctor, treating families from birth until the end of their lives, and this program was offering me the opportunity to do so with more insight and skill, across a much wider spectrum of preventative as well as therapeutic care for every member of the family, not only those who engaged in competitive sports. So, after changing my research topic a few times, I finally settled on the chosen theme for this dissertation which reflects what I regard as being important. I can honestly say that, in the end, this research project turned out to be much more than a box that had to be ticked to obtain my degree; instead, it offered the opportunity for deep, self-directed learning which helped to shape my convictions, what I advocate to colleagues and patients and my approach to medical practice.

7.3 FORMULATION OF THE QUESTIONNAIRE

After weathering the storm of finding and defining a research question, the first tempest on my research journey was the design of the questionnaire. My original approach to formulating the questionnaire was to LAL (Look and Learn) from other researchers. Being a novice researcher I looked for published questionnaires with a primary focus on the contents of the questionnaires without much regard for the structure. It was only with the analysis of the data that the importance of the correct structure in combination with the contents highlighted the need for considering both aspects to ensure the quality of the question itself. Having multiple correct answers within a single multiple choice question inherently opened the option for also including multiple incorrect answers, making it extremely complicated to distinguish true knowledge from guesswork and making it virtually impossible to draw sound conclusions founded on statistical analyses. So, what knowledge did I gain from this? Multiple choice questionnaires are most commonly used to assess the basic category of Bloom's taxonomy – knowledge and as such recall of information, but may also be used to assess the use and application of knowledge (Harper, 2003). The National Board of Medical Examiners suggests that application of knowledge, integration, synthesis, and judgement questions can better be assessed by single-best-answer questions (Case and Swanson, 2002). Therefore, in retrospect, my questionnaire should have included only a single correct, best suited or most true answer to each question. However, at the time it seemed like a good idea to make use of "check all that apply" questions since this type of questions are extremely compatible with internet surveys and rather than restraining respondents to only one answer, multiple items can be selected, causing the design of check-all questions to be very effective (Smyth, Dillman, Christian et al., 2006). Nonetheless, it would have been better if the question stem consisted of a clinical vignette, as it provides a good basis for a question. Another potential mistake was to use “None of the above” as an option, as the phrase “None of the above” may cause problems in interpretation in items where judgement is involved.

Item reduction caused the next bunch of problems. It was necessary to limit the large number of potentially relevant questions to a manageable number without eliminating important questions, since extensive questionnaires are less likely to be completed (Burns, Duffett and Kho, 2008). The questionnaire was developed by following a review of the literature, with selected questions taken from previous studies (Connaughton et al., 2001; Lawlor et al., 1999). Similar to previous studies, our questionnaire had questions on knowledge about current recommendations of physical activity (PA) for sedentary adults, advice given during consultations with adult patients who are apparently healthy, attitudes associated with health promotion and PA advising and perceived barriers to giving routine PA advice to patients (Douglas et al., 2006; Lawlor et al., 1999). However, doctors do not only give advice on exercise to apparently healthy patients, but also to patients with known non-communicable diseases. This aspect could have been teased out more effectively within the questionnaire. However, given the fact that medical students under-rated the risk of physical inactivity, and was not as knowledgeable about the PA guidelines compared to other health promotion guidelines (Dunlop and Murray, 2013), how can it be expected that general practitioners should be knowledgeable about advising patients with chronic diseases on PA? I freely admit that at the time of starting this postgraduate degree, I was aware that most guidelines for treatment for non-communicable diseases start with “lifestyle modification and exercise prescription”, but not much more. Through this Masters programme and scavenging through the literature for this research project, I had a profound revelation about the fact that I and my fellow physicians are not trained to prevent disease (Matheson et al., 2011), and I was not even playing lip service to it. As with any additional knowledge that I received in medicine, I was again made aware that loose lips sink ships, and we as doctors should be cognisant of the fact that uninformed advice on exercise prescription, however good the intention, can have potentially devastating results on the health of our patients. Although the ACSM Guidelines for Exercise Testing and Prescription were used as foundation to ensure content validity of the questionnaire, in the light of the possible risks involved with exercise and exercise testing, knowledge on contra-indications and exercise guidelines for specific population groups with non-communicable diseases could have enjoyed more in-depth attention. More importantly, the recommendation that preventative care should receive considerably more focus in undergraduate medical training became a personal conviction for me – something that flows directly from the research process behind this dissertation.

7.4 DEALING WITH A LOW RESPONSE RATE

The medal for the perfect storm on my research journey has to go to the low response rate from my fellow colleagues. Despite my best efforts to strengthen the attempt, the magnitude of this unexpected outcome almost capsized my boat. As mentioned previously, the use of the Internet and the World Wide Web has rapidly risen since its inception. Electronic surveys are an important and popular approach to conducting health services research (Scott et al., 2011). Given the importance of physician surveys to determine knowledge and practice patterns and the fact that doctors should have nearly universal access to the internet, I was confident that I was started off on the right track. The claimed benefits of web-based surveys (Matteson, Anderson, Pinto et al., 2011) together with the cost-effectiveness thereof (Cook, Heath and Thompson, 2000) made a strong case for going down this route with my research, especially since we had easy access to an e-mail database of 4657 general practitioners through our independent practitioner association, HealthMan®. The well published advice on increasing and optimizing response rates have also been taken onboard; repeat reminder emails were sent so that the questionnaire reached all 4657 e-mails on three separate occasions, while incentives in the form of prizes for respondents were awarded through a lottery (Dillman, Reips and Matzat, 2010; Nulty, 2008; Scott et al., 2011). It was therefore completely unexpected that the response rate would be so very low. However, when scouring through the literature to explain, or rather, assist debriefing of this unfortunate outcome, some valuable lessons were learned which future researchers should take into account when choosing their method for collecting survey-based data.

One of the easiest mistakes to make is to assume that the widespread availability and potential ease of internet-based surveys will translate into higher response rates compared to paper-based surveys (Leece, Bhandari, Sprague et al., 2004), especially since doctors are notoriously bad responders to surveys (Cummings, Savitz and

Konrad, 2001; Flanigan, McFarlane and Cook, 2008). There are many reported reasons why doctors do not respond to surveys. These include being inundated by the volume of questionnaires arriving on their desks (including those from pharmaceuticals that tout Continued Professional Development points), the length of questionnaires or the time taken to partake in research (Hummers-Pradier et al., 2008; McAvoy and Kaner, 1996; Scott et al., 2011). Speculating on the reason behind the low response rate from this study, I know that as a medical practitioner in private practice, my days are filled to the brim with patients and time constraints are a stark reality. Perhaps they also felt the same cynicism our British colleagues feel about the miniscule impact of their views on service planning and provision (Whitfield, 1997). Perhaps the most worrisome speculative reason for the low response rate could be that the doctors were just simply uninterested in Exercise Medicine, a topic I feel so passionate about. My personal response to the low response rate bordered on disillusionment – imagine; only seven percent of doctors that were invited to participate in this research cared enough about Exercise Medicine to fill out the survey! After chewing on these emotions for a while, I realised that one's personal interests cannot be extrapolated to others, and more importantly, just how important it is to choose a research topic you are extremely interested in. As it was, there were times where I admittedly wanted to throw the dissertation out of the window. I can just imagine that obstacles like these can potentially cause a young researcher to abandon ship altogether if he or she is not completely sold out on the chosen research topic.

7.5 PEARLS OF ~~WISDOM~~ experience

I was somewhat naïve when I started out on this research journey. I was full of enthusiasm, thinking this was an opportunity for not only gathering research information, but also increasing awareness that "Exercise is Medicine". I thought that colleagues would share this passion, but was left disappointed. My voyage through uncharted seas of e-mail based research was rather stormy (for me) and should have been filled with markers that said "dragons be here!" To those hopefully continuing this research journey and spreading the message that "Exercise is Medicine", take note of the following:

One of the things that would have made the journey much easier, not only for me but also for the crew on my boat, would have been better communication. We were working through an Independent Physician Association (IPA) - HealthMan®, which in turn used E2 Solutions to write the code for the surveys. The statistical analyses were not only problematic because of the low response rate, but also because it was extremely difficult to extract the data from the third party in a suitable format for the Department of Biostatistics to work with. I would strongly suggest that before doing a web-based survey, the researcher sits down with the statisticians, find out exactly in which format the data should reach them and get a knowledgeable person to translate this to the Information Technology (IT) technicians writing the code for the survey. It would also have been helpful to get designated persons from each of these departments to communicate directly with each other. Going through a layman like me caused garbled messages that could be (and sometimes was) misunderstood by all. Good communication will provide feedback from the data collectors which may identify confusing and misleading questions, unforeseen ambiguities or conflicts and inefficiencies in data collection from the very beginning.

Secondly, being in a full time practice with a busy schedule, time management is of vital importance. Make optimal use of every minute, there are loads of reading to be done. Let articles on your research topic surround you so that you are able to read it when queuing at the bank or waiting to pick up a child from school. Being a general practitioner means irregular hours, after hours, emergencies and telephone calls just as you have a thought that is important for the research, or even worse, just when you scraped together time to sit down in front of your dissertation. Keep a notebook handy, even next to your bed, to jot down those inspiring thoughts which pop up in the early morning hours. Sometimes it will be necessary to take several days off from work to meet deadlines (this of course increased the opportunity costs of doing research, something which should be factored in when counting the cost prior to the engagement).

Thirdly, before starting on a journey like this there is a certain skill set that is invaluable. LEARN TO TYPE. It will save a lot of hassle and frustration, not mentioning time. On the topic of technology, make use of the infamous “cloud”, however daunting. Working on more than one computer is part and parcel of part time research as you travel between your work and home environment. Being able to access the most up to date version of your document without the need to carry (and potentially loose) a memory stick of some sort is a life saver. Oh yes, and reference correctly from the word go! It is unendingly frustrating when you remember you read it somewhere, but can’t pinpoint the relevant article.

7.6 PERSONAL REMARKS

For me this journey was not a solitary voyage. My ship was surrounded by a whole armada of others that needed my attention. My family still needed me to be there for them, so it is imprudent to think that the decision to undertake postgraduate studies will not affect your family. In the same breath, they are a lighthouse on the mainland and a steadfast beacon amidst the storms, a valuable source for keeping sane.

Without my crew my research ship would have floundered at the onset of my journey. A first-rate first officer that doubles up as bosun (research supervisor) is invaluable on a perilous journey; someone that could crack a whip at times, but even more importantly hold the whole ship together. I was privileged to have that first-rate officer on board.

As for the rest of the crew, thank you for responding to the survey. For those general practitioners that did not respond to the questionnaire, I can understand and do not hold a grudge against you for doing so. I still find myself deleting questionnaires if it looks too lengthy, or if I have to struggle to figure out what the next step should be. However, following this endeavour, I think twice about the potential importance of participating in research to further medical knowledge.

At the end of my journey into the research on Exercise prescription: knowledge, practice and attitudes among South African doctors, I still find myself bursting with enthusiasm on the wonderful treatment that is exercise. Consequently my family and I have a more active lifestyle. This journey also changed my way of practicing medicine. I am, after all, a family doctor that accompanies my patients on a journey of health.

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APPENDIX A

Ethical Approval by the Ethics Committee, Faculty of Health Sciences, University of the Free State

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2010-12-01

DR MG ROOS
PO BOX 10576
KLERKSDORP
2570

REC Reference number: REC-230408-011

Dear Dr Roos

ETOVS NR 190/2010
PROJECT TITLE: EXERCISE PRESCRIPTION: KNOWLEDGE, PRACTICE AND ATTITUDES AMONG SOUTH AFRICAN DOCTORS.

- You are hereby kindly informed that the Ethics Committee approved the above study at the meeting held on 30 November 2010 on condition that the Information Leaflet and Informed Consent have to be available in the language the trial person prefers.
- Committee guidance documents: Declaration of Helsinki, ICH, GCP and MRC Guidelines on Bio Medical Research. Clinical Trial Guidelines 2000 Department of Health RSA; Ethics in Health Research: Principles Structure and Processes Department of Health RSA 2004; Guidelines for Good Practice in the Conduct of Clinical Trials with Human Participants in South Africa, Second Edition (2006); the Constitution of the Ethics Committee of the Faculty of Health Sciences and the Guidelines of the SA Medicines Control Council as well as Laws and Regulations with regard to the Control of Medicines.
- Any amendment, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.
- The Committee must be informed of any serious adverse event and/or termination of the study.
- A progress report should be submitted within one year of approval of long term studies and a final report at completion of both short term and long term studies.
- Kindly refer to the ETOVS reference number in correspondence to the Ethics Committee secretariat.

Yours faithfully

CHAIR: ETHICS COMMITTEE

Cc: Dr LJ Holtzhausen

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APPENDIX B

E-mail Information Sheet (Example)

"EXERCISE PRESCRIPTION: KNOWLEDGE, PRACTICE AND ATTITUDES AMONG SOUTH AFRICAN DOCTORS"

Dear doctor,

We would like to invite you to participate in a survey regarding exercise prescription among South African doctors. This study has been developed in conjunction with the Department of Sports Medicine at the University of the Free State where the primary investigator is enrolled in a part-time Masters Degree programme

Participation is completely voluntary. By completing the questionnaire, you will give consent to be included in the study. The questionnaire will be completed **anonymously**. Your name will not be connected to any of the data, and nothing that could reveal your participation in the study will be disclosed. After the data have been analyzed, it may be published totally anonymously in scientific journals and made available to regulating authorities to inform them of potential issues that needs addressing. After the total completion of the project, the data will be stored on University data storage devices for training purposes.

Please click here to be directed to the online survey. The survey is fairly short and should not take more than 10 minutes to complete.

Thank you for your contribution. We look forward to your response. Participation reward to the total pool value of R3'000 for the entire study will be applicable for this survey.

Kind regards.

Contact details of Primary Investigator:

Dr. Marius Roos

Tel no.: 083 3687 666 E-mail: roos@lantic.net

APPENDIX C

Questionnaire

Questionnaire: Exercise is Medicine

1. MP No. (This is only needed to check whether you are a registered doctor and to be included in the prize draw.)

2. In which year did you complete your undergraduate training as doctor?

- Before 1980
- 1981 – 1985
- 1986 – 1990
- 1991 – 1995
- 1996 - 2000
- 2001 – 2005
- After 2006

3. How are you currently employed?

- Full time private practice
- Part time private practice
- Full time public sector
- Part time public sector
- Tertiary education sector
- Not in Healthcare

4. In which province do you currently practise medicine?

a) Gauteng
b) Limpopo
c) Mpumalanga
d) North West
e) Free State
f) Northern Cape
g) Western Cape
h) Eastern Cape
i) KwaZulu Natal

5. Did you obtain postgraduate qualification in sports medicine?

- Yes
- No

6. Do you ever prescribe exercise to your patients as a therapeutic modality? *Note that "prescription" does not involve casual advice such as "you should stop smoking and do more exercise"*.

- Yes
- No

7. If you do prescribe exercise, is it:

a) Verbal
b) Written
c) Refer to trainer
d) Via the Internet
e) Not applicable; I already answered "no" to question 6

8. If you do not prescribe exercise, why not?

a) I don't believe that exercise is as effective as medicine
b) It is not really my job, there are physiotherapists and biokineticists for that
c) I don't feel confident in my knowledge to be able to prescribe it
d) It's a waste of time, the patients won't adhere anyway …
e) It takes up too much of my consultation time
f) I do not have the necessary resources
g) I am afraid of medical-law issues because of the high risk of sudden death or other complications
h) Patients expect medication to cure them, not exercise
i) Not applicable; I do prescribe exercise

9) If there are any other reasons why you don't prescribe exercise, please elaborate in no more than 25 words.____

____

____

10. How important do you feel exercise prescription is in the prevention and management of chronic diseases of lifestyle, e.g. Diabetes?

a) Very important
b) Somewhat important
c) Not important at all
d) I don't know how exercise can prevent chronic diseases

11. What percentage of patients do you advise to engage in regular physical activity as part of treatment for their disease conditions?

a) 80 – 100%
b) 60 – 79%
c) 40 – 59%
d) 20 – 39%
e) 1 - 19%
f) 0%

12. Regarding exercise prescription:

a) Exercise is beneficial in preventing chronic diseases.
b) Physical activity yields benefits for individuals of any age.
c) Exercise promotion is not within the scope of a GP practice.
d) Primary care practitioners should be proactive in prescribing exercise for all patients.
e) Ascertaining information on preventive health behaviours, including exercise, is an important part of patient history-taking.

13. Recommendations for physical activity in a non-pregnant healthy adult are:

a) Moderate aerobic exercise for 20 min. 5 days per week.
b) Vigorous exercise, 20 min, 3 days per week
c) Combination of moderate and vigorous intensity exercise
d) Every adult should perform activities to maintain or increase muscular strength and endurance a minimum of 2 days per week

14. Benefits of regular exercise are the following:

a) Increased minute ventilation

b) Decreased myocardial oxygen cost

c) Decreased heart rate

d) Increased threshold for the onset of disease signs or symptoms

e) Decreased resting blood pressure

f) Decreased serum high-density lipoprotein as well as serum triglycerides

g) Increased insulin needs

h) Reduced platelet adhesiveness and aggregation

i) Effective therapy for many chronic diseases in older adults

j) Weight reduction due to decrease in muscle mass

15. Which of the following are risk factors for cardiovascular disease?

a) Men > 45 years of age

b) Positive family history of myocardial infarction

c) Sedentary lifestyle

d) Obesity

e) Hypertension

f) Dyslipidemia

g) Diabetes

h) Women > 45 years of age

16. Which of the following are contra-indications for patients with known cardio vascular disease to exercise?

a) Unstable angina

b) Resting systolic Bp > 200 mm Hg

c) Resting diastolic Bp > 110 mm Hg

d) Acute systemic illness or fever

e) Thrombophlebitis

f) Uncontrolled diabetes mellitus

g) Sinus tachycardia 110 beats per minute

h) Uncompensated congestive heart failure

i) Obese patients

j) Active pericarditis or myocarditis

17. What are the components of exercise that needs to be addressed?
   a) Intensity
   b) Targeted training
   c) Mode of exercise
   d) Frequency
   e) Total health
   f) Time
   g) Injury prevention
   h) Fat loss

18. Exercise intensity may be estimated using the following:
   a) Heart rate reserve
   b) Respiratory rate (per minute)
   c) Percentage of Age-predicted maximum heart rate ($HR_{(max)}$).
   d) Percentage estimated $VO_{2(max)}$.
   e) Rate of perceived exertion

19. Age predicted heart rate maximum ($HR_{(max)}$) can easily be determined as follows:
   a) 220 minus age
   b) 200 minus age
   c) I don't know how to determine a person's age predicted maximum heart rate.

20. The recommended minimum quantity of physical activity according to the American College of Sports Medicine (ACSM) and the American Heart Association (AHA) are:
   a) 1000 kcal. per week
   b) 150 min. per week
   c) 30 min. per day
   d) 1000 - 2000 steps per day
   e) 3000 - 4000 steps per day

APPENDIX D

Proportionate population of South Africa in 2007

Rank	**Province**	**Population (2007)**[1]	**Percentage**	**Participants proportion (%)**
1	Gauteng	10,667,578	22.0	32.04
2	KwaZulu-Natal	10,259,230	21.2	17.15
3	Eastern Cape	6,527,747	13.5	9.06
4	Western Cape	5,278,585	10.9	20.61
5	Limpopo	5,238,286	10.8	2.29
6	Mpumalanga	3,643,435	7.5	2.91
7	North West	3,056,083	6.3	6.47
8	Free State	2,773,059	5.7	7.77
9	Northern Cape	1,058,060	2.2	1.62
South Africa		**48,502,063**	**100.0**	

According to the *Community Survey 2007*

Appendix E

Approval Letter from HealthMan

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16 November 2010

Dr Marius Roos
PO Box 10576
KLERKSDORP
2570

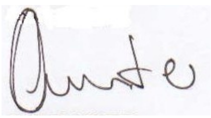
Dear Dr Roos

SURVEY ON: EXERCISE PRESCRIPTION: KNOWLEDGE, PRACTICE AND ATTITUDES AMONG SOUTH AFRICAN DOCTORS

With reference to our correspondence regarding the proposed research on the above topic, we hereby wish to confirm that we will use the database of GP's as compiled by HealthMan, to conduct this electronic survey via E2 Solutions on your behalf.

Please do not hesitate to contact me should you have any queries.

Kind regards



CASPER VENTER
DIRECTOR