

# **Physical activity related to health components and medical costs in employees of a financial institution**

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the North-West University**

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***‘For I know the plans I have for you’ says the Lord. ‘They are plans for good and not for disaster, to give you a future and a hope’***

***Jeremiah 29:11***

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# Summary

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Physical activity has several advantages for health. The first objective of this research was to determine the relationship between physical activity and selected physical and psychological health components. The physical components include: diabetes risk, obesity, cholesterol and cardiovascular disease. The psychological health components include stress and depression. Secondly, this research aimed to determine the relationship between physical activity and medical costs. Medical costs were divided into pharmaceutical, general practitioners and hospital claims. A total of 9 860 employees of the same financial institution in South Africa, between the ages 18 and 64 ( $\bar{x} = 35.3 \pm 18.6$  years), participated in the study and participation was voluntary. No differentiation was made between race groups. The assessment of selected health risk factors and physical activity was done by using the Health Risk Assessment (HRA) methodology developed by the company, Monitored Health Risk (MHM). Assessment included a physical activity, diabetes risk and cardiovascular risk questionnaire, BMI and random blood glucose measurements, as well as stress and depression scores. The amount of days absent from work in the past six months was also determined by the questionnaire. Participants was categorised in three groups – low, moderate and high physical activity participation. Medical expenditure data was obtained from Monitored Health Risk Management Pty (Ltd). Hospital, pharmaceutical and general practitioners (GP) claims included all costs occurring during a six month period.

The majority of the study group showed low physical activity participation (78.27%). The results also showed that both men and women showed an increased risk for diabetes, and high physical activity levels have a practically and statistically significant effect on the reduction of diabetes risk. In this study all the physical activity groups of both males and females showed an increased average body mass index (BMI) and therefore are considered to be an increased risk according to the classification as stipulated by the study perimeters. The average means for cholesterol in all groups are categorised as low risk. No significant differences are seen between the female groups as well as between the different male groups. The men in the study group showed higher cardiovascular risk than women. There are no statistically significant differences between the women's groups. However, regarding the male groups, the low physically active male group showed significant differences to the high physical active male group. Thus, in this study it appears that the men participating in high levels of physical activity

show the lowest risk for cardiovascular disease and therefore appear to be influenced by physical activity.

The majority of the study group is shown to be in the high stress category (55.48%). It seems that work issues (82%), financial problems (74%) and family problems (69%) contribute most to the population's high stress levels and depression experience. The Physical activity index (PAI) in relation to stress only shows practical significance in moderate and high physical women. The PAI and stress-related index reports statistically ( $p \leq 0.05$ ; 0.001) significant and practice significant difference within the population. There was also a statistically significant ( $p \leq 0.05$ ) relation between stress and physical activity in relation to days absent. Although high levels of stress and low levels of physical activity are present in the population, the relation become statistically significant in relation with depression.

The study group was divided into two groups when the medical cost was examined. One group consisted of those individuals who do not use chronic medication and the other group, those individuals that use chronic medication. The majority of the study group (chronic and non-chronic medication use), show low physical activity participation (average of 78.80%). The results show statistically and practically significant differences between the groups that do not use chronic medication and the groups that use chronic medication. The women that use chronic medication show an increase in pharmaceutical costs with an increase in physical activity. However, when investigating the GP cost of women who use chronic medication, there is only a small difference in GP cost in the different physical activity participation categories. The data shows that men have higher pharmaceutical costs than women in all the physical activity categories. The results also indicate that men who use chronic medication, participating in low levels of physical activity do show higher pharmacy and GP costs. Medical cost associated with hospitalisation of those men whose chronic medications show an average higher medical cost (R231.72 versus R672.71). The women who are on chronic medication show about two and a half times higher hospitalisation cost (R253.97 versus R650.82) and the men an almost four times higher cost (R189.34 versus R721.71). No practically significant difference was found between the groups. The women show an increased incidence of low physical activity participation (82.38%), whereas 68.80% of the men show low physical activity participation. Women who use chronic medication and participate in moderate physical activity show lower hospital costs. The women in this study group that use chronic medication and participate in high levels of physical activity show the highest hospital cost. The men's profile indicates that medical cost due to hospital claims rise with the higher levels of physical activity.

**Keywords: Physical activity, health, medical cost, cardiovascular disease, cholesterol, body mass index, diabetes, stress, depression**

# Opsomming

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Fisieke aktiwiteit hou baie voordele vir gesondheid in. Die eerste doelwit van hierdie navorsing was om die verwantskap tussen fisiese aktiwiteit en fisieke- asook psigologiese gesondheidskomponente te bepaal. Die fisieke komponente sluit die volgende in: diabetesrisiko, obesiteit, cholesterol en kardiovaskulêre siektes. Die psigologiese gesondheidskomponente sluit stres en depressie in. Tweedens is hierdie navorsing gerig op die vasstelling van die verwantskap tussen fisiese aktiwiteit en mediese koste. Mediese koste is verdeel in apteker-, algemene praktisyns- en hospitaaleise. Altesaam 9 860 werknemers tussen die ouderdomme van 18 en 64 ( $\bar{x} = 35.3 \pm 18.6$  jaar) van dieselfde finansiële instelling in Suid-Afrika het aan die navorsing deelgeneem, en deelname was vrywillig. Daar is nie tussen rasse-groepe gedifferensieer nie. Die assessering van geselekteerde gesondheidsrisikofaktore en fisiese aktiwiteit is gedoen deur die Health Risk Assessment (HRA)-metode wat deur die maatskappy Monitored Health Risk (MHM) ontwikkel is, te gebruik. Assessering het 'n fisiese aktiwiteit, 'n diabetes- en kardiovaskulêre- risikovraelys, liggaamsmassa indeks (LMI), en lukraak bloedglukosemetings, en stres- en depressietellings ingesluit. Die hoeveelheid dae afwesig van werk die afgelope ses maande is ook deur die vraelys vasgestel. Deelnemers is in drie groepe ingedeel – lae, matige en hoë deelname aan fisiese aktiwiteite. Data van mediese uitgawes is van Monitored Health Risk Management Pty. (Ltd.) verkry. Hospitaal, aptekers- en algemene praktisyns-eise het alle koste ingesluit wat oor 'n tydperk van ses maande voorgekom het.

Die meerderheid van die studiegroep het 'n lae deelname aan fisiese aktiwiteit getoon (78.27%). Die resultate het ook getoon dat mans en vroue 'n verhoogde risiko vir diabetes getoon het, en hoë vlakke van fisieke aktiwiteite het 'n praktiese en statisties beduidende uitwerking op die vermindering van 'n diabetesrisiko. In hierdie navorsing het al die fisieke aktiwiteitsgroepe van mans en vroue 'n verhoogde gemiddelde LMI getoon, en is daarom as 'n verhoogde risiko beskou volgens die klassifikasie soos deur die navorsingsperimeters gestipuleer is. Die rekenkundige gemiddelde vir cholesterol in al die groepe word as lae risiko ingedeel. Die mans in die studiegroep het 'n hoër kardiovaskulêre risiko as vroue getoon. Daar is geen beduidende statistiese verskille tussen die vroulike groepe nie. Wat betref die manlike groepe, het die lae fisies aktiewe groep egter beduidende verskille teenoor die hoë fisieke aktiewe groep getoon. In hierdie navorsing wil dit dus voorkom of die mans wat aan 'n hoë vlak van fisiese aktiwiteit deelneem, die laagste risiko vir kardiovaskulêre siektes toon.

Die meerderheid van die navorsingsgroep het getoon in die hoë stres kategorie te wees (55,48%). Dit wil voorkom of werkkwessies (82%), finansiële (74%) en gesinsprobleme (69%) die meeste tot die populasie se hoë stresvlakke en ervaring van depressie bydra. Die fisieke-aktiwiteitsindeks (FAI) in verband met stres toon slegs praktiese beduidendheid in vroue met 'n matige en hoë deelname aan fisieke aktiwiteit. Die FAI- en stresverwante indeks lewer verslag van 'n statisties en prakties beduidende verskil ( $p \leq 0.05$ ; 0,001) in die populasie. Daar was ook 'n statisties beduidende ( $p \leq 0.05$ ) verwantskap tussen stres en fisiese aktiwiteit in vergelyking met aantal dae afwesig. Hoewel hoë stresvlakke en lae vlakke van fisiese aktiwiteit in die populasie teenwoordig is, het die verwantskap statisties beduidend geword in verhouding tot depressie.

Die navorsingsgroep is in twee groepe verdeel vir die bestudering van mediese koste. Die een groep het bestaan uit individue wat nie kroniese medikasie gebruik nie, en die ander groep uit die individue wat wel kroniese medikasie gebruik. Die resultate toon statisties en prakties beduidende verskille tussen die groepe wat nie kroniese medikasie gebruik nie en die groep wat wel kroniese medikasie gebruik. Die vroue wat kroniese medikasie gebruik, het 'n toename in aptekerskoste getoon met 'n toename in fisieke aktiwiteit. By bestudering van die algemene-praktisynskoste van vroue wat kroniese medikasie gebruik, is daar egter net 'n klein verskil in algemene-praktisynskoste in die verskillende kategorieë groepe wat aan verskillende vlakke van fisieke aktiwiteite deelneem. Die data toon dat mans hoër aptekerskoste as vroue het in al die fisiese-deelnamekategorieë. Die resultate dui ook aan dat mans wat kroniese medikasie gebruik en aan lae vlakke van fisiese aktiwiteit deelneem, wel hoër aptekers-en algemene-praktisynskoste het. Mediese koste ten opsigte van hospitalisering van die mans op kroniese medikasie toon 'n gemiddelde hoër mediese koste in vergelyking met diegene wat nie kroniese medikasie gebruik nie (R231.72 teenoor R672.71). Die vroue wat op kroniese medikasie is, toon ongeveer twee en 'n half maal hoër hospitaliseringskoste (R253.97 teenoor R650.82) en die mans 'n koste wat bykans vier keer hoër is (R189.34 teenoor R721.71) in vergelyking met diegene wat nie kroniese medikasie gebruik nie. Geen prakties beduidende verskil is tussen die groepe gevind nie. Die vroue het 'n verhoogde voorkoms van lae deelname aan fisiese aktiwiteit getoon (82.38%), terwyl 68,80% van die mans lae deelname aan fisieke aktiwiteit toon. Vroue wat kroniese medikasie gebruik en matig aan fisiese aktiwiteit deelneem, toon laer hospitaalkoste. Die vroue in hierdie navorsingsgroep wat kroniese medikasie gebruik en aan hoë vlakke van fisiese aktiwiteit deelneem, toon die hoogste hospitaalkoste. Die profiel van die mans dui aan dat mediese koste as gevolg van hospitaalkoste met hoër vlakke van fisieke aktiwiteit styg.

**Sleutelwoorde:** Fisiese aktiwiteit, gesondheid, mediese koste, kardiovaskulêre siekte, cholesterol, liggaamsmassa-indeks, diabetes, stres, depressie

# Declaration

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The co-authors of the articles in this thesis, Prof C.J. Wilders (Promotor) and Prof S.J Moss (Assistant-Promoter), hereby give permission to the candidate, Miss Madelein Smit, to include the articles as part of a Ph.D thesis. The contribution (advisory and supportive) of these co-authors was kept within reasonable limits, thereby enabling the candidate to submit this thesis for examination purposes. This thesis therefore serves as fulfilment of the requirements for the Ph.D degree in Biokinetics within the School of Biokinetics, Recreation and Sport Science in the Faculty of Health Science at the North-West University, Potchefstroom campus.

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**Prof C.J Wilders**

*Promotor*

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**Prof S.J Moss**

*Assistant-Promotor*

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# List of Abbreviations

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<b>ACSM</b>	<b>American College of Sports Medicine</b>
<b>BMI</b>	<b>Body mass index</b>
<b>CAD</b>	<b>Coronary artery disease</b>
<b>CVD</b>	<b>Cardiovascular disease</b>
<b>ES</b>	<b>Effect size</b>
<b>PAI</b>	<b>Physical activity index</b>
<b>GP</b>	<b>General practitioner</b>
<b>HDL-C</b>	<b>High-density lipoprotein cholesterol</b>
<b>HRA</b>	<b>Health risk assessment</b>
<b>kcal</b>	<b>Kilocalories</b>
<b>kJ</b>	<b>Kilojoules</b>
<b>LDL-C</b>	<b>Low-density lipoprotein cholesterol</b>
<b>MDD</b>	<b>Major depressive disorder</b>
<b>MEPS</b>	<b>Medical expenditure panel survey</b>
<b>MET</b>	<b>Metabolic equivalent</b>
<b>MHM</b>	<b>Monitored health risk</b>
<b>N</b>	<b>Number of respondents</b>
<b>NWU</b>	<b>North-West University</b>
<b>SADHS</b>	<b>South African demographic health survey</b>
<b>SD</b>	<b>Standard deviation</b>
<b>TG</b>	<b>Triglycerides</b>
<b>WHO</b>	<b>World Health Organisation</b>
<b>x</b>	<b>Statistical average</b>

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# Chapter 1

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## Introduction

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1. Introduction
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### 1. Introduction

Over the past two decades, physical activity has become widely recognised as one of the most important health behaviours associated with reduced all-cause mortality and morbidity, as well as chronic disease related to lifestyle (Lambert & Kolbe-Alexander, 2006:23); to such an extent that exercise is even referred to as medicine (Pate, 2007:23). This is not a new concept, due to the fact that, since ancient times, physical activity and physical fitness have been linked with health and longevity (Hardman & Stensel, 2009:3). Many ancient cultures, scientists, and physicians recognised the role of physical activity in promoting the health of mind and body (Pate, 2007:22). These findings were documented more than 5 000 years ago (Pate, 2007:23). Ancient Greek physicians, including Herodicus and Hippocrates, prescribed exercise to prevent and treat a variety of ailments as early as the 5<sup>th</sup> century B.C. (Hardman & Stensel, 2009:3). Hippocrates wrote extensively about the benefits of exercise for a variety of illnesses/ailments, including mental illnesses. He stated that “Eating alone will not keep a man well; he must also exercise” (cited by Berryman, 1992:13).

## 2. Problem statement

In the modern world, the prevalence of a physically active lifestyle has decreased, even with all the advantages and health benefits that physical activity demonstrates with regard to health (Sharkey & Gaskill, 2007:25-28; Hardman & Stensel, 2009:14). In many developed and developing countries, less than one third of the people are active to the extent that is beneficiary for their health (Hardman & Stensel, 2009:14). A decline in physical activity appears to follow in the wake of economic and technological growth, so that the prevalence of inactivity worldwide may be expected to rise as the economies of developing countries progress (Hardman & Stensel, 2009:14). Even the nature of occupational work has altered throughout the 20<sup>th</sup> century; the pace of these changes accelerated during and after the World War II situation of economic expansion within industrialised nations. Fewer people performed hard physical labour at work, and more workers spent the majority of their day sitting or standing and doing light work (Blair & LaMonte, 2007:145). In South Africa 76% of adult men and 86% of adult women do not participate in regular physical activity (SADHS, 2007:293). This trend of inactivity could have serious health consequences (Sharkey & laskill, 2007:25-28).

Research has shown that physical inactivity can lead to certain chronic diseases, such as cardiovascular disease, hypertension, diabetes, obesity and high cholesterol (Jackson *et al.*, 2004:180; Nieman, 2007:380; Matfin, 2009:484; ACSM, 2010:7-8). These diseases are collectively known as non-communicable diseases. Non-communicable diseases are a major contributor to the burden of chronic disease in developed countries and are increasing rapidly in developing countries (Puoane *et al.*, 2008:74). This is mainly due to urbanisation, industrialisation and a Western lifestyle (Steyn, 2006:1; Puoane *et al.*, 2008:74). Steyn (2006:1) identified lack of regular physical activity, or more accurately, physical inactivity, as one of the most relevant elements of an unhealthy lifestyle that predisposes people to the development of any chronic non-communicable disease.

In South Africa, non-communicable diseases account for more than one- third of all deaths (Kolbe-Alexander *et al.*, 2008:228). However, this burden can be reduced by addressing risk factors such as physical inactivity (Kolbe-Alexander *et al.*, 2008:236). It is essential to recognise the importance of physical activity and its relation to certain health factors in a population, due to the fact that physical activity reduces the risk to develop certain chronic diseases (Jackson *et al.*, 2004:180; Nieman, 2007:380; Matfin, 2009:484; ACSM, 2010:7-8).

As with physical health, physical activity can have beneficial effects on mental health as well. Mental disorders are major health problems: depression and anxiety are among the most common, with their cost to the individual and society being enormous (Martinsen, 2008:28). In the USA, medical expenditure for mental disorders was estimated to be \$35.2 billion (in 2006 dollars) in 1996, and this estimated increased to \$57.5 billion in 2006 (Soni, 2009:1). In 2007,

medical expenditure to treat anxiety and mood disorder totalled \$ 36.8 billion. This amounted to an average of \$1374 per adult (Soni, 2009:1). Greenberg *et al.* (2003:1471) estimated that the economic burden of depression (direct and indirect cost) in the US was \$ 42.7 billion in 1990. This amount rose by 7% from 1990 to 2000, going from \$ 77.4 billion in 1990 (inflation-adjusted dollars) to \$ 83.1 billion in 2000.

Over the last few decades, research has documented that physical activity is as beneficial for the mind as it is for the body (Raglin *et al.*, 2007:256). Exercise can provide important benefits to patients suffering from mild and moderate depression or anxiety (Raglin *et al.*, 2007:252). Research shows that regular participation in physical activity is associated with reductions in depressive symptoms (Craft *et al.*, 2007:1508; Brenes *et al.*, 2007:65-66; Wise *et al.*, 2006:74). The benefits of exercise appear to equal those associated with medication in individuals with depression (Raglin *et al.*, 2007:252). Psychological stress has also been recognised as a health problem. Statistics show that up to 90% of visits to physicians are for ailments related to stress (Leeming, 2009). According to Sharkey and Gaskill (2007:39), regular moderate physical activity also minimises the effect of stress and is a coping mechanism that serves to improve tolerance to psychological stress. Regular moderate physical activity is the best form of stress management, because it provides benefits such as relaxation, while delivering added health benefits, including the reduction and or prevention of several risk factors for chronic diseases, and may also increase vitality (Sharkey & Gaskill, 2007:39-40).

Apart from the negative impact of physical inactivity on physical and psychological health components, it can influence medical expenditures and daily work performance (Patel, 2010:43). These interrelationships of an unhealthy lifestyle, risk factors and the result of chronic non-communicable disease emphasise the need to plan integrated comprehensive programmes to manage chronic diseases in South Africa (Patel, 2010:43). In order to do so, the workplace has been identified as a good setting in which to reach a large section of the adult population. The work environment is an excellent place to encourage better health and wellness habits for employees, particularly as they spend the majority of their waking hours in the workplace (Patel, 2010:43).

Employee assistance programmes can also be beneficial for the employers and corporations, due to the fact that physical activity is linked to a reduction in absenteeism (Proper *et al.*, 2006:173). High absenteeism rates caused by chronic diseases can reduce company resources (Ladd, 2009:25). Individual health and well-being may significantly affect the health costs of employers (Patel, 2010:43). Unplanned sick leave taken by employees can cost South Africa up to R19 billion per year (Schoonbee, 2008). This is not even counting the indirect costs such as lost production, overtime, reduction in the quality of service, and hiring and training of replacements (Johnson, 2008). Research illustrates that employees are more likely to show up for work and perform at high levels when they are in optimal physical and psychological health

(Viljoen, 2008). As with absenteeism, presenteeism is a concern as well and can result in reduced productivity. Presenteeism occurs when workers are physically present at work, but they do not function optimally and their productivity is reduced due to illness or other medical conditions including stress (Leutzinger, 2009:118). This may also have financial implications for an organisation or company due to a reduction of productivity (Hemp, 2004).

This study will firstly focus on the relationship between physical activity and selected physical health components which include: diabetic risk, obesity risk (Body mass index), cholesterol and cardiovascular risk. This is due to the fact that these conditions have been identified to be influenced by physical activity, and consequently also have an effect on medical cost (Smit, 2008). Secondly, the relationship between physical activity and psychological health components, stress and depression, and the role stress play in absenteeism, will also be investigated. The influence that physical activity has on stress, depression and absenteeism will also be determined. Furthermore, the relationship between physical activity and medical cost (pharmacy, general practitioners and hospital) will be investigated.

Research and information with regards the physical activity and its effect on medical cost in South Africa are limited and rare. Consequently the following questions that are to be answered with this thesis are:

- What is the relationship of physical activity with selected health components which include diabetes risk, obesity risk, cholesterol and cardiovascular disease?
- What is the relationship between physical activity, stress and depression? Do any of these variables have a influence on absenteeism?
- What is the relationship between physical activity and medical costs associated with pharmaceutical and general practitioners' claims?
- Does physical activity have an effect on the medical cost associated with hospital claims?

This information will be valuable to determine the health status of the employees of a financial institution, where the work related stress is high. This kind of information should help to lay a cornerstone for future research with the aim of designing intervention programmes suitable for the South African market that can help with the reduction of medical costs.

### **3. Objectives**

The objectives of the study are to determine:

- the relation between physical activity and selected physical health components of employees at a financial institution,
- the relationship between physical activity and selected psychological health components of employees at a financial institution,
- the relationship between physical activity and medical costs associated with pharmaceutical and general medical practitioner's claims of employees at a financial institution.
- the relationship between physical activity and medical costs as represented by hospital claims of employees at a financial institution.

### **4. Hypothesis**

The study will be based on the following hypotheses:

- There is a significant negative relation between physical activity and health components of employees in a financial institution.
- A highly significant negative relation between physical activity and selected psychological health components will exist in employees at a financial institution.
- Physical activity will show a significant negative relation to medical cost related to pharmaceutical and general medical practitioner's claim of employees at a financial institution.
- Physical activity will be significantly negative related to medical cost as represented by hospital claims of employees at a financial institution.

### **5. Thesis structure**

The structure of the thesis will be presented in article format as approved by the North-West University (Potchefstroom Campus) and will be as follows:

#### **Chapter 1: Problem statement and introduction**

This chapter describes the problem, purpose and hypotheses of the study. A complete bibliography of Chapter 1 is presented at the end of the chapter. The referencing of Chapter 1 is according to the NWU-Harvard style.

## **Chapter 2: Literature review: Physical activity and selected health components.**

Chapter 2 presents the literature review on physical activity and selected health components.. A complete bibliography of Chapter 2 is presented at the end of the chapter. Referencing is according to the NWU-Harvard style.

## **Chapter 3 – Article 1: Physical activity in relation to selected physical health components in employees of a financial institution**

Chapter 3 is presented in the form of a manuscript prepared for submission and according to the requirements of the *African Journal for Physical, Health Education, Recreation and Dance (AJPHERD)*. The bibliographic style of the journal will be applied. The guidelines of *AJPHERD* are presented in appendix A.

## **Chapter 4 – Article 2: The relation of physical activity with regards to selected psychological health components and absenteeism of employees in a financial institution**

Chapter 4 is presented in the form of a manuscript prepared for submission and according to the requirements of the *Journal of occupational and environmental medicine (JOEM)*. The bibliographic style of the journal will be applied. The guidelines of *JOEM* are presented in appendix A.

## **Chapter 5 – Article 3: The influence of physical activity on pharmacy and general medical practitioners' claims of employees in a financial institution**

Chapter 5 is presented in the form of a manuscript prepared for submission and according to the requirements of the *Health Economics*. The bibliographic style of the journal will be applied. The guidelines of *Health Economics* are presented in appendix A.

## **Chapter 6 – Article 4: Physical activity in relation to hospital claims in a group of employees in a financial institution**

Chapter 5 is presented in the form of a manuscript prepared for submission and according to the requirements of the *Journal of Health Economics*. The bibliographic style of the journal will be applied. The guidelines of *Journal of Health Economics* are presented in appendix A.

## **Chapter 7: Summary, conclusion, limitations and recommendations**

In Chapter 7 a summary of the research will be presented together with the main conclusions of the researched based on the hypotheses that are set in Chapter 1. Limitations to the study will be presented with recommendations for future research.

The references of Chapter 1, 2, and 7 will be presented according to the Harvard style as prescribed by the North-West University (Potchefstroom Campus). The references of Chapter 3, 4, 5 and 6 will be presented according to the requirements of the specific journal to which the articles will be presented for publication.

## 6. References

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# Chapter 2

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## Literature review:

### Physical activity and selected health components

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1. Introduction
  2. Related terms
  3. Physical activity, physical fitness and health
  4. Physical activity and selected health components
  5. Physical activity and medical cost
  6. Physical activity among employees in South Africa
  7. Interaction of physical activity, physical health, psychological health and medical cost
  8. Conclusion
  9. References
- 

#### 1. Introduction

Regular physical activity is associated with improved health and quality of life (Durstine *et al.*, 2009:23; ACSM, 2010:72; Jurakic *et al.*, 2010:1307; Wanderley *et al.*, 2011:1375; Farid & Dabiran, 2012:206; Pucci *et al.*, 2012:1542-1543). Physical activity is also associated with the reduction in prevalence and the prevention of certain non-communicable chronic diseases, which include cardiovascular diseases (Durstine *et al.*, 2009:23; ACSM, 2010:72). Studies have also shown that physical activity can reduce medical cost and thus help with the economic burden of disease (Katzmazyk *et al.*, 2000; Andreyeva & Sturm, 2006; Sari, 2009; Cho & Cho, 2011). Research with regards to physical activity and medical cost in South African are very rare. South Africa as a country and its population is unique and cannot always be compared to first world countries, thus it is important to establish their own reference point.

In this chapter, physical activity, physical fitness and exercise will be discussed as concepts, as well as the effects physical activity have on physical and emotional health. The effects of

physical activity on medical cost will also be discussed. The discussion will outline the different effects of physical activity on direct and indirect medical costs; subsequently the concepts of absenteeism and presenteeism will be explained in the contexts of indirect medical cost. Due to the rare nature of information on the medical cost in SA, international reference will be included in some of the discussions.

## 2. Related terms

Physical activity, physical fitness, exercise, health and wellness are terminologies that are used to describe different concepts, and the following definitions are outlined in the literature. **Physical activity** is any bodily movement produced by skeletal muscle that results in energy expenditure (Caspersen *et al.*, 1985:126; Bouchard *et al.*, 2007:12; Williams, 2007:6; ACSM, 2010:2). **Physical fitness** is a set of attributes that individuals have or achieve that relate to the ability to perform physical activity with ample energy (Caspersen *et al.*, 1985:128; Bouchard *et al.*, 2007:12; Williams, 2007:6; ACSM, 2010:2). **Exercise** is not synonymous with physical activity but it is a subcategory of physical activity (Caspersen *et al.*, 1985:128). Exercise is defined in the literature as planned, structured, repetitive and purposive in the sense that improvement or maintenance of one or more components of physical activity is an objective (Caspersen *et al.*, 1985:126; Bouchard *et al.*, 2007:12; Nieman, 2007:32; ACSM, 2010:2). The literature also distinguishes between exercise and training, where exercise is a one-time event, whereas training refers to a chronic progression of exercise sessions designed to improve physiological function (Plowman & Smith, 2011:11). **Health** is a state of complete physical, mental and social well-being, and not merely the absence of disease (Bouchard *et al.*, 2007:18; WHO, 2011a). **Wellness** is the constant and deliberate effort to stay healthy and achieve the highest potential for well-being. It encompasses seven dimensions namely, physical, emotional, mental, social, environmental, occupational and spiritual well-being and integrates them all into a quality life (Corbin *et al.*, 2009:5; Hoeger & Hoeger, 2009:10; Powers & Dodd, 2009:2). Each of these terms will be used in the text as it appeared in the references.

### 2.1 Physical activity

Physical activity is defined as any bodily movement produced by skeletal muscles that result in substantial increase over resting energy expenditure (Caspersen *et al.*, 1985:126; Bouchard *et al.*, 2007:12). Energy expenditure can be measured in kilocalories (kcal) or kilojoules (kJ). One kcal is equivalent to 4.184 kJ (Caspersen *et al.*, 1985:126; Nieman, 2007:30).

Every person performs physical activity in order to sustain life. The amount varies considerably from person to person and is largely subject to personal choice (Nieman, 2007:30). Thus, physical activity can be categorised in broad concepts which include:

- Leisure-time physical activity
  - It is an activity undertaken in the individual's discretionary time that increases the total daily energy expenditure (Bouchard *et al.*, 2007:12; Powers & Dodd, 2009:6)
- Exercise
  - Exercise is a form of leisure-time physical activity that is usually performed repeatedly over an extended period of time (training) with a specific external objective such as improvement of fitness, physical performance or health (Caspersen *et al.*, 1985:128; Bouchard *et al.*, 2007:12; Powers & Dodd, 2009:6).
- Sport
  - Sport is a form of physical activity that involves competition (Bouchard *et al.*, 2007:12).
- Work, chores and transport
  - Work is an important component of daily activities and can be occupational work and even transportation (walking or cycling) (Bouchard *et al.*, 2007:12).

Physical activity is quantified in type or mode of activity (walking, cycling, swimming), the intensity (low, moderate or vigorous), frequency (how many times a day and week), the duration (how long is each session) and the volume (how much activity was done in total) (Welk, 2002:4; Cooper, 2003:85). It is important to consider these components when planning physical activity, due to the fact that there are minimum requirements that must be obtained to gain the desired physiological responses (ACSM, 2010:153-154).

## **2.2 Physical fitness**

Physical fitness is a physiological state of well-being that provides the foundation for the tasks of daily living, a degree of protection against hypokinetic disease and a basis for participation in sport (Plowman & Smith, 2011:11). In other words, physical fitness is a multidimensional concept individuals possess or achieve that relates to the ability to perform physical activity and is comprised of skill-related physical fitness, health-related and physiologic components (Caspersen *et al.*, 1985:28; ACSM, 2010:2). Bouchard *et al.* (2007:13) stated that fitness

implies that the individual has attained those characteristics that permit an acceptable performance of a given physical task in a specified physical, social and psychological environment. Physical fitness is primarily determined by variables including individuals' patterns, level of habitual activity and heredity (Bouchard *et al.*, 2007:13).

Physical fitness is typically categorised in performance-related fitness and health-related fitness (Caspersen *et al.*, 1985:128; Jackson *et al.*, 2004:9; Bouchard *et al.*, 2007:13; Williams, 2007:6; ACSM, 2010:3; Plowman & Smith, 2011:11).

Performance-related fitness is also described in the literature as sport-specific physical fitness or athletic fitness (Plowman & Smith, 2011:11). Performance-related fitness has a narrow focus and is the portion of physical fitness directed towards optimising athletic performance (Plowman & Smith, 2011:11). It also refers to the components of fitness that are necessary for maximal sport performance and include agility, balance, coordination, speed, power and reaction time (Caspersen *et al.*, 1985:128; Bouchard *et al.*, 2007:14; ACSM, 2010:3).

Health-related fitness refers to those components of fitness that benefit from a physically active lifestyle and relate to health (Caspersen *et al.*, 1985:128; ACSM, 2010:3; Bouchard *et al.*, 2007:14; Williams, 2007:6). It is directed toward the prevention of, or rehabilitation from disease, the development of a high level of functional capacity for the necessary and discretionary task of life (ACSM, 2010:3; Plowman & Smith, 2011:11). Thus, health-related fitness possesses the traits and capacities that are associated with a low risk of premature development of hypokinetic diseases (ACSM, 2010:3). Components of health-related fitness include; cardiovascular endurance (also known as cardiorespiratory endurance/fitness or aerobic fitness), muscular strength and endurance, flexibility and body composition (Caspersen *et al.*, 1985:128; Nieman, 2007:34-35; Powers & Dodd, 2009:9; ACSM, 2010:3). Cardiorespiratory fitness is often considered the key component of health-related physical fitness. Cardiorespiratory fitness is a measure of the heart's ability to pump oxygen-rich blood to the working muscles during exercise and of the muscles' ability to take up and use the oxygen. The oxygen delivered to the muscles is used to produce the energy needed for prolonged exercise (Powers & Dodd, 2009:9).

The ACSM (2006:3) also refers to a third component, namely physiological fitness. Limited information is available on physiological fitness. Physiological fitness differs from health-related fitness in that it includes non-performance components that relate to biological systems influenced by habitual activity (ACSM, 2006:3). Components of physiological fitness include; metabolic fitness, morphologic fitness and bone integrity. Metabolic fitness is a reference to the status of the metabolic system and variables predictive of the risk for diabetes and cardiovascular disease. Morphological fitness refers to the status of body compositional factors such as circumference, body fat content and regional body fat distribution. Bone integrity

describes the status of bone mineral density (ACSM, 2006:3). Health-related and physiologic fitness measures are closely associated with disease prevention and can be modified through regular physical activity and exercise (ACSM, 2006:4).

## 2.3 Exercise and training

Exercise is defined as a single acute bout of bodily exertion or muscular activity that requires an expenditure of energy above resting level (Plowman & Smith, 2011:6). Exercise is a form of leisure-time physical activity that is usually performed repeatedly over an extended period of time (exercise training) with a specific external objective such as improvement of fitness, physical performance or health (Caspersen *et al.*, 1985:128; Bouchard *et al.*, 2007:12; Nieman, 2007:32; ACSM, 2010:2). The term exercise has been used interchangeably with physical activity, which is not always correct. Exercise and physical activity do share several elements (see Table 2.1), but are not synonymous. Exercise is a type of physical activity, therefore a subcategory of physical activity (Caspersen *et al.*, 1985:128). The following table describes the elements of physical activity and exercise as indicated by Caspersen *et al.* (1985:128).

**Table 2.1 Elements of physical activity and exercise (Caspersen *et al.*, 1985:128)**

Physical activity	Exercise
Bodily movement via skeletal muscle	Bodily movement via skeletal muscle
Results in energy expenditure	Results in energy expenditure
Energy expenditure (kilocalories) varies continuously from low to high	Energy expenditure (kilocalories) varies continuously from low to high
Positive correlation with physical fitness	Very positively correlated with physical fitness
	Planned, structured and repetitive bodily movement
	An objective is to improve or maintain physical fitness component(s)

Virtually all conditioning and many sport activities are considered exercise because they are generally performed to improve or maintain physical fitness (Nieman, 2007:33). Exercise regimen covers mode, intensity, frequency and duration (Bouchard *et al.*, 2007:12).

The literature also refers to *exercise training*. Training is a consistent or chronic progression of exercise sessions designed to improve physiological function, whether for health or sport benefits (Plowman & Smith, 2011:11). Thus, the main goals for exercise training are health-related, physical fitness and/or sport-specific physical fitness (Plowman & Smith, 2011:11).



## 2.4 Health

Health is a state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity (Bouchard *et al.*, 2007:18; WHO, 2011a). The three dimensions of health, namely; physical, mental and social, are tightly interdependent and quality of life demands that each receives balanced attention. If one dimension is neglected or overemphasised, the other areas will be negatively influenced (Jackson *et al.*, 2004:6; Nieman, 2007:3). **Physical health** is defined as the absence of physical disease. This also implies that an individual has energy and vigour to perform moderate to vigorous levels of physical activity without undue fatigue and has the capability of maintaining such ability throughout life (Nieman, 2007:3-4; Powers & Dodd, 2009:2). **Mental health** refers to both the absence of mental disorders and an individual's ability to negotiate the daily challenges and social interactions of life without experiencing mental, emotional or behavioural problems (Nieman, 2007:3-4; Powers & Dodd, 2009:2). **Social health** is the ability to interact effectively with other people and the social environment, as well as enjoying satisfying personal relationships (Nieman, 2007:4; Powers & Dodd, 2009:2).

It is clear from the above discussion that health is not merely the absence of disease, but it is very complex and multi-factorial. Therefore, traditional illness and mortality statistics do not provide a full assessment of health, and this clearly indicates that a more comprehensive approach must be established (Bouchard *et al.*, 2007:8)

## 2.5 Wellness

Wellness is a holistic concept that describes a state of positive health in the individual comprising of physical, social and psychological well-being (Bouchard *et al.*, 2007:9). Wellness is defined as a dynamic process of becoming aware of and making conscious choices towards a more balanced and healthy lifestyle. It includes learning new skills that address both the positive and negative aspects of human existence (Corbin *et al.*, 2009:5; Hoeger & Hoeger, 2009:10; Powers & Dodd, 2009:2).

The concept of wellness has expanded into seven dimensions; physical, emotional, mental, social, environmental, occupational and spiritual (Corbin *et al.*, 2009:5; Hoeger & Hoeger, 2009:10). **Physical wellness** is the dimension most commonly associated with being healthy (Hoeger & Hoeger, 2009:10). Physical wellness is a person's ability to function effectively in meeting the demands of the day's work and to use free time effectively (Corbin *et al.*, 2009:5). It also refers to an individual's good physical fitness and confidence in their personal ability to take care of health problems (Hoeger & Hoeger, 2009:13). **Emotional wellness** involves the ability to understand one's own feelings, accept one's limitations and achieve emotional stability

(Hoeger & Hoeger, 2009:13). This includes a person's ability to cope with daily circumstances and to deal with personal feelings in a positive, optimistic and constructive way (Corbin *et al.*, 2009:5). **Mental wellness** can also be referred to as intellectual wellness, which implies that your mind is in a state to engage in lively interaction with the world around you. It also implies that one can apply the things he or she has learned and create opportunities to learn more (Corbin *et al.*, 2009:5; Hoeger & Hoeger, 2009:14). **Social wellness** is the ability to relate well to others, both within and outside the family unit. It is accompanied by a positive self-image, endows one with the ease and confidence to be outgoing, friendly and affectionate towards others (Corbin *et al.*, 2009:5; Hoeger & Hoeger, 2009:14). **Environmental wellness** is the capability to live in a clean and safe environment that is not detrimental to health (Hoeger & Hoeger, 2009:14). **Occupational wellness** is the ability to perform one's job skilfully and effectively under conditions that provide personal and team satisfaction and adequately rewards each individual (Hoeger & Hoeger, 2009:15). **Spiritual wellness** is a person's ability to establish a value system and act on the systems' beliefs, as well as to establish and carry out meaningful and constructive lifetime goals. Spiritual wellness is often based on a belief in a force greater than the individual that helps one contribute to an improved quality of life (Corbin *et al.*, 2009:5)

The seven dimensions of wellness show how the concept clearly goes beyond the absence of disease (Hoeger & Hoeger, 2009:10). These dimensions are interrelated, where one frequently affects the other (Hoeger & Hoeger, 2009:10). Wellness also incorporates factors such as adequate fitness, proper nutrition, stress management, disease prevention, spirituality, not smoking or abusing drugs, personal safety, regular physical examination, health education and environmental support (Corbin *et al.*, 2009:5-6; Hoeger & Hoeger, 2009:10; Powers & Dodd, 2009:2)

### **3. Physical activity, physical fitness and health**

#### **3.1 Interaction between physical activity, physical fitness, genetic and selected additional factors**

Physical activity is associated with decreased risk for certain chronic diseases and premature mortality (ACSM, 2010:72; Durstine *et al.*, 2009:23). Carlsson *et al.* (2007:258) did a study on twins and found that the more active twins show 20% reduced risk for all causes of mortality and a 32% reduced risk for mortality due to cardiovascular disease. As with physical activity, physical fitness, and especially cardiorespiratory fitness, is associated with many health benefits. According to ACSM (2010:71), low levels of cardiorespiratory fitness are associated

with an increased risk for premature death from all causes and specifically from cardiovascular disease.

Moderate- to vigorous intensity aerobic activities improve maximal cardiorespiratory fitness (Blair & LaMonte, 2007:149). Thus, it is reasonable to assume that cardiorespiratory fitness is a good indicator of recent habitual physical activity (Blair & LaMonte, 2007:149). However, the potential to improve aerobic fitness with training is limited (Sharkey & Gaskill, 2007:79). Sharkey and Gaskill (2007:79), as well as Bouchard (1990:147), stated that heredity plays a significant role in physical fitness. According to Sharkey and Gaskill (2007:79), physical activity has the potential to improve fitness only by 20-25% and in adolescents it can be up to 30%. Bouchard and Rankinen (2001:S446) indicated that heredity can contribute to about 20-50% of health-related fitness components. According to Plowman and Smith (2003:150), endurance activities can be influenced by genetics up to 32%. Bouchard *et al.* (1999:1003) and Bouchard *et al.* (1998:252), indicated that genetics contribute 47%-50% to an individual's VO<sub>2</sub>-max. This genetic influence explains why different results are achieved in individuals who participate in the same exercise program (Plowman & Smith, 2003:344). The total effect that genetics have on anaerobic fitness is still unidentified but it is speculated to be between 44% and 99% (Plowman & Smith, 2003:115-116). Physical fitness is therefore, a product of heredity and training. With good heredity a sedentary person could have a higher level of fitness than an active individual. Moving from a sedentary to active lifestyle imparts a sizable drop in health risk and all-cause mortality. When an already active person improves his or her fitness, the decrease in risk is more subtle but still important, especially for someone with inherited risk (Sharkey & Gaskill, 2007:20).

Genetics do not only affect physical fitness, but it is also possible to affect the participation in physical activity (Lauderdale *et al.*, 1997:1062). Heredity can determine up to 62% of an individual's physical activity participation (Bouchard & Rankinen, 2006:3). According to Bouchard and Rankinen (2006:3), several studies on twins indicate that 40%-50% of physical activity participation is determined by genetics.

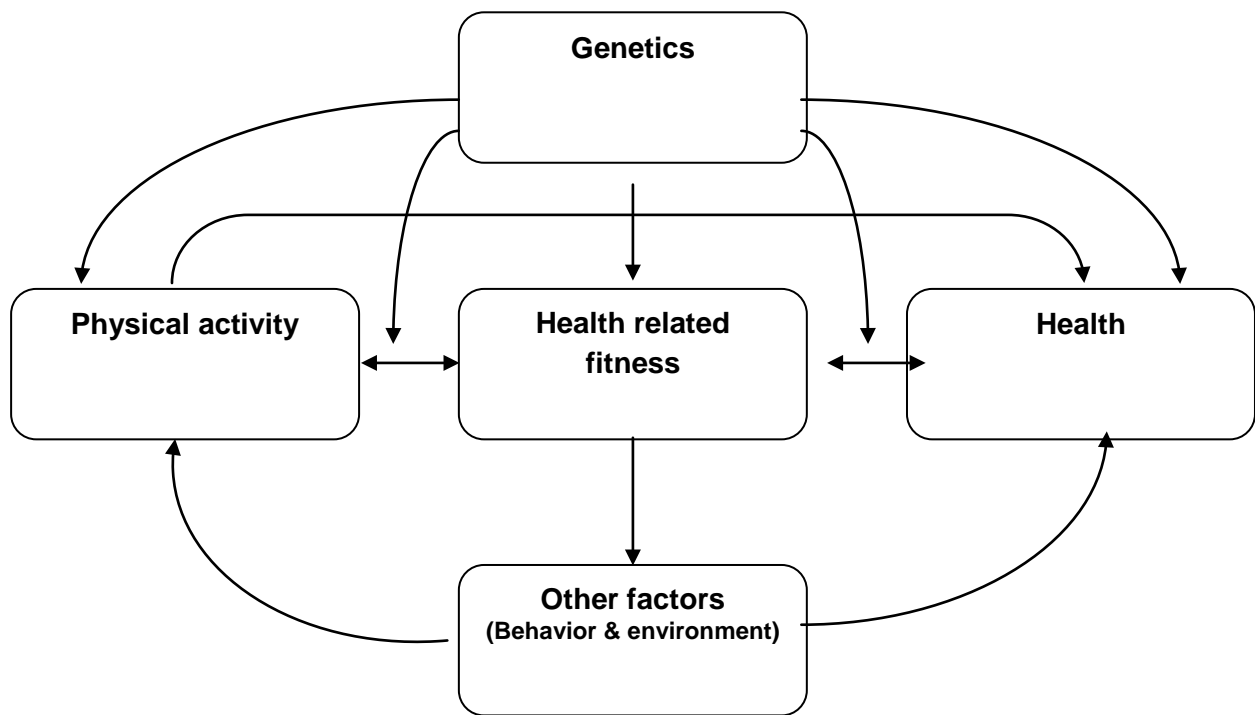
As with physical activity and physical fitness, genetics can also play a role in an individual's health, due to the fact that genetics can be a contributing factor in certain pathologies. Several chronic diseases, such as heart disease, cancer, Type 2 diabetes, obesity and other chronic conditions aggregate in families. The level of familial aggregation varies from condition to condition with a range from about 30% to 50% of the age and gender-adjusted variance (Bouchard *et al.*, 2007:9). This strongly suggests that genetic factors are involved (Bouchard *et al.*, 2007:9).

Physical activity and physical fitness have both been shown to have a meaningful positive impact on health and especially in the reduction of cardiovascular disease (Durstine *et al.*,

2009:23-25). However, uncertainty exists whether physical activity and physical fitness contribute separately to these health benefits. With regard to this, Plowman (2005:155) stated that physical activity, physical fitness and health are all separate but interrelated, and are all influenced by heredity. This indicates that the inclusion of a genetic component does not reduce the importance of physical fitness as a predictor of health or the importance of physical activity as part of a healthy lifestyle (Plowman, 2005:155). Plowman (2005:143) suggests that physical activity and physical fitness might be independent risk factors. Ekblom-Bak *et al.* (2010) have the same opinion and concluded that physical activity and cardiovascular fitness are independently associated with lower cardiovascular risk, and both variables should be taken into account. Williams (2010:213) also suggested that cardiovascular fitness is a cardiovascular risk factor, largely independent of physical activity.

It is important to note that the aetiology of certain diseases can be influenced by several other factors as well. Strong evidence indicated that behavioural factors contribute to the aetiology of certain diseases and are associated with an increased risk of mortality or morbidity (Bouchard *et al.*, 2007:9). Among these behaviours are smoking, poor nutrition habits, excess alcohol consumption, a sedentary lifestyle and substance abuse (Bouchard *et al.*, 2007:9). Beyond the genetic factors and behavioural traits, which together explain most of the predisposition to major chronic disease, the social and physical environment play an important role as well (Bouchard *et al.*, 2007:9-10). For example, people in low socioeconomic classes or with less education are more likely to be economically disadvantaged and are at a greater risk of being affected by chronic diseases and dying prematurely (Bouchard *et al.*, 2007:10).

Bouchard *et al.* (2007:17) compiled a model to represent the complex relation and interaction among the different contributing factors as discussed. See Figure 2.1.



**Figure 2.1: A model defining the relationship between physical activity, health-related fitness and health (Bouchard *et al.*, 2007:17)**

It is clear from the presentation that a complex interaction occurs and that each contributing factor is affected by another and this should be taken into account when physical activity and physical fitness are assessed.

### 3.2 Physical activity patterns in South Africa

According to Sharkey and Glaskill (2007:2), the active life is one that people led before society achieved the benefits of industrial modernisation – technological developments, the automobile, labour-saving devices, television and computers. These marvels of ingenuity now make it possible to minimise daily energy expenditure. The result is an alarming growth in the epidemic of diseases.

South Africa is not excluded from this physical inactive behaviour. The SADHS (2007) did a survey to determine the health status of the South African population. This survey included the physical activity pattern or participation in physical activity levels of the South African population.

Physical activity participation was divided into three categories:

- Category 1 is inactive, low or insufficient activity and was defined as no activity reported or some activity, but not enough to qualify as categories 2 or 3 or energy expenditure less than 600 MET-minutes/week.

- Category 2 is moderate to minimal activity and is defined as 20 minutes of vigorous activity for three days or more, or 30 minutes of moderate intensity activity like walking at least five days a week or more.
- Category 3 is high or sufficient activity and is defined as vigorous activity at least three days a week with an energy expenditure of 1500 MET-minutes/week or any combination of activity for seven days a week that resulted in an energy expenditure of 3000 MET-minutes/week (SADHS, 2007:291-292).

According to this classification, only 24% of men and 14% of women reported being highly or sufficiently physically active (SADHS, 2007:292). The survey also indicated that 48% of men and 63% of women in South Africa are physically inactive (SADHS, 2007:292). These percentages of physical inactivity are greater than the World Health Organization (WHO, 2005:5) determined in 2002, which showed that 44% of men and 49% of women are physically inactive. The prevalence of inactivity is higher in urban areas than in rural areas in South Africa. The data shows that 49% of men and 66% of women living in urban areas are inactive and 46% of men and 59% of women in rural areas are inactive (SADHS, 2007:292). Due to the high prevalence of inactivity in urban areas, the risk for chronic diseases is increasing (SADHS, 2007:292). In addition to this, Marais (2008:71) reported that only 13.2% of the population were physical activity more than three days a week, for longer than 30 minutes at a time in the South African corporate environment. She furthermore indicated that only 9.7% female and 20.0 % males shown high levels of physical activity.

This trend of inactivity could have serious health consequences, due to the fact that physical inactivity is regarded as a risk factor for the development of cardiovascular disease and other chronic diseases (Jackson *et al.*, 2004:180; Nieman, 2007:380; Matfin, 2009:484; ACSM, 2010:7-8). A low level of physical activity is associated with loss of functional capacity and premature mortality (Bouchard *et al.*, 2007:4). Due to the increased risk of chronic diseases and mortality due to physical inactivity, it is essential to emphasise the importance of physical activity. In the next section of this chapter the effect of physical activity on selected health components will be discussed in detail.

## **4. Physical activity and selected health components**

### **4.1 Physical activity related to selected components of physical health**

Physical activity has a protective effect on premature mortality and morbidity in persons with chronic diseases. Subsequently, in the following section of this chapter, the effect of physical activity on selected risk factors for chronic conditions of lifestyle will be discussed.

#### **4.1.1 Blood pressure**

Hypertension is defined as a transitory or sustained elevation of systemic arterial blood pressure to a level likely to induce cardiovascular damage or result in other adverse consequences (Contractor & Gordon, 2009:233). The aetiology of hypertension is unknown in 80-90% of the cases and is called essential, idiopathic or primary hypertension (Contractor & Gordon, 2009:233; Camm & Bunce, 2009:798). There are, however, multi-factorial aetiologies that might be linked to essential hypertension and include genetic, fetal and environmental factors such as obesity, alcohol intake, sodium intake and stress (Camm & Bunce, 2009:798). Secondary hypertension is systemic hypertension where blood pressure elevation is the result of a specific and potentially treatable cause. Conditions include renal disease, endocrine causes, drugs and pregnancy (Contractor & Gordon, 2009:233; Camm & Bunce, 2009:799).

Elevated arterial blood pressure is a major cause of premature vascular disease leading to cerebrovascular events, ischemic heart disease and peripheral vascular disease (Camm & Bunce, 2009:799). These pathological conditions arise due to hypertension damages of the endothelium, which predispose the individual to atherosclerosis and other vascular pathologies. In the presence of hyperlipidaemia and a damaged endothelium, atherosclerotic plaque develops, where as in its absence, the intima thickens (Camm & Bunce, 2009:799). This hypertension-induced vascular damage can lead to strokes and transient ischemic attacks (Contractor & Gordon, 2009:235).

This is why hypertension is considered one of the major risk factors for cardiovascular disease and is often found clustered with other cardiovascular risk factors (ACSM, 2010:28). High blood pressure contributes to a considerable burden of cardiovascular disease in South Africa and especially poorly managed elevated blood pressure (Norman *et al.*, 2007:697). High blood pressure is the second leading risk factor for death in South Africa (Norman *et al.*, 2007:695). In 2000, almost 47 000 deaths in South Africa were attributed to hypertension (Norman *et al.*, 2007:695). SADHS (2007:242) indicated that 40% of men and 51% of women in South Africa have elevated blood pressure.

It has been indicated that physical inactivity is associated with an increased prevalence of hypertension (Brown *et al.*, 2006:144). Therefore, physical activity has been identified as a possible lifestyle intervention in the prevention and management of hypertension. Studies have shown that exercise helps prevent the development of hypertension (Barlow *et al.*, 2006:142; Parker *et al.* 2007; Contractor & Gordon, 2009:245). Parker *et al.* (2007) observed a statistically significant inverse association of physical activity and incidence of hypertension in young adults. Vigorous physical activity was independently associated with low incidence of hypertension in men (Hernelahti *et al.*, 2004:306). According to Barlow *et al.* (2006:142), an active lifestyle should be promoted for the primary prevention of hypertension.

Exercise also help reduces the blood pressure of those with hypertension (Sohn *et al.*, 2007:506; Collier *et al.*, 2008:682; Terra *et al.*, 2008:275; Contractor & Gordon, 2009:245). Chronic endurance training has been shown to reduce both systolic and diastolic blood pressure by 5mmHg–10mmHg (Contractor & Gordon, 2009:245). According to Collier *et al.* (2008:682), as little as four weeks of exercise can reduce systolic blood pressure on average with 4.6 mmHg and diastolic blood pressure with 3.1 mmHg. Thus, mean arterial pressure can be reduced on average with 3.2 mmHg in individuals who are pre-hypertensive and those with essential hypertension. Vieceili *et al.* (2009:366) found that physical exercise, such as walking of moderate intensity for 20 minutes on alternate days resulted in important blood pressure decrease, and the most part of the hypotensive effect occurred as early as after the first five sessions. Sohn *et al.* (2007:503) have the same opinion and stated that, by increasing an individual's daily waking by 30 minutes, there is a reduction in systolic and diastolic blood pressure in newly diagnosed hypertensives (Sohn *et al.*, 2007:506). According to Sohn *et al.* (2007:503), walking is considered one of the safest and simplest modes of exercise for hypertension patients of all age groups (Sohn *et al.*, 2007:503). Terra *et al.* (2008:276) investigated the effect of resistance training on individuals with hypertension and found that a 12-week resistance training program promotes significant reduction in systolic blood pressure, diastolic blood pressure and mean arterial blood pressure, as well as the rate pressure product values at rest in individuals with controlled hypertension. However, the mechanism is still unclear, but this reduction can help reduce the risk of acute myocardial infarction and coronary disease (Terra *et al.*, 2008:275).

Physical activity does not only prevent and reduce the prevalence of hypertension, but several other advantages specific to the pathology were observed in studies with regard to hypertension and physical activity and fitness. Other advantages include:

- *Arterial stiffness*

Aerobic exercise decreases arterial stiffness in individuals with pre- to essential hypertension (Collier *et al.*, 2008:681). According to Madden *et al.* (2009:1533), a relative short aerobic exercise intervention (3 months) can reduce multi-factorial



(geriatric age, Type 2 diabetes, hypertension and hypercholesterolemia) arterial stiffness in older adults.

- *Carotid atherosclerosis*

According to Jae *et al.* (2007:1004), hypertensive men with higher levels of cardiorespiratory fitness were less likely to have carotid atherosclerosis. This relationship was independent of established risk factors.

- *Left ventricular hypertrophy*

Regular physical activity prevents the development of left ventricular hypertrophy in individuals with hypertension. This effect is independent from the reduction in blood pressure caused by exercise (Palatini *et al.*, 2009:225). The mechanism is unclear, but a possible explanation is that there is a reduction in blood pressure or reduction in vascular resistance, blood volume and cardiac output, enhanced endothelial vasodilator function, suppression of the activity of the renin-angiotensin-aldosterone system, reduction of insulin resistance and a reduction in sympathetic nervous system – which all occur after programmed physical activity (Palatini *et al.*, 2009:225).

- *Baro-reflex sensitivity*

Studies show that physical activity can influence the baro-reflex of individuals with hypertension (Laterza *et al.*, 2007:1302; Collier *et al.*, 2009:344). Collier *et al.* (2009:344) found that four weeks of aerobic exercise improves baro-reflex sensitivity in pre to essential hypertensive individuals. According to Laterza *et al.* (2007:1302), the baro-reflex control of heart rate and muscle sympathetic nerve activity (MSNA) is impaired in hypertensive patients, and moderate exercise training improves the baro-reflex control of muscle-sympathetic nerve activity (MSNA). Thus, exercise training normalises MSNA and significantly reduces blood pressure in never treated hypertensive individuals (Laterza *et al.*, 2007:1302).

Physical activity does not only help reduce the prevalence and severity of the pathology, but also plays a role in the quality of life of individuals of all ages with hypertension. Physical activity is associated with high levels of health-related quality of health among individuals with hypertension (Brown *et al.* 2006:137). Brown *et al.* (2006:144) observed a higher prevalence of lower levels of health-related quality of health among individuals with hypertension compared to those without. Fernandez *et al.* (2007:354) show a positive connection of physical exercise and quality of life has been established and especially in women over 65 years.

From the discussion it is clear that physical activity should be part of the intervention to treat and prevent hypertension. According to Norman *et al.* (2007:692), results indicate that there is

potential for health gain from implementing blood pressure lowering intervention that includes physical activity that is known to be highly cost-effective.

#### 4.1.2 Cholesterol

Hyperlipidaemia is any condition that elevates fasting blood triglycerides (TG) or cholesterol concentrations, however, when genetic, environmental and pathological factors combine to alter blood lipid and lipoprotein concentration abnormally, the condition is termed dyslipidaemia (Biggerstraff & Wooten, 2009:247). The commonly used classification system for hyperlipidaemia is based on the type of lipoprotein involved. Several factors, including nutrition, genetics, medication, co-morbid condition and metabolic disease can raise blood lipid levels. Most cases of elevated levels of cholesterol are most likely multifactorial (Matfin, 2009:482).

This discussion will mainly focus on low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C) and triglycerides (TG). Low-density lipoprotein (LDL-C) is the main carrier of cholesterol (Matfin, 2009:281). LDL-C is essential for supplying cells with the cholesterol they require to synthesise cell membranes and, in the case of the gonad and adrenal glands, steroid hormones (Widmaier *et al.*, 2011:557). However, if LDL-C levels are too high in the plasma, it is associated with increased deposition of cholesterol in arterial wall and higher incidence of heart disease (Widmaier *et al.*, 2011:557). High density lipoprotein (HDL-C) participates in the reverse transport of cholesterol by carrying cholesterol from the peripheral tissues back to the liver where it may be excreted, hence it is often revered to as 'good cholesterol' (Matfin, 2009:482; Widmaier *et al.*, 2011:558). There are two known types of HDL-C particles, HDL<sub>2</sub>-C and HDL<sub>3</sub>-C. HDL<sub>2</sub>-C are larger particles that carry cholesterol from the arterial wall to the liver for disposal and also have antioxidant and anti-inflammatory effects (Hoeger & Hoeger, 2009:330). HDL<sub>3</sub>-C also transports cholesterol out of the arterial wall but to a lesser extent. HDL<sub>3</sub>-C seems to protect against cholesterol oxidation that results in atherosclerosis (Hoeger & Hoeger, 2009:330). Triglycerides (TG) are used in energy metabolism. Triglycerides are transported by lipoproteins or various tissues for energy utilisation, lipid deposition, steroid hormone production and bile acid formation (Matfin, 2009:481-482; Widmaier *et al.*, 2011:32).

Risk for disease is indicated by certain values of an individuals' lipid profiles. Therefore, a low level of HDL-C ( $\leq 40\text{mg/dl}$ ), a high level of LDL-C ( $\geq 160\text{mg/dl}$ ) and a high level of Triglycerides ( $\geq 200\text{mg/dl}$ ) are considered a risk for the development of cardiovascular disease (ACSM, 2010:28). The best indicator to determine the likelihood of developing atherosclerotic health disease is not the total cholesterol, but rather the ratio of plasma LDL-C to plasma HDL-C. The lower the LDL-C:HDL-C ratio, the lower the risk (Widmaier *et al.*, 2011:558).

In South African, an estimated 5.7 million individuals have abnormal lipid profiles (SADHS, 2007:xxvi). These abnormal lipid profiles can be altered by certain lifestyle interventions. It can be used to lower total cholesterol/HDL-C ratio, total cholesterol, LDL-C and increase HDL-C (Nieman, 2007:183-185). Combination of lifestyle therapies is an efficacious, preliminary means of improving cholesterol levels in those with dislipidaemia (Varady & Jones, 2005:1829). According to Varady and Jones (2005:1829), exercise intervention alone resulted in the increase of HDL-C and a decrease in TG, but with a combination of exercise and nutrition intervention resulted in an increase in HDL-C and a decrease in TG, LDL-C and total cholesterol (TC). The following discussion will only focus on physical activity as a lifestyle intervention to positively affect lipid profiles.

Regular exercise has positive, longitudinal effects on plasma lipid levels associated with the risk of cardiovascular heart disease and can reduce cardiovascular disease (Teramota & Golding, 2009:143-144). Several studies indicated the positive effect of physical activity on lipids (Halverstadt *et al.*, 2007:448; Kodama *et al.*, 2007:1006; Teramota & Golding, 2009:143-144; Carvalho *et al.*, 2010:3). Kelley and Kelley (2006:213) indicated that aerobic exercise is efficacious for an increase in HDL-C and decreasing TC, LDL-C and TG in women. According to Kelley and Kelley (2006:213), aerobic exercise can also increase HDL<sub>2</sub>-C independent of changes in body weight. Halverstadt *et al.* (2007:448) found after a 24-week endurance exercise program resulted in a significant increase in the HDL sub fractions HDL<sub>2</sub>-C and HDL<sub>3</sub>-C, as well as a significant decrease in TC, TG and LDL-C. These favourable changes in plasma lipoprotein and lipid profiles were independent of diet and baseline or change in body fat. Carvalho *et al.* (2010:3) did a similar study that also looked at an 8-month exercise program of moderate intensity (3x per week), and found that there is an improvement in blood lipid profiles which include a significant decrease in TG and TC/HDL ratio and a significant increase in HDL-C. They also found that there is a positive modulation of antioxidant capacity. No effect on TC and LDL-C was documented. According to Teramota and Golding (2009:143-144), regular exercise could improve HDL-C and TG levels and LDL-C and TC could be affected by exercise by means of possibly reducing weight. Kodama *et al.* (2007:1006) agreed that exercise increases HDL-C levels, but stated that it appears there is a minimum exercise volume for a significant increase to exist, which is 120 minutes per week or a 900 kcal energy expenditure per week. Kodama *et al.* (2007:1006) concluded that exercise duration per session is the most important element of an exercise prescription to affect lipid profiles positively.

The effect of resistance and combination exercise programs has also shown to be efficient in the reduction of cholesterol levels (Jose *et al.*, 2007:60; Ghaharmanloo *et al.*, 2009:765; Marques *et al.*, 2009:87; Shaw *et al.*, 2009:293-294). According to Jose *et al.* (2007:60), resistance training programs resulted in significant decreases in TC, LDL-C and TG in men with a BMI greater than 27kg/m<sup>2</sup>. Shaw *et al.* (2009:293-294) conducted a study to determine if

there is a difference in effect on LDL-C in healthy previously untrained men. Individuals were divided in two groups, one consisting of aerobic training only and the other, aerobic training combined with resistance training. Both groups trained for 16 weeks at a moderate intensity for 45 minutes per session, three times a week. Both groups showed significant and similar decreases in LDL-C. This indicates that a larger dose of aerobic exercise does not necessarily equate to a greater improvement in LDL-C concentration if the lost aerobic exercise is replaced with resistance training (Shaw *et al.*, 2009:294). According to Marques *et al.* (2009:87), an exercise program of eight months (2x per week) allowed for a significant decrease in TG and an increase in HDL-C in a multi-component exercise program (aerobic exercise, muscular endurance exercise and activities to improve balance and flexibility). This multi-component program proves to be more effective than just resistance exercise. Ghaharmanloo *et al.* (2009:764) found that, after an 8-week concurrent training there is a significant improvement in lipid profile in untrained apparently healthy men. HDL-C and LDL-C improved significantly with endurance training. TG and TC improved with endurance training, concurrent training and strength training (Ghaharmanloo *et al.*, 2009:765).

It is clear from the discussion that physical activity does play a role in the lipid profiles of individuals. Lipid changes may be noticeable during the early years of participation in a regular exercise program, but lipid improvements continue over time and potentially even after 20 years of participation. Therefore lifetime physical activity should be promoted to reduce the risk of cardiovascular disease, which will improve mortality and morbidity due to cardiovascular disease and increase longevity (Teramota & Golding, 2009:143-144).

### **4.1.3 Diabetes**

Diabetes mellitus is defined as a group of metabolic diseases characterised by high blood glucose resulting from defects in insulin secretion, insulin action or both (Nieman, 2007:482; Albright, 2009:191). There are four categories of diabetes mellitus, namely (Nieman, 2007:482, Albright, 2009:192):

- Type 1 Diabetes Mellitus
  - There are two major forms of Type 1 diabetes; immune-mediated diabetes (Type 1A) and idiopathic diabetes (Type 1B) (Guven *et al.*, 2009:1054). Immune-mediated diabetes results from the destruction of the beta cells and commonly occurs in childhood and adolescence, but it can occur at any age. Auto-immune destruction of beta cells has multiple genetic predispositions and is also related to environmental factors that are still poorly defined (Nieman, 2007:482). Idiopathic diabetes refers to rare forms of the disease that have no known cause. This form of diabetes is

strongly inherited and lacks immunological evidence for beta cell destruction (Nieman, 2007:482; Guven *et al.*, 2009:1056; Widmaier *et al.*, 2011:581).

- Type 2 Diabetes Mellitus
  - Type 2 diabetes usually arises because of insulin resistance; combined with relative insulin deficiency (Nieman, 2007:483; Widmaier *et al.*, 2011:581). Individuals with Type 2 diabetes mellitus can range from predominantly insulin resistant with relative insulin deficiency to predominant deficiency in insulin secretion with some insulin resistance (Nieman, 2007:482)
- Gestational diabetes
  - Gestational diabetes mellitus refers to any degree of glucose intolerance that is first detected and develops during pregnancy, but disappears afterward (Nieman, 2007:482; Guven *et al.*, 2009:1056).
- Other specific types of diabetes
  - This results from specific genetic syndromes, surgery, drugs, malnutrition, infection and other illnesses (Nieman, 2007:482).

The World Health Organization (WHO, 2011b) estimated that more than 220 million people worldwide have diabetes, and in 2004, an estimated 3,4 million people died from consequences of high blood sugar. According to SADHS (2007:200), 3% of men and 4% of women in South African have diabetes. The chronic hyperglycaemia of diabetes is associated with long-term damage, dysfunction and failure of various organs, especially the eyes, kidneys, nerves, heart and blood vessels (Nieman, 2007:477; WHO, 2011b).

Exercise is considered to be one of the cornerstones of diabetic care, and therefore an exercise program has the potential to provide several benefits for individuals with diabetes (Hornsby & Albright, 2009:184). However, the benefits of exercise for individuals with diabetes are accompanied by an increased risk for hypoglycaemia; therefore extreme caution must be taken by diabetic individuals that participate in exercise (Albright, 2009:192; Guven *et al.*, 2009:1062). Other complications that may arise and must be taken into account when a diabetic individual exercises, are chronic complications like macro- and micro-vascular diseases and neuropathy which involve both the peripheral and autonomic nervous system (Albright, 2009:192; Guven *et al.*, 2009:1067-1070). Macro-vascular diseases include coronary artery disease with or without angina, myocardial infarction, cerebrovascular accidents and peripheral arterial disease. Micro-vascular diseases include diabetic retinopathy and diabetic nephropathy. Peripheral neuropathy typically affects the legs and is initially accompanied with sensory symptoms and loss of tendon reflexes. Diabetic autonomic neuropathy may occur in any system of the body (Albright, 2009:192; Guven *et al.*, 2009:1067-1075). Even with the risk and complications, with the correct precautions, regular physical activity can have several health benefits for the diabetic individual (Powers & Howley, 2009:346-347).

Individuals with Type 1 diabetes are encouraged to exercise to gain health benefits, but blood glucose must be reasonably controlled for the person to exercise safely (Hornsby and Albright, 2009:184). Regular exercise can reduce the insulin requirements of well-controlled Type 1 diabetes individuals by 30-50%. Each bout of exercise leads to an improvement in insulin sensitivity that lasts for 1 to 2 days before falling back to pre-exercise levels (Nieman, 2007:499).

Physical activity is associated with a lower risk of Type 2 diabetes mellitus (Hsia *et al.*, 2005:24; Borodulin *et al.*, 2006:1027; Brouwer *et al.*, 2010:377). This association even applies to individuals with manifested arterial disease or poorly controlled risk factors at any level of BMI (Brouwer *et al.*, 2010:377). The combination of physical activity and being non-obese is associated with an even lower risk of developing Type 2 diabetes mellitus (Brouwer *et al.*, 2010:372). Jeon *et al.* (2007:750) suggested moderate intensity physical activity, such as brisk walking, to substantially reduce the risk of Type 2 diabetes. According to Hu *et al.* (2007:592), 30 minutes of moderate or high level of physical activity a day, avoiding excessive weight gain and a healthy diet is effective and safe way to prevent Type 2 diabetes. Borodulin *et al.* (2006:1027) stated that higher levels of leisure-time physical activity were associated with decreased levels of fasting insulin and reduced the risk of having impaired glucose tolerance and Type 2 diabetes, independent of the level of abdominal obesity. Even with these - recommendations for physical activity, studies have shown that any physical activity is better than no physical activity. Gill and Cooper (2008:822) conducted a review of the literature and came to the conclusion that the majority of the studies suggests that there is no clear minimum threshold of activity that needs to be achieved before being beneficial – all levels of activity above baseline appear to be beneficial. According to Brouwer *et al.* (2010:372), insufficient and sufficient physical activity is likely to improve health in high-risk patients leading to a lower risk of developing Type 2 diabetes and new cardiovascular events (Brouwer *et al.*, 2010:377).

There are several possible mechanisms by which physical activity can prevent and reduce the severity of diabetes. In the following section each of them will be discussed in short.

- *Glucose control*

Physical activity increases glycaemic control (Kirk *et al.*, 2003:1189; Villa-Gaballero *et al.*, 2007:285; Marcus *et al.*, 2008:1353; Nojima *et al.*, 2008:175; Irvine & Taylor, 2009:244). Marcus *et al.* (2008:1353) found a significant improvement in long-term glycaemic control in a group participating in a 16-week exercise program. According to Irvine and Taylor (2009:244), progressive resistance exercise leads to small but statistically significant improvement in glycaemic control.

- *Oxidative stress*

Physical activity can reduce oxidative stress in diabetic individuals (Villa-Gaballero *et al.*, 2007:285). Nojima *et al.* (2008:175) suggest that long-term aerobic exercise training can be regarded as an effective antioxidant therapy. Moderate intensity aerobic exercise training (12 months) reduces oxidative stress in patients with Type 2 diabetes. This also improved glycaemic control which is associated with the reduction of oxidative stress (Nojima *et al.*, 2008:174).

- *Insulin resistance*

Physical activity reduces insulin resistance (Gill, 2007:47; Kirwan *et al.*, 2009:E153-E154). Both intensity and genetics may modulate the magnitude of this effect (Gill, 2007:47). According to Kirwan *et al.* (2009:E153-E154), one week of vigorous exercise training can induce significant improvements in insulin action in Type 2 diabetes mellitus. Improvements include an increase in insulin sensitivity and responsiveness, as well as enhanced suppression of hepatic glucose production. In a review, Gill (2007:47) studied data from several intervention studies and suggests that the effect of exercise on visceral adiposity specifically may contribute to the changes in insulin sensitivity following an exercise intervention.

- *Neuropathy and muscle weakness*

Neuropathy is an important factor in the development of muscle weakness in diabetes mellitus (Albright, 2009:192). Praet *et al.* (2008:168) found that short-term (10 weeks) resistance and interval exercise significantly improved muscle strength, work load capacity and blood pressure regulation in longstanding insulin treated Type 2 diabetes mellitus patients with diabetic neuropathy. Thus, resistance and interval exercise is feasible in deconditioned Type 2 diabetes individuals with neuropathy and accompanied by improvement of muscle function (Praet *et al.*, 2008:168).

- *$\beta$  cell function*

Exercise improves the  $\beta$  cell function in individuals with impaired glucose tolerance and Type 2 diabetes mellitus (Michishita *et al.*, 2008:295).

- *Mitochondria capacity*

Reduced mitochondrial capacity in skeletal muscle occurs in Type 2 diabetic individuals and in those at increased risk for this disorder. Toledo *et al.* (2007:2146) found that intensive short term lifestyle modifications can restore mitochondrial content and functional capacity in skeletal muscle in Type 2 diabetes. The improvement in the oxidative capacity of skeletal

muscle may be a key component mediating beneficial effect of lifestyle intervention on hyperglycaemia and insulin resistance.

Physical activity does not only play a role in the prevention and management of diabetes; it can also give rise to several other benefits for the individual with diabetes, which include health-related quality of life (Häkkinen *et al.*, 2009:803). According to Kirk *et al.* (2003:1189), an increase in physical activity can decrease the cardiovascular risk in Type 2 diabetes. Physical activity can also be beneficial for the haemodynamics of the diabetic individual (Villa-Gaballero *et al.*, 2007:285). According to Di Loreto *et al.* (2005:1300-1301), an increase in physical activity, equivalent of 45 minutes a day, 3 times a week of walking may suffice to improve blood pressure values (both systolic and diastolic), body mass index and lipid metabolism in individuals with Type 2 diabetes.

An important factor in the prevention and management of diabetes, with regards to physical activity, is the type of exercise. According to WHO (2011b), at least 30 minutes of regular, moderate-intensity activity on most days can prevent Type 2 diabetes. In the management of diabetes, studies have identified different regimens that might be considered. Villa-Gaballero *et al.* (2007:290) found that individuals who perform regular aerobic physical activity for at least 180min/week, demonstrate a more adequate metabolic, hemodynamic and antioxidant profile in comparison to the sedentary counterparts. Misra *et al.* (2008:1286) suggested that resistance training should be an integral part of the exercise regime for individuals suffering from Type 2 diabetes. This conclusion came after a study in which they found that moderate intensity progressive resistance exercise for 3 months resulted in significant improvements in insulin sensitivity, glycaemic, lipid and peripheral subcutaneous adipose tissue compartment in individuals with Type 2 diabetes mellitus (Misra *et al.*, 2008:1284-1286). According to Maiorana *et al.* (2002:119-120), an 8-week circuit training (combined aerobic and resistance exercise) is an effective method of training that improves functional capacity, lean body mass, strength and glucose control in Type 2 diabetes. It is well tolerated and combines the beneficial effect of aerobic conditioning and skeletal muscle strength training and improves body composition and glucose control (Maiorana *et al.*, 2002:121).

From the discussion it is clear that physical activity is an important part of a diabetic individual's treatment regimen due to the fact that physical activity has the potential to provide several health-related benefits. (Hornsby & Albright, 2009:184).

#### **4.1.4 Obesity**

Obesity is defined as a severe excess of fat in proportion to lean body mass, whereas overweight is defined as a body weight that exceeds a reference threshold value (Murdy &



Ehrman, 2009:211). Body mass index (BMI) is a simple index of weight-for-height that is commonly used to classify overweight and obesity in adults (WHO, 2011c). The WHO (2011c) defines overweight as having a BMI greater than or equal to 25 and obesity as having a BMI greater than or equal than 30. BMI provides a useful measure of overweight and obesity, but it should be considered as a rough guideline, because it may not correspond to the same degree of fatness in different individuals (WHO, 2011c). Waist circumference can also be used as a screening tool, and can be used to determine the distribution of body fat (Pleuss & Matfin, 2009:993). The distribution of body fat may contribute more to diseases than total body fat alone. Fat distribution is divided in upper body fat distribution (also known as android, central, abdominal or visceral obesity) or lower body distribution (also known as gynoid, peripheral, gluteal-femoral obesity), whereas upper body fat distribution is seen as an independent predictor of morbidity and mortality associated with obesity (Pleuss & Matfin, 2009:993). Factors that contribute to obesity include: genetics, energy balance and lifestyle (Jackson *et al.*, 2004:94).

In 2008, the World Health Organization estimated that 1,5 billion adults over the age of 20 were overweight. Of these 1,5 billion an estimated 200 million men and nearly 300 million women were obese (WHO, 2011c). This means that about one tenth of the world's adult population is obese. South African statistics show that 9% of men and 27% of women in South Africa are obese (SADHS, 2007:278). According to SADHS (2007:278), about 21% of South African men and 28% of South African women are overweight.

It is clear that overweight and obesity have become global health problems and are associated with the leading risk factors for premature mortality and numerous chronic health conditions that reduce the overall quality of life (Ross & Janssen, 2007:176). Chronic health conditions associated with obesity include:

- Increased prevalence of high blood pressure (Nieman, 2007:515; Pleuss & Matfin, 2009:993)
- Increased levels of cholesterol and other lipids in the blood (Nieman, 2007:515; Pleuss & Matfin, 2009:993)
- Increased prevalence and risk of diabetes (Nieman, 2007:516; Pleuss & Matfin, 2009:993, WHO, 2011c)
- Increased risk and prevalence of cancer (Nieman, 2007:516; WHO, 2011c)
- Increased prevalence and risk of cardiovascular disease (Nieman, 2007:517; Pleuss & Matfin, 2009:993; WHO, 2011c)
- Increased risk of musculoskeletal disorders like osteoarthritis (Nieman, 2007:510; WHO, 2011c)
- Reduced lung volumes and alternation in respiratory mechanics (DeLorey *et al.*, 2005:1046).

The risk for these non-communicable diseases increases with the increase of BMI (WHO, 2011c). It is important to find a way to combat obesity, because there are several potential health benefits if an obese individual can reduce their weight. Elia (2009:230) compiled a table of the possible health benefits if weight can be reduced.

**Table 2.2: Potential benefits that may result from the loss of 10 kg in patients who are initially 100 kg and suffer from co-morbidities (Elia, 2009:230)**

Potential benefits	
Mortality	20-25% fall in total mortality 30-40% fall in diabetes-related deaths 40-50% fall in obesity-related cancer deaths
Blood pressure	Fall of about 10 mmHg (systolic and diastolic)
Diabetes	Reduces risk of developing diabetes by >50% Fall of 30-50% in fasting blood glucose Fall of 15% in HbA <sub>1c</sub>
Serum lipids	Fall of 10% in total cholesterol Fall of 15% in LDL cholesterol Fall of 30% in triglycerides Increase of 8% in HDL cholesterol

Exercise is an essential component in the management of obesity, along with diet and lifestyle changes (Murdy & Ehrman, 2009:211). The following discussion will only focus on the role of exercise with regards to the prevention and management of obesity.

As mentioned, physical activity and exercise play an important role in the management of obesity, but is also important in the prevention of obesity. Having an active lifestyle reduces the likelihood of developing obesity (Waller *et al.*, 2008:359; Mustelin *et al.*, 2009:34; Li *et al.*, 2010:1). Waller *et al.* (2008:359) did a 30 year follow-up study of habitual physical activity of 146 pairs of twins and found that persistent participation in leisure-time physical activity is associated with decreased rate of weight gain and with a smaller waist circumference. Research also indicates that physical activity reduces the influence of genetic factors to develop high BMI and waist circumference (Mustelin *et al.*, 2009:34; Li *et al.*, 2010:1). According to Li *et al.* (2010:1), living a physically active life is associated with a 40% reduction in the genetic predisposition to developing obesity. Therefore, individuals at greatest genetic risk for obesity would benefit the most from physical activity (Mustelin *et al.*, 2009:34).

In the management of obesity, physical activity is an essential part. Aerobic exercise training increases energy expenditure by the activation of lipolysis and affects the reduction of body

weight and body fat percentage (Chaudhary *et al.*, 2010:183). Besson *et al.* (2009:502) further observed a strong inverse association between total physical activity, BMI and waist circumference. Bergstörn *et al.* (2009:312) indicated that moderate exercise training reduced waist circumference in a training intensity dependent manner.

The role of physical activity in the management of obesity extends to other health factors as well. Participation in levels of moderate or vigorous physical activity is independently associated with higher, overall levels of health-related quality of life and perceived health status among adults who are overweight or obese (Heath & Brown, 2009:406). The risk for cardiovascular heart disease associated with elevated BMI is considerably reduced by increased physical activity levels (Weinstein *et al.*, 2008:889). This reduction of cardiovascular disease risk can be by means of several factors, namely:

- Exercise training causes a significant reduction in ventricular epicardial fat thickness (epicardial fat thickness is recognised as a cardiac risk) along with a decrease in visceral fat (Kim *et al.*, 2009:10).
- Schrauwen-Hinderling *et al.* (2010:1936) indicated that cardiac lipid content decreases with physical exercise training in healthy overweight individuals. This improvement is paralleled by improved systolic function.
- Miyaki *et al.* (2009:826-827) found that weight reduction due to aerobic exercise training of 12 weeks, in overweight and obese men increases arterial dispensability and these increases might contribute to an improvement in endothelial function. Mestek *et al.* (2010:1669) also concluded that regular physical activity improves endothelial dependent vasodilatation in overweight and obese adults, independent of change in body mass or composition. Greater endothelial vasodilatation function may be an important mechanism underlying the cardio protection conferred to overweight and obese adults who engage in regular aerobic exercise (Mestek *et al.*, 2010:1669). Thus, exercise can improve obesity associated cardiovascular and metabolic abnormalities (Kim *et al.*, 2009:10).

In conclusion, physical activity and the pursuit of physical fitness are important in the treatment of obesity because exercise training can improve a number of metabolic risk factors independent of weight loss; therefore exercise can provide important health benefits irrespective of weight loss in obese and overweight individuals (Hammer & O'Donovan, 2010:5).

#### 4.1.5 Coronary artery disease (CAD)

Cardiovascular disease comprises of diseases of the heart and blood vessels and is not a single disorder, rather a general name for different diseases such as, coronary heart disease, stroke, myocardial infarction, heart failure – to name a few (Nieman, 2007:369). An estimated 17,1 million people died from cardiovascular disease in 2004, which is 29% of all global deaths. Of these deaths an estimated 7,2 million were due to coronary heart disease (WHO, 2011d).

Coronary artery disease (CAD), sometimes referred to as coronary heart disease or ischemic heart disease, is a major form of heart disease and describes cardiac disease caused by impaired coronary blood flow (Nieman, 2007:374; Balistrieri & Mussatto, 2009:536).

Atherosclerosis, the underlying cause of coronary heart disease, is a chronic inflammatory condition involving the sub-endothelial layer of the coronary as well as other large and medium-sized arteries (Balistrieri & Mussatto, 2009:536). Diseases of the coronary arteries can cause myocardial ischemia and angina, myocardial infarction, cardiac arrhythmias, conduction defects, heart failure and sudden death (Balistrieri & Mussatto, 2009:536). Risk factors for the development for atherosclerosis can be divided in modifiable, non-modifiable and contributing risk factors. Major modifiable risk factors include; diabetes, cigarette smoke, cholesterol, obesity, hypertension and physical inactivity (Jackson *et al.*, 2004:180; Nieman, 2007:377; Matfin, 2009:484; ACSM, 2010:28). Major non-modifiable risk factors are age, gender and genetics (Jackson *et al.*, 2004:180; Nieman, 2007:377; Matfin, 2009:484). Stress and excessive alcohol use are considered contributing risks factors (Jackson *et al.*, 2004:180; Nieman, 2007:377; Matfin, 2009:484).

As already stated, physical inactivity has been identified as a major risk factor for the development of CAD, therefore the increase to physical activity patterns in individuals who have or are at risk of CAD has been identified as possible means to reduce the risk of CAD and the certain risk factors. Physical activity is associated with a reduced risk of CAD (Sundquist *et al.*, 2005:224; Rothenbacher *et al.*, 2006:1320). D'Amore and Mora (2006:284) stated that 30 minutes of physical activity most days of the week have been associated with 30-50% reduction in coronary events and coronary mortality. According to Sundquist *et al.* (2005:222), women and men who participate in physical activity at least twice a week have a 41% lower risk for developing CAD. Changing from a sedentary to a more active lifestyle even later in adulthood can strongly decrease CAD risk (Rothenbacher *et al.*, 2006:1320).

The mechanism by which physical activity reduces the risk for CAD by reducing risk factors has been discussed in the previous section. However, there are several other possible mechanisms by which physical activity reduces and prevents the prevalence of cardiovascular artery disease and will be briefly discussed:

- *Coronary flow*

Exercise training shows a favourable effect on blood flow in an ischemic myocardium (Kendziorra *et al.* 2005; Yoshinaga *et al.*, 2006:1324.e17). These effects include increased coronary flow reserve, in normal and diseased segments as well a hyperaemic myocardial blood in diseased segments in individuals with chronic stable coronary artery disease and exercise induced myocardial ischemia (Yoshinaga *et al.*, 2006:1324.e14-1324.e15). Kendziorra *et al.* (2005) investigated the effect 12 months of regular training on myocardial perfusion and concluded that ischemia is reduced in not only the target region of the leading stenosis, but also the ischemic myocardial regions. These improvements of myocardial perfusion after exercise training may be part of the explanation of the benefits of physical activity and CAD.

- *Carotic intima media thickness*

According to Sato *et al.* (2008:161), an increase in daily walking distance could retard the progression of carotid intima-media thickness in individuals with coronary artery disease. Lee *et al.* (2009:674-675) indicated that high levels of cardiorespiratory fitness were associated with a lower risk of having carotid atherosclerosis in middle-aged and elderly men.

- *Cytokines and Inflammation*

Exercise training in individuals with CAD induces significant reduction in inflammatory cytokines (Goldhammer *et al.*, 2005:96-98; Kim *et al.*, 2008:1087; Fernades *et al.*, 2011:83). Physical activity may lower the risk for CAD in individuals with chronic CAD by mitigating inflammation which plays a role in the pathophysiology of atherosclerosis. Aerobic exercise training in CAD is an effective means in inducing certain pro- and anti-inflammatory cytokines and C-reactive proteins, thus a possibility of improving the risk profile (Goldhammer *et al.*, 2005:96-98; Rankovic *et al.*, 2009:46).

- *Endothelial dysfunction*

Endothelial dysfunction has been identified as a predictor of cardiovascular events, because endothelial dysfunction and lipid infiltration are fundamental for the initiation and progression of the atherosclerotic process (Widmaier *et al.*, 2011:415). According to Faisidfar *et al.* (2008:373), moderate intensity exercise, nearly at anaerobic threshold level, should be recommended for individuals with CAD as a therapeutic and preventative strategy to reduce the level of endothelial dysfunction. Linke *et al.* (2006:281) considered that the partial reversal of endothelial dysfunction secondary to exercise training might be most likely the mechanism responsible for the exercise training induced reduction in cardiovascular mortality and morbidity in individuals with CAD.

- *Baro-reflex*

Long-term, mixed type moderate intensity exercise training leads to beneficial effects of baro-reflex activity (Mameletzi *et al.*, 2011:225). These effects include baro-reflex sensitivity and effectiveness index. Mameletzi *et al.* (2011:223) concluded that this type of exercise regimen could be a positive intervention strategy.

From the discussion it is clear that regular physical activity prevents or reduces the development of coronary arterial disease. The prevention can be by means of reducing risk factors or by several interrelated physiological adaptations.

## **4.2 Physical activity in selected components of psychological health**

Physical activity does not only affect physical components of health but the psychological components as well. In the following section two of the emotional health components, namely; stress and depression, will be discussed.

### **4.2.1 Stress**

Stress is a state of physical and mental tension in response to a situation that is perceived as a threat or challenge (Powers & Dodd, 2009:295). Therefore, stress can be defined as any situation or action that places special physical and psychological demand on an individual (Nieman, 2007:574). Hans Selye, the originator of the concept of stress, wrote that in its medical sense, stress is essentially the rate of wear and tear in the body and the nonspecific response of the body to any demand (Selye, 1956:55). This chronic wear and tear of stress can contribute to poor quality of life and an increased risk for diseases such as CVD and hypertension and can cause suppression of the immune system (Jackson *et al.*, 2004:282). However, according to Selye (1956:300), not all stress is harmful, and stress applied in moderation is necessary for life. It appears that humans need some degree of stress to stay healthy, because even though the human body needs some sort of balance (homeostasis), it also requires occasional arousal to ensure that the heart, muscles, lungs, nerves, brain and other tissue stay in good shape (Selye, 1956:300). Due to this opinion, stress can be divided into two categories namely, eustress and distress. Eustress is good stress and appears to motivate and inspire, whereas distress is considered bad stress and can be acute or chronic (Powers & Dodd, 2009:295; Nieman, 2007:574). Acute distress is quite intense, but disappears quickly, whereas chronic distress is not so intense, but lingers for prolonged periods of time (Nieman, 2007:574). Some level of stress (eustress) is desirable for optimal performance and well-being; however, it can reach a point where stress can become too much (distress) and it

starts to inhibit an individual's mental, emotional and physiological abilities to function effectively (Buckworth & Dishman, 2002:77).

When the human body is under threat or is excited, it elicits a set of neuroendocrine responses, including an increased secretion of glucocorticoids and catecholamines from the adrenal gland and the activation of the sympathetic nervous system (Tsatsoulis & Fountoulakis, 2006:196; Widmaier *et al.*, 2011:336). The process occurs when the hypothalamus stimulates the anterior pituitary gland to secrete adrenocorticotrophic hormone (ACTH), a chemical messenger that travels to the adrenal cortex and stimulates the release of hormones such as cortisol (Sharkey & Gaskill, 2007:39; Widmaier *et al.*, 2011:336). As mentioned, stressful situations also elicit a response in the sympathetic nervous system that leads to the secretion of hormones from the adrenal medulla, including epinephrine and norepinephrine (Widmaier *et al.*, 2011:339). These hormones mobilise energy and support the cardiovascular response to the stressor and are necessary for the body to respond to stressful situations. This aspect of the stress response is called the fight-or-flight mechanism (Sharkey & Gaskill, 2007:39; Widmaier *et al.*, 2011:336).

The stress response was essential for survival from physical aggression in ancient times; however this threat has disappeared in our industrialised societies. In today's environment the same stress response can be elicited by emotional stimuli or professional or social stress (Tsatsoulis & Fountoulakis, 2006:196). This kind of psychological stress may be protracted and unrelated to an increased metabolic demand which results in a chronic activation of the stress system. This chronic activation of the stress response can result in several health adverse effects. These effects include:

- The increase in plasma cortisol associated with psychological stress can decrease the activity of the immune system enough to reduce the body's resistance to infection. It can worsen the symptoms of diabetes because of its effect on blood glucose and it may possibly cause an increase in the death rate of certain neurons (Widmaier *et al.*, 2011:339).
- The prolonged and repeated activation of the sympathetic nervous system may enhance the development of certain diseases, particularly atherosclerosis and hypertension (Widmaier *et al.*, 2011:339).
- The mobilisation of energy, but not used, resulted in the storage of visceral fat depots by the combined action of hypercortisolism and hyperinsulinemia (Tsatsoulis & Fountoulakis, 2006:199).

Due to these metabolic disturbances it could lead to the clinical expression of a number of comorbidities including central obesity, hypertension, dyslipidaemia and endothelial dysfunction, all components of the metabolic

syndrome and cardio-metabolic risk factors (Tsatsoulis & Fountoulakis, 2006:200; Widmaier *et al.*, 2011:339). For example, Epinephrine makes the blood clot faster and increases blood pressure, an advantage in a fight, but a disadvantage in the workplace, where it can precipitate a heart attack or stroke (Sharkey & Gaskill, 2007:39).

- The suppression of the gonadal, growth hormone and thyroid axes (Tsatsoulis & Fountoulakis, 2006:198).
- Moreover, chronic stress has deleterious effects on the brain and in particular affects hippocampal structures and functions leading to cognitive and mood disturbances (Tsatsoulis & Fountoulakis, 2006:2003).

Regular physical activity is considered one of the most important habits an individual can acquire to improve mood and manage stress (Nieman, 2007:579). This is because regular, moderate physical activity minimises the effects of stress and can offset negative stress emotions and possibly enhance positive stress emotions (Buckworth & Dishman, 2002:77; Sharkey & Gaskill, 2007:39). According to Lavie *et al.* (2011:469), marked improvements in psychological stress and psychological stress-related mortality were demonstrated after a formal exercise program. Lavie *et al.* (2011:469) concluded that exercise, training and improvements in cardiovascular fitness may be highly beneficial in the management of individuals with high levels of psychological stress.

One of the mechanisms that has been identified as a possible means by which physical activity or exercise can reduce the effects of psychological stress is its effect on the cardiovascular reaction (Plante & Karpowitz, 1987:676; Spalding *et al.*, 2004:560; Alderman *et al.*, 2007:764). Individuals that exercise show less physiological reaction to stressors and the recovery periods (Plante & Karpowitz, 1987:676). Spalding *et al.* (2004:560) are of the same thought and concluded that aerobic training lowered cardiovascular activity levels during psychological stress and recovery. Alderman *et al.* (2007:764) determined that cardiovascular responses during psychological stress and recovery from stress are reduced following a low or high intensity bout of aerobic exercise.

This lowered cardiovascular activity could imply a protective role against an age-related increase in coronary heart disease for individuals who adopt aerobic exercise early in life and maintain the behaviour across the life span (Spalding *et al.*, 2004:560). According to Spalding *et al.* (2004:560), a six week program of aerobic exercise training lowered overall heart rate and systolic blood pressure, as well as stress and recovery rate-pressure product. Alderman *et al.* (2007:764) also found that low and high intensities of aerobic exercise can result in significantly reduced heart rate, systolic blood pressure and diastolic blood pressure reactivity, as well as heart rate recovery values during stress.



As with physical activity, physical fitness can also play a role. In a meta-analysis Forcier *et al.* (2006:723) investigated whether physical fitness attenuates cardiovascular reactivity and improves recovery from acute psychological stressors. Forcier *et al.* (2006:734-735) indicated that fit individuals significantly attenuated heart rate and systolic blood pressure reactivity and a trend toward attenuated diastolic blood pressure reactivity. These individuals also showed faster heart rate recovery.

Other positive effects that regular physical activity can contribute is: it can have a relaxing and tranquilising effect, counters the tendency to form blood clots, lowers blood pressure and reduces epinephrine and cortisol (Sharkey & Gaskill, 2007:39). Regular activity also enhances the function of the immune system, but it is important to note that the exhaustion of running a marathon is immunosuppressive (Sharkey & Gaskill, 2007:39).

In conclusion, regular physical activity is a coping mechanism that serves to improve tolerance to psychological stress. Although meditation and other forms of stress management are useful, regular moderate physical activity is the best form of stress management, because it provides the benefits of meditation and relaxation while delivering added health benefits, including weight loss, reduced risk of CVD, hypertension, cancer, diabetes and other illnesses (Sharkey & Gaskill, 2007:40).

#### **4.2.2 Depression**

The term depression is often used to describe varying levels of psychological distress, ranging from a dysphoric mood state to the diagnosis of a clinical disorder such as major depressive disorder (MDD) (Barbour, 2009:169). Thus, depression is difficult to define due to the fact that it includes several different types of mood disorders with opposite symptoms such as an increase or decrease in sleep and appetite (Buckworth & Dishman, 2002:132). The most common form of clinically diagnosed depression is major depressive disorder. When an individual experiences a major depressive episode, the symptoms cause significant distress and impairment in social and occupational settings as well as in other areas of the person's life (Jackson *et al.*, 2004:273).

Depression can occur on its own, independent of any other illness, or it can arise secondary to other medical disorders (Widmaier *et al.*, 2011:239.). Thus, depression can be caused by diseases that have biological consequences for the brain, psychological or catastrophic events or even stem from loss of self-esteem. It can also be caused by overstimulation of the sympathetic nervous system and the hypothalamic-pituitary-adrenal cortical system resulting from persistent anxiety or other forms of emotional stress (Jackson *et al.*, 2004:273).

In South Africa, the prevalence of MDD was investigated in the time period of 2002-2004 by the South African Stress and Health study. It was concluded that 4,9% of South Africans experienced MDD in a 12-month period (Herman *et al.*, 2009:340; Tomlinson *et al.*, 2009:369). Lifetime prevalence was estimated at 9,7% of South Africans (Tomlinson *et al.*, 2009:369). These results indicated that South African have lower rates of depression than USA but higher rates than Nigeria (Tomlinson *et al.*, 2009:369).

Physical activity is associated with reduced concurrent depression symptoms (Harris *et al.*, 2006:84). It appears that physical activity may be especially helpful in the context of medical problems and major life stressors (Harris *et al.*, 2006:84)

Studies suggest that an inverse association exist between physical activity, or more precise exercise, and depression or the prevention of depression symptoms, and that this association between exercise and reduced depression scores is observed in individuals of all ages (Augestad *et al.*, 2008:543; Harbour *et al.*, 2008:524; Taliaferro *et al.*, 2009). Augestad *et al.* (2008:543) indicated that young men and women who exercise are less likely to have high depression scores, compared with physically inactive individuals. Taliaferro *et al.* (2009) found that among college students, those who participated in physical activity, especially aerobic activity, showed a reduced risk of hopelessness, depression and suicidal behaviour, compared to their inactive counterparts. Harbour *et al.* (2008:524) gained similar results that indicated that students who reported depression symptoms most often also reported being engaged in significantly less vigorous physical activity than those reporting being downhearted and blue none of the times, suggesting an increasing trend (these results were consistent by gender).

Physical activity can also help with the reduction of depression symptoms and an additional effect of reducing physical disability and enhancing physical health in older adults (Brenes *et al.*, 2007:65-66; Lee & Park, 2008:255). Lee and Park (2008:255) indicated that the effect of physical activity pertains to at least a moderate amount of activity and is prominent in individuals with high initial levels of depressive symptoms and disability. Lindwall *et al.* (2006:49) found that inactive elderly had higher depression scores than more active individuals. Individuals who are continuously active also report lower depression scores (Lindwall *et al.*, 2006:49). Therefore, exercise shows promise as treatment for late-life minor depression; however exercise has the added benefit of improving physical functioning as well (Brenes *et al.*, 2007:65-66).

According to research, the intensity, type, frequency and program type of physical activity play a role in its effect on depression (Balkin *et al.*, 2007:33; Legrand & Heuze, 2007:357-358; Harbour *et al.* 2008:523; Lin *et al.*, 2008:102). Lin *et al.* (2008:102) found that leisure-time physical activity is predictive of lower depression scores in women and that it appears that *high intensity* leisure-time physical activity can result in even lower depression scores. Harbour *et al.*

(2008:523) are of the same opinion by stating that vigorous physical activity may be associated with a reduction in depressive symptoms. These results might indicate that a dose-response relationship exists between vigorous physical activity and symptoms of depression. Legrand and Heuze (2007:357-358) signify that the *frequency* of physical activity might also be a contributing factor in depression scores. Their results show that after an eight-week aerobic exercise program, individuals in the study group that participated in physical activity more frequently reported lower depression scores than those who participated in physical activity less frequently (Legrand & Heuze, 2007:357-358). Balkin *et al.* (2007:33) considered the efficiency of aerobic or anaerobic exercise participation in the reduction of the depression. They concluded that young women who participated in aerobic exercise experienced a significant and meaningful decrease in depression symptoms; however this effect was not seen in women who participated in anaerobic exercises. Thus, although physical exercise is an important aspect to overall wellness, the type of physical exercise should also be considered when working with women who exhibit depressive symptoms (Balkin *et al.*, 2007:33). Craft *et al.* (2007:1507) investigated the difference between a three month clinic and home-based exercise program for the reduction of depression symptoms. Both programs were associated with a reduction in depressive symptoms, as well as an increase in physical activity participation by the participants after the study was done. Therefore, even a home-based exercise program appears to be beneficial for individuals with depression symptoms (Craft *et al.*, 2007:1507).

Higher cardiorespiratory fitness is also associated with a lower risk of incident depressive symptoms independent of other clinical risk predictors (Sui *et al.*, 2009:548). According to Sui *et al.* (2009:548), men with high cardiorespiratory fitness have 51% lower depression symptoms and those with moderate cardiorespiratory fitness have 31% prevalence of depression symptoms.

Physical activity has the potential to improve mild to moderate cases of depression (Sharkey & Gaskill, 2007:38). The following section will discuss the proposed mechanism by which physical activity improves emotional and psychological health

### **4.3 Proposed mechanisms by which physical activity improves emotional and psychological health**

Given the complexity of physical activity behaviour and the various psychological responses to exercise, it is possible that no particular mental health effect can be adequately explained by a single process. Multiple mechanisms may well interact to affect both short-term and long-term psychological functioning (Raglin *et al.*, 2007:254). As a result, both neurochemical (physiological) and psychosocial variables have been implicated to contribute to the pathophysiology of depression (Barbour, 2009:170). Therefore, both physiology and cognitive explanations have been used in an attempt to explain improvements in mental health as a result of physical activity participation (Shakey & Gaskill, 2007:34; Raglin *et al.*, 2007:253). However, the exact mechanism responsible for this relationship is unknown (Raglin *et al.*, 2007:253). Table 2.3 summarises the proposed biological mechanisms that may be responsible for the benefits of exercise in mental health and Table 2.4 the psychological mechanisms.

**Table 2.3: Proposed biological mechanisms for the psychological benefits of exercise.**

	Hypothesis	Comments
Biological Mechanisms	Central monoamine theory	Disturbances in the brain secretions of three monoamine neurotransmitters – serotonin, dopamine and norepinephrine – have been implicated in depression and other psychological disorders (Raglin <i>et al.</i> , 2007:253-254; Nieman, 2007:583). Physical activity may alter mood states through its effect on one or all three of these neurotransmitters (Raglin <i>et al.</i> , 2007:253-254). In other words, exercise could play a role in the treatment and prevention of depression and other mental disorders by promoting optimal neurotransmitter secretions (Nieman, 2007:583). Unfortunately, this remains uncertain on the basis of available data due to that it is impossible to accurately measure levels of these hormone in the brain (Nieman, 2007:583; Raglin <i>et al.</i> , 2007:254).
	Endogenous opioids/ endorphins	Endorphins are chemical substances produced by the brain, pituitary glands and other bodily tissue. The most prominent endorphins are $\beta$ -endorphin and enkephalin. Endorphins act as natural opiates by binding to opiate receptor sites involved in perception of pain and they have been implicated in reward mechanisms and positive emotions. Physical stressors such as exercise can stimulate the production of endorphins and this has led to the belief that endorphins are responsible for the popular but unsubstantiated phenomenon known as the 'runners high' (Raglin <i>et al.</i> , 2007:253-254). However, most investigators do not favour this theory due to the lack of direct evidence (Raglin <i>et al.</i> , 2007:254).
	Thermogenic	This hypothesis proposes that corresponding changes in body temperature that occur during exercise are associated with increase central and peripheral neuron activity in the brain, as well as decreased muscle tension. These physiological changes enhance mood state (Jackson <i>et al.</i> , 2004:284-285; Raglin <i>et al.</i> , 2007:253-254)
	Hypothalamic-pituitary-adrenal cortex system	During stress the brain stimulates energy production through the Hypothalamic-Pituitary-Adrenal Cortex system. The front half of the pituitary gland co-release $\beta$ -endorphin and the hormone, adrenocorticotropin (ACTH), which stimulates the outer part of the adrenal gland to secrete cortisol (Jackson <i>et al.</i> , 2004:288). Cortisol repairs tissue and maintains blood glucose levels during stress (Jackson <i>et al.</i> , 2004:288). Highly fit individuals can secrete more ACTH and cortisol during maximal exercise than individuals who have low fitness levels, but ACTH and cortisol during submaximal exercise are lowered by exercise training. Thus, fit individuals have an increase capacity to respond to severe stress (Jackson <i>et al.</i> , 2004:288)  Cortisol has a role in the response to physical and mental stress as well as in central nervous system dysregulation associated with mood disorders (Buckworth & Dishman, 2002:53). The major effects of cortisol include control over metabolism (stimulation of gluconeogenesis and mobilisation of fatty acids for fuel during exercise (Buckworth & Dishman, 2002:53).

**Table 2.4: Proposed psychosocial mechanisms for the psychological benefits of exercise**

	Hypothesis	Comments
<b>Psychological Mechanisms</b>	Cognitive-behavioural/ Mastery	Feelings of achievement or personal mastery result from the successful completion of task (Raglin <i>et al.</i> , 2007:254). Therefore, individuals who master something that they perceive as difficult (exercising regularly) may experience a positive change in their psychological health manifested by increased self-confidence, improved self-efficacy, ability to cope with personal problems, uplifted vigour and general well-being and lessening anxiety and depression (Nieman, 2007:583; Jackson <i>et al.</i> , 2004:283). For example, in the case of exercise, the successful completion of an acute bout of exercise or a long-term exercise regimen improves mood and mental health through enhancing an individual's self-efficacy (Raglin <i>et al.</i> , 2007:253-254).
	Social interaction	Exercise is often performed with others, leading to improved opportunities for social interaction, pleasure, and personal attention. It has been hypothesised that this could account for the antidepressant and mood elevation effects of exercise (Nieman, 2007:583).
	Time-out/distraction	Psychological benefits associated with exercise may not be related to underlying physiological mechanisms but rather the fact that participation in physical activity typically occurs in a setting removed from stressful environments (Raglin <i>et al.</i> , 2007:253-254). Evidence suggests that the mood elevation experienced after exercise is due to more than simply taking time out from one's daily routine (Nieman, 2007:583). Hence, an individual is distracted from potential stressors and provided with a pleasant diversion (Raglin <i>et al.</i> , 2007:253-254). This hypothesis maintains that being distracted from stressful stimuli, or taking a 'time-out' from the daily routine is responsible for the mood elevation seen with exercise. Exercise has been found to reduce depression and anxiety more than relaxation (time-out) or enjoyable activities (distraction) (Nieman, 2007:583; Sharkey & Gaskill, 2007:34). Regular exercise may lead to a more effective long-term mood elevation than habitual relaxation (Nieman, 2007:583).

## 5. Physical activity and medical costs

### 5.1 Financial burden of disease

Chronic diseases affect individuals of all ages, thus have a major economic impact on individuals, families, the health system and society at large (Puoane *et al.*, 2008:79). These economic burdens can be due to direct medical expenditures/costs or indirect medical expenditure/costs. Direct medical expenditure refers to the treatment and the management of the disease and indirect medical expenditure refer to loss of income due to illness that affect productivity or employment due to major disabilities.

Selected physical and emotional health conditions will subsequently be discussed with regards to the medical expenditures. South African data and statistics with regards to the medical

expenditure of these conditions are relative few, thus international data and statistics will also be discussed.

## **5.2 Direct medical cost of physical- and psychological health components**

*Cardiovascular disease* remains the leading cause of death worldwide and is the second biggest cause of death in South Africa (HSSA, 2011:1). Therefore, CVD has a severe impact on the South African economy. The direct medical cost of CVD includes screening individuals for heart disease or risk factors thereof, the actual cost of drugs, the cost of clinic and doctor's visits and laboratory tests done to monitor individuals (Steyn, 2007:27). In 1991, the estimated total cost of CVD in South Africa was between R4 135 billion and R5 035 billion (Pestana *et al.*, 1996:682). The direct medical costs were estimated to be approximately 42% of the total cost. This did not include the cost of rehabilitation and follow-ups for CVD patients. With this substantial financial burden of CVD, it is important to consider the medical expenditures of the risk factors for CVD. According to Jee *et al.* (2001: 244), the presence of multiple risk factors can double the medical cost. In some cases these conditions co-exist and therefore increase the medical expenditures even more. Risk factors of CVD include hypertension, high cholesterol, diabetes, obesity and physical inactivity (ACSM, 2010:28).

In the USA, *hypertension* expenditure represents a significant amount of health care resources used, and the increment direct medical expenditures are estimated at nearly \$55 billion in 2001, after adjusting for demographics and co-morbidities (Balu & Thomas, 2006:810). According to NAAS (2000:5), the annual median health care expenditures for adults with hypertension are four times greater than the expenditures of those without hypertension. Flack *et al.* (2002:28) evaluated the effect of inadequate blood pressure control on selected CVD in USA patients with hypertension. The results indicated that inadequate blood pressure control resulted in \$964 million in direct medical expenditures. Within the medicated population with CVD, the incremental costs of failure to attain blood pressure goals reached approximately \$ 467 million. According to Nakamura *et al.* (2005:863), hypertension-related medical costs for all hypertensives accounted for 23,7% of the total medial cost for the Japanese population.

*Cholesterol* is one of the leading risk factors for the development of CVD (ACSM, 2010:28). The data from the 2004 USA Medical Expenditure Panel Survey (MEPS) indicated that cholesterol-reducing medication ranked first and second of the total medicine expenditure. The estimated medical expenditure for beneficiaries in medical private insurance was \$423 billion and for outpatient prescriptions an estimated \$713 billion (Stagnitti, 2007).

*Obesity* is a worldwide health concern and can lead to substantial medical expenditures. Arterburn *et al.* (2005:335) indicated that in 2000, the odds of incurring any health care

expenditure among adults with morbid obesity, compared with normal weight individuals, the expenditure was two-fold greater. In this year, per capita health care expenditure for morbidly obese adults was 81% greater than normal weight adults, 65% greater than overweight adults and 47% greater than Class I obesity (Arterburn *et al.*, 2005:336). Arterburn *et al.* (2005:338) discovered that 10,2% of all US healthcare expenditures in 2000 were associated with excess body weight. This total adds up to \$56 billion (Overweight = \$17,2 billion; Class I obesity = \$16,5 billion; Class II obesity = \$11,2 billion and Class III obesity = \$11.1 billion). These excess costs among morbidly obese adults result from greater expenditure for office based visits, outpatient hospital care, in-patient care and prescription drugs (Arterburn *et al.*, 2005:336). Wang *et al.* (2006:673) found that within the BMI range of 25-45 kg/m<sup>2</sup>, medical costs increased by \$ 119,7 per BMI unit (adjusted for age and gender). These medical costs can even increase in the presence of diabetes and CVD. The likelihood of having any medical claim increases by 11,6% per BMI unit for diabetes and 5,2% for CVD (Wang *et al.*, 2006:670-671).

*Diabetes* is also a major health concern and risk factor (ACSM, 2010:28). According to Schmitt-Koopmann *et al.* (2004:8), individuals in Switzerland spent 10,3 consultations annually related to diabetes, and patients spent on average 2,7 days annually in hospital due to diabetes and diabetes-related complications. Schmitt-Koopmann *et al.* (2004:8) also indicated that 22% of the country's total health care costs are represented by diabetes, which shows that the mean annual diabetes-related medical expenditure per patient amounted to €2323. In Italy, the average medical expenditure was found to be €1901,67 per patient with diabetes and that included pharmacological therapies (52%), hospitalisation (28%) and diagnostics examinations (11%). However, these annual costs increase with the number of diabetes-related co-morbidities (Morsanutto *et al.*, 2006:167). In 2002 the MEPS indicated that in the USA an estimated cost of diabetes ranged from \$79,1 billion to \$88,8 billion (Olin *et al.*, 2008:17). Medical expenditures due to diabetes increased with co-morbidities and with complications (Egede *et al.*, 2002:467; Schmitt-Koopmann *et al.*, 2004:8; Morsanutto *et al.*, 2006:167; Pelletier *et al.*, 2008:110). According to Egede *et al.* (2001:467), individuals who have diabetes are twice as likely to suffer from clinical depression and thus will have higher medical expenditures. Egede *et al.* (2002:467) estimated that the total health expenditure for individuals with diabetes and depression were 4,5 times higher than for individuals without depression (\$ 247 million vs. \$ 55 million).

Depression as a co-morbidity is not only a complication in cases with individuals with diabetes. It is also prevalent in other chronic diseases (Simon *et al.*, 1995). According to Simon *et al.* (1995), individuals with depression are more likely to experience greater chronic medical illness with cost differences that are approximately 50% higher than for those who do not have depression. Welch *et al.* (2009) showed similar findings in a study where researchers examined insurance claims for individuals with certain chronic diseases. Results show that individuals



with depression had a higher median per patient annually, and non-mental health costs than individuals without depression across certain chronic diseases (Welch *et al.*, 2009).

Depression and other mental disorders can be an economic burden on its own. According to Greenberg *et al.* (2003), the economic burden of depression (direct and indirect cost) in the US was estimated to be \$ 42,7 billion in 1990. Greenberg *et al.* (2003:1471) indicated that the economic burden of depression rose by 7% from 1990 to 2000, going from \$ 77,4 billion in 1990 (inflation-adjusted dollars) to \$ 83,1 billion in 2000. These costs reflect direct medical costs (\$26,1 billion = 31%), suicide-related mortality (\$5,4 billion = 7%) and workplace cost (\$51,1 billion = 62%). This shows that the mental and emotional components of health can cause a substantial increase in medical cost. In the USA, medical expenditure for mental disorders was estimated in 1996 to be \$35,2 billion (in 2006 dollars) and this estimated increased to \$57,5 billion in 2006 (Soni, 2009:1). In 2007, medical expenditure to treat anxiety and mood disorder totalled \$ 36,8 billion. This amounted to an average of \$1374 per adult (Soni, 2009:1). In Canada the total spending on mental health was \$ 6,6 billion for the period 2003/2004. This was estimated to be 5,6% of all health expenditure (Jacobs *et al.*, 2008:308).

### **5.3 Physical activity and direct medical cost**

Physical activity plays an important role in the advancement and maintenance of an individual's health. However, the question arises whether this benefit extends to medical expenditures. Researches have investigated this question in several studies and on several medical conditions (Pratt *et al.*, 2000; Garrett *et al.*, 2004; Wang & Brown, 2004; Wang *et al.*, 2004; Anderson *et al.*, 2005; Brown *et al.*, 2005; Andreyeva & Sturm, 2006). Studies that investigate the effect of physical activity on medical expenditure are rare in South Africa. The following table gives a summary of studies done about the influence of physical activity or the lack thereof (physical inactivity) on direct medical expenditure.

**Table 2.5: Studies that investigate the influence of physical activity (or the lack thereof) on medical expenditures or costs**

Reference	Data and method	Aim of study	Important results and conclusions
Keeler <i>et al.</i> , 1989	Data: National Health Interview Survey and the RAND health insurance experiment Study: N= 22418, 18 years and older	To estimate the external cost (cost borne by others) of a sedentary lifestyle.	1. Individuals with sedentary lifestyles incur higher medical cost.
Katzmarzyk <i>et al.</i> , 2000	Data: Data used from the Physical Activity Monitor Survey by the Canadian Fitness and Lifestyle Research Institute. Study: N=1875, 18 years and older	To estimate the direct health care cost attributable to physical inactivity in Canada.	1. About \$2,1 billion (2.5%) of the total direct health care cost in Canada, was attributable to physical inactivity in 1999. 2. About 21 000 lives were lost prematurely in 1995 because of physical inactivity. 3. A 10% reduction in the prevalence of physical inactivity has the potential to decrease direct health care expenditures by \$150 million a year
Pratt <i>et al.</i> , 2000	Data: 1987 National Medical Expenditures Survey (USA) Study: N= 20041, 15 years and older with no physical limitation, and non-pregnant women.	To describe the direct medical expenditure associated with physical inactivity	1. The average annual direct medical cost for those who were regularly physically active was \$1 019 and those who reported being inactive \$1 349. 2. Medical care use (hospitals, physician visits and medication) was lower for physically active individuals than for inactive individuals. 3. The mean net annual benefit of physical activity was \$330 per person in 1987 dollars. 4. Results indicate that annual national medial costs can be reduced by as much as \$29,2 billion in 1987 dollars (\$76,6 billion in 2000 dollars) by increasing participation in regular moderate physical activity.
Garrett <i>et al.</i> , 2004	Data: Behavioural risk factor surveillance system and medical claim (2000) Study: N= 1,5 million, 18 years and older	To estimate the total medical expenditures attributable to physical inactivity	1. Nearly 12% of depression and anxiety and 13% of colon cancer, heart disease, osteoporosis and stroke cases were attributable to physical inactivity. 2. Heart disease was the most expensive (\$35,3 million in 2000) outcome of physical inactivity. 3. Total health plan expenditures attributable to physical inactivity were \$83.6 million.

**Table 2.5: Studies that investigate the influence of physical activity (or the lack thereof) on medical expenditures or costs (continue)**

Reference	Data and method	Aim of study	Important results and conclusions
Wang <i>et al.</i> , 2004	Data: 1996 Medical expenditure panel survey and 1995 National health interview survey Study: N=2472, 19 years and older, pregnant women excluded	To estimate the direct medical expenditure of cardiovascular disease associated with inactivity	<ol style="list-style-type: none"> <li>1. The prevalence of cardiovascular disease was 21,5% (16.7% in active persons, 23,6% in inactive persons and 49,5% in persons with physical limitations). There was 7,3 million CVD cases; 1.1 million (15.3%) associated with inactivity.</li> <li>2. The total medical expenditure of persons with cardiovascular disease was \$41.3 billion, of which \$5,.4 billion (13,1%) were associated with inactivity</li> <li>3. Applying these percentages to the total health and economic burdens of cardiovascular disease in the USA, there was 9,2 million CVD cases (\$237 billion direct medial expenditure) associated with inactivity in 2001.</li> </ol>
Wang & Brown, 2004	Data: 1987 National medical expenditures survey (USA) Study: N=12 250, older than 19 years, men and non-pregnant women. Expenditures were updated to 2003	To examine inactivity-associated medical expenditures in adults, controlling for depression symptoms	<ol style="list-style-type: none"> <li>1. Medical expenditures were \$354 lower for active than inactive persons: 6,1% of the expenditure (\$133 in 1987. \$429 in 2003) was inactivity associated.</li> <li>2. The total inactivity-associated expenditure was near \$12 billion in 1987 and \$38 billion in 2003.</li> <li>3. Medical expenditure was lower for individuals with depression symptoms that are physical active.</li> </ol>
Anderson <i>et al.</i> , 2005	Data: 8000 health plan members Study info: members are 40 years and older. Individuals are defined by physical activity status, body mass index, age, sex, smoking status and selected chronic diseases	To estimate the proportion of total health card charges associated with physical inactivity, overweight and obesity in a USA population	<ol style="list-style-type: none"> <li>1. Physical activity, overweight and obesity were associated with 23% of health plan health care charges and 27% of national health care charges</li> </ol>
Brown <i>et al.</i> , 2005	Data: 1996 Medical expenditure panel survey (USA) and 1995 National health interview survey (USA) Study: 354 adults older than 19 years	To determine whether leisure-time physical activity is associated with lower direct annual medical expenditures among adults with mental disorders	<ol style="list-style-type: none"> <li>1. The per capita annual direct medical expenditures were \$2785 higher for sedentary than for active individuals.</li> <li>2. The total expenditures associated with sedentary behaviours were \$21,7 billion (\$19,1 billion in men and \$12,6 billion in women).</li> <li>3. Therefore, physical activity is associated with a reduced economic burden among people with mental disorders.</li> </ol>

**Table 2.5: Studies that investigate the influence of physical activity (or the lack thereof) on medical expenditures or costs (continue)**

Reference	Data and method	Aim of study	Important results and conclusions
Andreyeva & Sturm, 2006	Data: Health and retirement study Study: national longitudinal survey (N=8788), between the age of 54 – 69 years	To examine how physical activity is associated with changes in health expenditure	<ol style="list-style-type: none"> <li>1. After correction for baseline differences in active and inactive groups, physical activity was associated with reduced health care cost of about 7% over 2 years (\$483 annually).</li> <li>2. Regular physical activity in late middle age may lower health expenditure over time.</li> <li>3. The effect is likely more pronounced for the obese, smoker and individual with some baseline health problems.</li> </ol>
Brown <i>et al.</i> , 2008	Data: Australian longitudinal study on women's health Study: cross-sectional analysis of 2001 survey data linked to health service use data for the same year from 7004 mid age women (50-55 years)	To examine the relationships between combined categories of physical activity and BMI with health care cost in women	<ol style="list-style-type: none"> <li>1. Mean annual cost of Medicare-subsidised services was \$ 542.</li> <li>2. Cost was 26% higher in sedentary than in moderately active women and 17% higher in obese than in healthy weight women.</li> <li>3. For sedentary obese women the mean costs were 43% higher, than in healthy weight, moderately active women.</li> </ol>
Bland <i>et al.</i> , 2009	Data: A stratified, random sample of 10000 yielded an analytic data set for 7983 members Study: Eighteen months of medical cost were analysed. Independent variables included self-reported health behaviours of smoking, drinking, nutrition and physical activity	To describe the relationship among modifiable health behaviours and short-term medical cost	<ol style="list-style-type: none"> <li>1. Physical inactivity and smoking were significant predictors of higher medical cost.</li> <li>2. Each day a member did not exercise there was a 2,9% difference in cost.</li> <li>3. Other modifiable health behaviours like alcohol consumption and nutrition were non-significant.</li> <li>4. Main conclusion, physical inactivity was associated with higher short-term medical cost</li> </ol>

## 5.4 Indirect medical costs of physical- and psychological health components

The indirect financial burden of disease is linked to reduced productivity (Pronk *et al.*, 2004:22; Pelletier *et al.*, 2004:750; Collins *et al.*, 2005:555; Cawley *et al.*, 2008:532; Loeppke *et al.* 2009:427; Jing, 2010:21). This can lead to an enormous financial burden. This concern will be discussed under two major subjects namely, absenteeism and presenteeism. Absenteeism is the lost of productivity due the individuals absence, whereas presenteeism is defined as lost productivity that occurs when employees come to work but perform below par due to any kind of illness. Health conditions can have an impact on both presenteeism and absenteeism (Holden *et al.*, 2011:255)

### 5.4.1 Absenteeism

Lilford (2006) indicated that in an average South African company, approximately 4.5% of the workforce is absent on any given day. This figure can even be as high as 18% in certain companies. Subsequently, the financial burden of absenteeism on the South African economy can be as high as R12 billion per year (Lilford, 2006). These figures increased in 2008 and showed that the average person takes 4,1 days unplanned sick leave per year, which is costing the country R19 billion in lost productivity annually (Johnson, 2008; Schoonbee, 2008).

Poor physical health and poor mental health are positively related to increased absenteeism (Frone, 2008:76). Therefore, the cost of absenteeism can rise significantly in the presence of chronic and other diseases (Pronk *et al.*, 2003:22; Pelletier *et al.*, 2004:750; Cawley *et al.*, 2008:532). Especially conditions like obesity and diabetes are prone to increased absenteeism (Pronk *et al.*, 2004:22; Pelletier *et al.*, 2004:750; Cawley *et al.*, 2008:532). Obesity is positively related to increases in the number of work days lost or rather, absenteeism (Tucker & Friedman, 1998; Pronk *et al.*, 2004:22; Adam & Cowen, 2004:135; Jans *et al.*, 2007; Frone, 2008:76). Tucker and Friedman (1998) indicated that obese individuals are more than twice as likely to experience high-level absenteeism (7 or more absences due to illness during a six-month period) and are 1,49 times more likely to suffer from moderate absenteeism (3-6 absences due to illness during a six-month period). Jans *et al.* (2007) showed similar findings and indicated that obese employees were absent 14 days more than normal weight employees and the frequency of absenteeism of more than 7 days was significantly higher. The difference in absenteeism between obese and normal-weight employees was also larger for employees who did not practice sport (Jans *et al.*, 2007).

Other chronic conditions that studies have shown to influence absenteeism are diabetes, cholesterol, hypertension and mental conditions such as stress and depression. According to Cawley *et al.* (2008:532), diabetes is strongly predictive of absenteeism among obese and

morbidly obese employees and costs can rise significantly. Tunceli (2007:1284) also indicated that poor glycaemic control in some cases is associated with increased absenteeism. The same result was established with poor lipid control in men (Tunceli, 2007:1284). Health-related absenteeism is shown to be 20-40% higher in individuals treated with antihypertensive medication (Boumendil & Mugnier, 1998). High levels of stress are also associated with increased absenteeism (Jacobson *et al.*, 1996; Adam & Cowen, 2004:135). According to the results of a study done by Jacobson *et al.* (1996), individuals with high stress levels are more likely to be absent five days and more per year than those with low stress levels. Individuals with symptoms of depression are 2,17 times more likely to take sick days (Adler *et al.*, 2006; Greener & Guest, 2007). Therefore, 50% of the loss of work productivity is due to absenteeism and short-term disability (Kessler *et al.*, 1999). According to Druss *et al.* (2001), depressed workers have 1,5 to 3,2 short-term disability days in a 30-day period.

Wang *et al.* (2003:1309) concluded that chronic conditions have more adverse effects on absenteeism than presenteeism. Therefore, due to these alarming figures, it is necessary that individuals reduce their health risk. According to Pelletier *et al.* (2004:750), an individual can reduce absenteeism by 2% if they reduce their health risks. As discussed in previous sections, physical activity is one of the best components of an intervention to reduce an individual's risk factors and thus reduce absenteeism. Serxner *et al.* (2001:351) have the same opinion and indicated that behavioural health risks which include physical activity and exercise are linked to a reduction in health risk and a reduction in absenteeism (Serxner *et al.*, 2001:351). Jacobson and Aldana (2001:1022) compared the frequency of weekly aerobic activity with annual illness-related absenteeism. A significant relationship was found between absenteeism and exercise. As little as one day of exercise was associated with lower absenteeism when compared with no exercise.

#### **5.4.2 Presenteeism**

Absenteeism's productivity-reducing counterpart, presenteeism, can be even more costly. The problem with presenteeism is that workers are at work but due to illness and other medical conditions are not functioning optimally. This can result in an individual's productivity to be reduced by one-third or even more (Hemp, 2004). Unlike absenteeism, presenteeism is not always apparent. You know when someone is not at work but one often can't tell when or how much an illness or medical condition is hindering an individual's performance (Hemp, 2004).

While the costs associated with the absenteeism of employees have been long studied, the cost of presenteeism is only recently being studied. According to Jing (2010:21), indirect health care costs due to presenteeism are greater than direct medical costs. Thus, presenteeism appears

to be a much costlier problem than absenteeism (Hemp, 2004). Loeppke *et al.* (2009:427) also indicated that this health-related productivity loss is significantly greater than medical and pharmacy costs alone. Collins *et al.* (2005:555) be of the same opinion and stated that the cost associated with performance based work loss (presenteeism) greatly exceeds the combined cost of absenteeism and medical treatment combined.

It is therefore clear that a strong link exists between productivity and health (Loeppke *et al.*, 2009:427; Lenneman *et al.*, 2011:59). Illness affects both the quantity (an individual might work slower than usual) of work and the quality (the individual could make more or more serious mistakes) (Hemp, 2004). As a result, the costs of health-related lost production time are substantial and relatively invisible to employees (Stewart *et al.*, 2003:1243). Health risk factors represent additional causes of lost productivity (Burton *et al.*, 2005:774). According to Stewart *et al.* (2003:1239), health-related lost productive time can cost employees up to \$225,8 billion a year, which add to \$1 685 per employee per year. As much as 71% of this financial burden is due to reduced performance at work.

As with absenteeism, the presence of certain illness or chronic health conditions can increase the prevalence of presenteeism (Pelletier *et al.*, 2004:750; Loeppke *et al.*, 2009:427; Goetzel *et al.*, 2009:495; Parker *et al.*, 2009:1141; Lenneman *et al.*, 2011:59). According to Goetzel *et al.* (2009:495), any health risk can double presenteeism in both men and women. Chronic conditions, such as heart disease, hypertension and obesity are important causes of productivity loss (Goetzel *et al.*, 2004:406; Loeppke *et al.*, 2009:427; Lenneman *et al.*, 2011:60). Goetzel *et al.* (2004:406) indicated that the annual economic burden for heart disease and hypertension are \$368 and \$348 respectively per individual. Of these expenses, presenteeism can be accountable for 18-60% of the cost (Goetzel *et al.*, 2004:406). Emotional health conditions such as depression has a significant economic burden as well and contributed strongly to productivity loss (Holden *et al.*, 2011:255). According to Goetzel *et al.* (2004: 406), the annual economic burden of depression and other mental disease can be up to \$348 per person per year. Of which \$246 of this expense is due to presenteeim.

The prevalence of presenteeism can be reduced by reducing individuals' health risk as Pelletier *et al.* (2004:750) stated that a reduction in health risk is associated with positive change in work productivity. According to Pelletier *et al.* (2004:750), an individual can improve presenteeism by 9% if they reduce their health risks (Pelletier *et al.*, 2004:750). Lifestyle-related modifiable health risk factors have been identified to have significantly impacted employee work performance (Pronk *et al.*, 2004:22). Therefore, an individual can focus on lifestyle-related modifiable health risks to reduce presenteeism.

Pronk *et al.* (2004:23) investigated the association between lifestyle-related modifiable health risks that include physical activity and cardiorespiratory fitness, and work performance, and

came to the conclusion that higher levels of physical activity is related to reduced decrements in quality of work performance. Higher levels of cardiorespiratory fitness is also related to reduced decrements in quality of work performance and a reduction in extra effort exerted to perform work (Pronk *et al.*, 2004:23).

## **5.5 Conclusion**

As discussed in the previous section of this chapter, physical activity and physical fitness play an important role in the prevention and reduction of certain physical and emotional health conditions, therefore by reducing these medical problems absenteeism, presenteeism and medical cost, whether direct or indirect, can be reduced.

## **6. Physical activity among employees in South Africa**

As discussed, physical activity has been linked to increase productivity and reduction in illness related absenteeism (Serxner *et al.*, 2001:351; Pronk *et al.*, 2004:23). However, studies specific to South Africa in this regard are limited and only a few will be discussed.

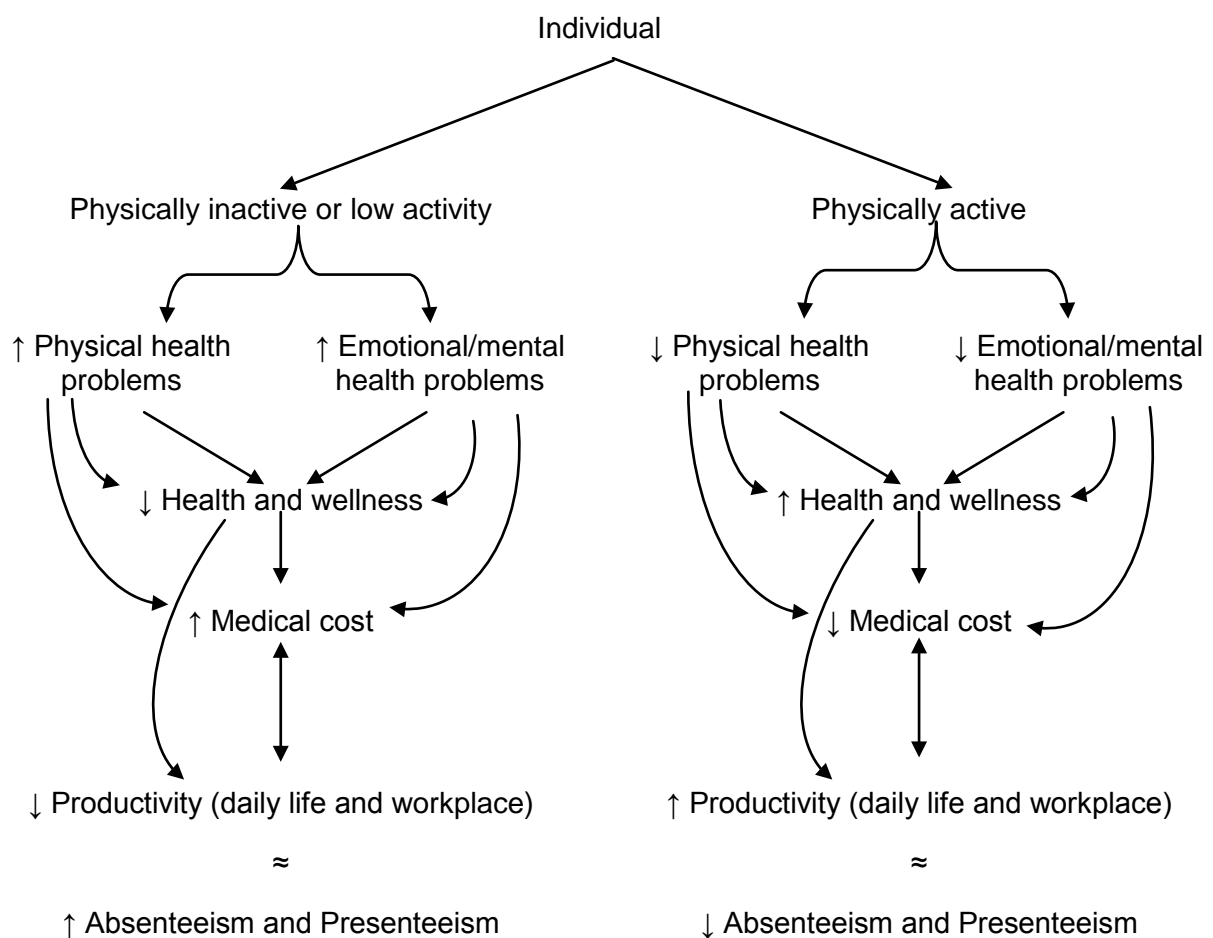
According to Labuschagne *et al.* (2007) employees of a specific financial institution start to show specific health risk before the age of 35 years. The study also indicates that both men and women show low levels of physical activity participation and show moderate risk category for coronary risk profile. This situation can cause employees hypokinetic diseases, which have a negative effect on their health as well as on their work productivity. It can also influence and increase health care costs (Scott, 2005).

A study by Labuschagne *et al.* (2011:90) showed that even moderate participation in physical activity, can help employees and particular the older group ( $\geq 46$  years), to keep healthy and extend their service and productivity for the company. The findings suggest the need for employers and employees to prevent hypokinetic disorders, which may result in reduced productivity, increased health care costs and increased morbidity and mortality (Labuschagne, 2011:88-89).



## 7. Interaction of physical activity, physical health, psychological health and medical cost

The aim of this chapter is to give an understanding of the effect that physical activity has on various factors of health and productivity, as well as the medical costs associated with these conditions. Physical activity, health, productivity and medical costs are part of daily life and affect each individual. Each of these categories is directly or indirectly interrelated and can affect each other on various levels. The following schematic presentation (Figure 2.2) is aimed to show the interaction between these components in a simplified manner.



**Figure 2.2: Interaction between physical activity, physical and psychological health components, medical cost and productivity**

Research shows that the lack of physical activity contributes to the development of hypokinetic diseases. These diseases included hypertension, diabetes, obesity, cardiovascular disease and other chronic diseases (Jackson *et al.*, 2004:180; Nieman, 2007:380; Matfin, 2009:484; ACSM, 2010:7-8). The insufficient participation in physical activity also contributes to certain

emotional conditions such as depression and stress (ACSM, 2010:8). Therefore, taking the above into account, it is clear that low physical activity levels contribute to decreased health and wellness (Nieman, 2007:380; ACSM, 2010:8). The decrease in health and wellness also gives rise to decreased productivity and in turn an increase in absenteeism and presenteeism (Pronk *et al.*, 2004:22; Pelletier *et al.*, 2004:750; Collins *et al.*, 2005:555; Cawley *et al.*, 2008:532; Loeppke *et al.*, 2009:427; Jing, 2010:21). However, the decrease in health and wellness, the decrease in certain health components (physical and emotional) as well as the decrease in productivity and increase in absenteeism and presenteeism, all contribute to an increase in medical cost (Pronk *et al.*, 2004:22; Pelletier *et al.*, 2004:750; Collins *et al.*, 2005:555; Cawley *et al.*, 2008:532; Puoane *et al.*, 2008:79; Loeppke *et al.*, 2009:427; Jing, 2010:21).

As for the opposite side of the schematic illustration, an individual who is physically active and participates regularly in physical activity tends to be less likely to develop certain chronic diseases. Alternatively, those individuals who do have certain chronic diseases and participate in regular physical activity can reduce the severity of the diseases and can control it better or in some cases be free of the disease (Hsia *et al.*, 2005:24; Sundquist *et al.*, 2005:224; Borodulin *et al.*, 2006:1027; Rothenbacher *et al.*, 2006:1320; Kodama *et al.*, 2007:1006; Collier *et al.*, 2008:682; Terra *et al.*, 2008:275; Waller *et al.*, 2008:359; Mustelin *et al.*, 2009:34; Teramota & Golding, 2009:143-144; Brouwer *et al.*, 2010:377; Carvalho *et al.*, 2010:3; Li *et al.*, 2010:1). Due to the decreased occurrence or lesser severity of certain physical health and emotional conditions, an individual will experience an improved health and wellness (Durstine *et al.*, 2009:23; ACSM, 2010:72; Walker *et al.*, 2010:737), which in turn results in lower medical costs and an increase in productivity and a decrease in absenteeism and presenteeism (Jacobson & Aldana, 2001:1022; Serxner *et al.*, 2001:351; Pronk *et al.*, 2004:23).

Consequently, physical activity influences several factors and areas of an individual's life. Therefore it is important to consider it as part of a healthy lifestyle and as part of an intervention when dealing with certain diseases.

## **8. Conclusion**

The role of physical activity in the prevention and reduction of certain diseases is well established in the literature (Hsia *et al.*, 2005:24; Sundquist *et al.*, 2005:224; Borodulin *et al.*, 2006:1027; Rothenbacher *et al.*, 2006:1320; Kodama *et al.*, 2007:1006; Collier *et al.*, 2008:682; Terra *et al.*, 2008:275; Mustelin *et al.*, 2009:34; Teramota & Golding, 2009:143-144; Brouwer *et al.*, 2010:377; Carvalho *et al.*, 2010:3), even to such an extent that physical inactivity is considered a risk factor for the development of cardiovascular diseases and other chronic diseases (ACSM 2010:7-8). Previously, physical activity was used to improve physical fitness

which will lead to improved health. However, in the last decades the focus has lifted from this concept due to the increased evidence that genetics play a major role in a person's fitness profiles. An individual can be inactive and still have high levels of physical fitness. This can cause a false comfort that they are protected from hypokinetic diseases. Due to this complex interaction between physical activity, physical fitness and genetics, it is difficult to establish the precise role of each of these components. Researchers do however agree that a physically active lifestyle is essential for health and quality of life. This has led to the understanding that both physical activity and physical fitness are important.

The majority of the South African population is inactive or insufficiently physically active, and therefore is in danger of certain chronic non-communicable chronic diseases. Not only do these diseases reduce the quality of life of the individuals, but they also have an influence on medical expenditure and can lead to higher levels of absenteeism and presenteeism. Research with regards to absenteeism and presenteeism and its economic burden is not well established in the South African population.

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# Chapter 3

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## Article 1

### Physical activity in relation to selected physical health components in employees of a financial institution

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# Physical activity in relation to selected physical health components in employees of a financial institution

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## Abstract

The aim of the study is to determine the relation between physical activity and selected physical health components. A total of 9 860 employees of a financial institution in South Africa, between the ages 18 and 64 ( $\bar{x} = 35.3 \pm 18.6$  years), voluntary participated in the study. No differentiation was made between race groups. The assessment of selected health risk factors and physical activity was done by using the Health Risk Assessment (HRA) methodology developed by the company, Monitored Health Risk (MHM). Assessment included a physical activity, diabetes risk and cardiovascular risk questionnaire, as well as body mass index (BMI), random peripheral blood glucose measurements and random peripheral blood cholesterol measurements. Physical activity participation was categorised in three groups – low, moderate and high physical activity participation. The results indicate that the majority of participants reported low physical activity participation (78.27%). The majority of men and women showed an increased risk for diabetes, while high physical activity levels have a practically and statistically significant effect on the reduction of diabetes risk. All the physical activity (PA) categories for both men and women show an increased average **BMI** (men =  $26.46 \text{ kg/m}^2 \pm 6.18$ ; women =  $26.46 \text{ kg/m}^2 \pm 6.18$ ), indicating an increased risk cardiovascular disease. According to the average **cholesterol** concentrations for all PA categories, a low risk was found. No significant differences are seen between the women's groups, nor between the different PA categories for men. The men show higher **cardiovascular risk** than women. With regard to physical activity and cardiovascular disease risk, all three women groups show statistically significant differences compared to all three men's groups. There are also moderate practically significant differences between the women's and men's groups. Therefore, in this study, physical activity does not seem to have a significant effect on the cardiovascular disease risk of the women groups. However, regarding the men's groups, the low physically active men group show significant differences with the high physically active men group. Thus, in this study it appears that the men participating in high levels of physical activity show the lowest risk for cardiovascular disease and therefore appears to be influenced by physical activity. In conclusion, high physical activity participation reduces the risk for diabetes in both men and women, and reduces the risk for cardiovascular disease in men.

**Keywords:** Physical activity, health, cardiovascular disease, diabetes, BMI, cholesterol

# 1. Introduction

In the modern world the prevalence of physical inactivity has increased. In many developed and developing countries, less than one third of the people are active to the extent that it can be beneficial for their health (Hardman & Stensel, 2009). This is mainly due to urbanisation, industrialisation and a Western lifestyle (Steyn, 2006; Puoane, Tsolekile, Sanders & Parker, 2008). This trend of inactivity could have serious negative consequences for health (Sharkey & Glaskill, 2007).

Physical activity has become widely recognised as one of the most important health behaviours associated with reduced all-cause mortality and morbidity, as well as chronic disease related to lifestyle (Lambert & Kolbe-Alexander, 2006); to such an extent that exercise is even referred to as medicine (Pate, 2007). In South Africa 76% of adult men and 86% of adult women do not participate in regular physical activity (SADHS, 2007). According Grace *et al.* (2007) the majority of the executive's physical health indicators, within the South African Colliery industry, falls into the category the will influence their functional capacity negatively and could lead to undesirable productivity levels. Marais (2008) reported that only 13.2% of the corporate environment in her study was physical activity more than three days a week, for longer than 30 minutes at a time in the South African. She furthermore indicated that only 9.7% female and 20.0 % males shown high levels of physical activity. According to Labuschagne *et al.* (2007) male executives do have higher physical activity levels due to the demanding roles of women in society.

Studies have shown that regular physical activity can prevent and reduce the severity of chronic diseases such as hypertension, diabetes, obesity and high cholesterol (ACSM, 2010). These chronic diseases are major contributors to the burden of chronic diseases in developed countries and even in South Africa, these chronic diseases account for more than one-third of all deaths (Kolbe-Alexander, Buckmaster, Nossel, Dreyer, Bull, Noakes & Lambert, 2008, Puoane *et al.*, 2008). Therefore, it is vital to increase physical activity participation due to the fact that physical activity has been shown to have a meaningful positive impact on health and especially in the reduction of cardiovascular disease and other chronic diseases (Durstine, Peel, Lamonte, Keteyian, Fletcher & Moore, 2009; ACSM, 2010).

The aim of this study is to determine the relation between physical activity and selected health components that include: risk for diabetes, risk for increased cholesterol, risk for being overweight and obese, as well as the risk for cardiovascular disease of employees in a financial institution. Information of this importance can help with the development of health promotion programs in South Africa.

## **2. Method and procedure**

### **2.1. Research design**

The study is a once-off cross-sectional observation study. Participants were part of a non-random availability population who voluntarily participated.

### **2.2. Study population**

A total of 9 860 (men=3 336; women=6 524) employees of the same financial institution in South Africa voluntary participated. Their ages varied between 18-64 years ( $\bar{x}=35.3 \pm 10.7$ ) and no differentiation was made between race groups.

### **2.3. Measurements**

The assessment of selected health risk factors and physical activity was done by using the Health Risk Assessment (HRA) methodology developed by the company, Monitored Health Risk (MHM). It was developed for the medical aid of a financial institution.

#### **2.3.1 Health Risk Assessment (HRA)**

Each participant was asked to complete a Health Risk Assessment (HRA). The HRA consisted of several sections to determine physical and psychological health. This HRA had been used in previous studies as well as the algorithms and classification of physical activity diabetes risk and cardiovascular risk (Marais, 2008).

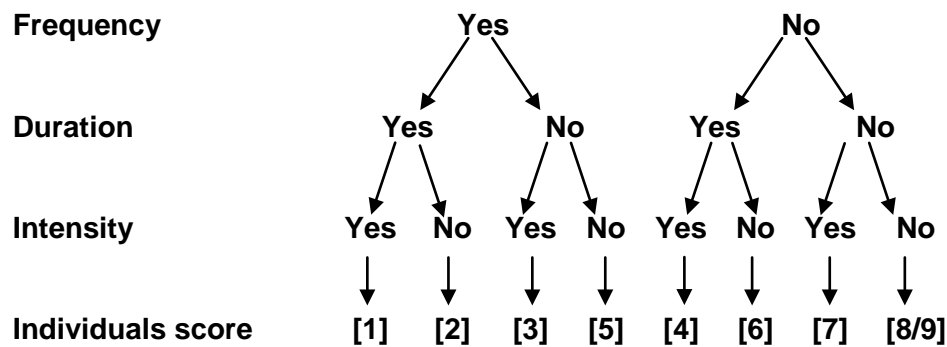
##### **2.3.1.1 Physical activity level**

Physical activity levels were determined by using a questionnaire with the following questions:

- Do you participate in regular physical activity? YES/NO
  - If you answered YES to the above questions
    - Do you exercise three times or more per week? YES/NO
    - Does each exercise session last at least 30 minutes? YES/NO
    - Do you ever exercise at a moderate to vigorous intensity (i.e. at a level that raises a sweat and you are able to talk, but not sing)? YES/NO

The Monitored Health Risk Management (MHM) (2005) developed an algorithm by which the physical activity level is determined by using the answers gained from the above questions.

The algorithm included the following:



If an individual score a classification is 1-2 it represents high physical activity, 3-4 indicates moderate physical activity and 5-9 (low physical activity) indicates physical inactivity. The classification was used in the study of Marias (2008).

### 2.3.1.2 Cholesterol

A random peripheral total cholesterol concentration was used to determine diabetic risk. The following classification was used: <5.2 mmol/L: desirable value; 5.2-6.2 mmol/L indicates borderline high and >6.2 mmol/L a high value (ACSM, 2010).

### 2.3.1.3 Diabetes risk

Diabetes risk was determined by a score system. The score was given as follows: Age 46-65 = 5 points; Age > 65 = 9 points; Body mass index > 25 = 5 points; Sibling(s) with Diabetes Mellitus = 1 point; Parents with Diabetes Mellitus = 1 point; Physical activity level > 1 = 5 points; Baby weight > 4kg or Gestational diabetes = 1 point and if Random blood glucose > 8 = 10 points.

Using these points, the diabetes risk was determined by the following scale: 0-2 indicative of low risk, 2-10 indicative of moderate risk and 11-32 indicate a high risk for Diabetes Mellitus. The classification was used in the study of Marias (2008).

### 2.3.1.4 Body Mass Index (BMI)

The Body Mass Index (BMI) was determined by the following equation:  $\text{weight (kg)} / [\text{height (m)}]^2$ . Classification is as follows, as stated in the ACSM (2010): Underweight < 18kg/m<sup>2</sup>; Normal 19-24 kg/m<sup>2</sup>; Overweight 25-29 kg/m<sup>2</sup> and Obese >30 kg/m<sup>2</sup>.

### **2.3.1.5 Cardiovascular disease (CVD) risk**

Cardiovascular disease risk was determined by the algorithm used by the Monitored Health Risk Management (MHM) (2005). The following factors were used in the calculation of absolute risk: sex, age, total cholesterol, systolic and diastolic blood pressure, diabetes risk and smoking habit. If an individual indicated that he/she received or is currently receiving treatment for the following: heart attack, coronary artery disease (angina), stroke, diabetes, temporary stroke (TIA), intermittent claudication, or aortic aneurysm, the absolute risk is >20%, which is high risk. The classification was used in the study of Marias (2008).

## **2.4 Test procedure**

Tests were performed by registered biokineticists. The biokineticists received the necessary training and were fully informed of the correct procedures and protocols as specified by Bankmed.

### **2.4.1 Ethical approval**

Ethical approval was granted by Bankmed ethical committee. The ethical application number of the North-West University is NWU.00109-12-S1.

### **2.4.2 Informed consent**

The test procedures were explained to each participant and they were asked to sign a document giving informed consent before the assessment.

## **2.5 Statistical analysis**

The CSS:STATISTICA computer software (Statsoft, Inc. 2004) that is used by the North-West University (Potchefstroom campus) will be used for the statistical analysis of the data. For the purpose of this study, a one-way analysis of variance was computed (Thomas *et al.*, 2011). In the statistical analysis, the 95% level of confidence ( $p \leq 0,05$ ) will be applied as the minimum to interpret significant differences among sets of data. Demographic information will be determined by frequency variance. One-way analysis of variance statistics will be used. The *post hoc* test will be implemented to determine the significant differences (Thomas *et al.*, 2011). Practical significance was determine by means of Cohen's effect size (ES) calculations (Steyn, 2002)

### 3. Results and discussion

#### 3.1 Results

The study group ranges between the ages of 18 and 64 and comprises of 9 860 ( $\bar{x}$ :  $35.3 \pm 10.7$  years) individuals, which include 6 524 ( $\bar{x}$ :  $35.1 \pm 10.6$ ) women and 3 336 ( $\bar{x}$ :  $35.9 \pm 10.9$  years) men.

**Table 3.1: Descriptive statistics of variables**

	n	$\bar{x}$	Min	Max	SD
Diabetes risk	9860	8.39	0.00	38.00	4.58
Body Mass Index (BMI)	9860	26.42	14.00	50.00	5.75
Total cholesterol	9860	4.41	2.00	10.00	0.91
Physical Activity Index (PAI)	9860	7.19	1.00	9.00	3.05

In this study, 82.41% of the women and 69.79% of the men reported low physical activity participation and 14.27% and 17.39% respectively reported high physical activity participation. The relationship between physical activity and selected health components are shown in Tables 3.2, 3.3, 3.4 and 3.5.

**Table 3.2: Physical activity index (PAI) and diabetes risk**

			Diabetic Risk (N)	
	PAI	N	$\bar{x}$	SD
Women	Low (a)	4885	8.55 c***++, d***, f***++	3.98
	Moderate (b)	197	8.26 c***+, d**, f***++	4.03
	High (c)	846	5.18 a***++, b***+. d***++, e***++	4.64
Men	Low (d)	2019	9.21 a***, b**. c***++, f***++	4.73
	Moderate (e)	186	9.05 c***++, f***++	4.01
	High (f)	688	4.95 a***++, b***++. d***++, e***++	4.77

Significant differences and practical significances with groups were indicated under the average means of each group by a group code of that group where the significance appears

- Statistical significance ( $p < 0.05$ ) was indicated with a \*, ( $p < 0.01$ ) with \*\* and ( $p < 0.001$ ) with \*\*\*
- Practical significances are indicated as follows: Moderate practical significance + = ( $ES \geq 0.5$ ) and highly practical significance ++ = ( $ES \geq 0.8$ ).



**Table 3.3: Physical activity index (PAI) and body mass index (BMI)**

			Body mass index (kg/m <sup>2</sup> )	
	PAI	N	$\bar{x}$	SD
Women	Low (a)	4885	26.52	6.28
	Moderate (b)	197	25.87	5.43
	High (c)	846	26.30	5.71
Men	Low (d)	2019	26.23	5.26
	Moderate (e)	186	25.99	4.26
	High (f)	688	25.89	4.50

Significant differences and practical significances with groups were indicated under the average means of each group by a group code of that group where the significance appears

- Statistical significance ( $p < 0.05$ ) were indicated with a \*, ( $p < 0.01$ ) with \*\* and ( $p < 0.001$ ) with \*\*\*
- Practical significances are indicated as follows: Moderate practical significance + = ( $ES \geq 0.5$ ) and highly practical significance ++ = ( $ES \geq 0.8$ ).

**Table 3.4: Physical activity index (PAI) and total cholesterol concentration**

			Cholesterol (mmol/L)	
	PAI	N	$\bar{x}$	SD
Women	Low (a)	4885	4.37 d***	0.90
	Moderate (b)	197	4.43	0.88
	High (c)	846	4.36 d***	0.89
Men	Low (d)	2019	4.54 a***, c***	0.98
	Moderate (e)	186	4.50	0.89
	High (f)	688	4.45	0.92

Significant differences and practical significances with groups were indicated under the average means of each group by a group code of that group where the significance appears

- Statistical significance ( $p < 0.05$ ) were indicated with a \*, ( $p < 0.01$ ) with \*\* and ( $p < 0.001$ ) with \*\*\*
- Practical significances are indicated as follows: Moderate practical significance + = ( $ES \geq 0.5$ ) and highly practical significance ++ = ( $ES \geq 0.8$ ).

**Table 3.5: Physical activity index (PAI) and Cardiovascular disease risk**

			Cardiovascular risk (CVD)	
	PAI	N	$\bar{x}$	SD
Women	Low (a)	4 885	2.67 d***+, e***+, f***	1.84
	Moderate (b)	197	2.65 d***+, e***+, f***	1.79
	High (c)	846	2.75 d***+, e***, f***	1.96
Men	Low (d)	2 019	4.63 a***+, b***+, c***+, f**	3.87
	Moderate (e)	186	4.71 a***+, b***+, c***	4.53
	High (f)	688	4.23 a***, b***, c***, d**	3.69

Significant differences and practical significances with groups were indicated under the average means of each group by a group code of that group where the significance appears

- Statistical significance ( $p < 0.05$ ) were indicated with a \*, ( $p < 0.01$ ) with \*\* and ( $p < 0.001$ ) with \*\*\*
- Practical significances are indicated as follows: Moderate practical significance + = ( $ES \geq 0.5$ ) and highly practical significance ++ = ( $ES \geq 0.8$ ).

## 3.2 Discussion

The findings from this study indicate that the majority of both men and women have a moderate risk of developing diabetes. Studies have shown that this risk for developing diabetes can be reduced by participating in physical activity (Hsia, Wu, Allen, Oberman, Lawson, Torrens, Safford, Limacher & Howard, 2005; Borodulin, Tuomilehto, Peltonen, Lakkas, Sundvall & Jousilahti, 2006; ACSM, 2010). Borodulin *et al.* (2006:1027) stated that higher levels of leisure-time physical activity were associated with decreased levels of fasting insulin and reduced risk of having impaired glucose tolerance and type 2 diabetes, independent of the level of abdominal obesity. According to Hu, Lakka, Kilpeläinen & Tuomilehto (2007:592), 30 minutes of moderate or high level of physical activity a day, avoiding excessive weight gain and a healthy diet is effective and safe way to prevent type 2 diabetes. In this regard, the results show that there is a significant statistical difference between the average means of the low and moderate physical activity groups with the high physical activity groups of both women and men, but no significant differences are seen between low and moderate physical activity groups (Table 3.2). However, the low and moderate physical activity women and men groups show a practically significant difference with the high physical activity group of both men and women. Therefore, the results indicated that physical activity does contribute to the reduction of diabetic risk in both men and women groups. Different opinions are apparent in the literature on the optimal intensity of physical activity that is needed to achieve reduction in diabetic risk. Some studies suggested

that any physical activity is better than no physical activity (Gill & Cooper, 2008:822; Brouwer, Van Der Graaf, Soedamah-Muthu, Wassink & Visseren, 2010). According to Brouwer *et al.* (2010:372), insufficient and sufficient physical activity is likely to improve health in high risk patients, leading to a lower risk of developing type 2 diabetes and new cardiovascular events. Gill and Cooper (2008:822) conducted a review of the literature and concluded that the majority of studies suggest that there is no clear minimum threshold of activity that needs to be achieved to be beneficial – any level of activity above baseline appears to be beneficial.

In this study all the physical activity groups of both men and women show an increased average **BMI** and therefore are considered to be an increased risk according to the classification as stipulated by the study parameters. These increased values in BMI can have certain negative consequences on health and are associated with numerous chronic health conditions such as hypertension, diabetes, cholesterol and cardiovascular disease (Pleuss & Matfin, 2009:993). The relation between physical activity and BMI (Table 3.3), in this study was not statistically or practically significant, which contradicts previous research. It could be that this captive population within the financial environment do receive information about their BMI and the health risks associated with a high BMI. Consequently they could be more prone to be involved in physical activity for health. Studies have shown that physical activity has been indicated as a way to improve health and is essential in the prevention of overweight and obesity and in the reduction in prevalence (Waller, Kaprio & Kujala, 2008; Mustelin, Silventoinen, Pietiläinen, Rissanen & Kaprio, 2009; Li, Zhao, Luan, Ekelund, Luden, Khaw, Wareham & Loos, 2010). Waller *et al.* (2008:359) conducted a 30-year follow-up study of habitual physical activity of 146 pairs of twins and found that persistent participation in leisure-time physical activity is associated with a decreased rate of weight gain and with a smaller waist circumference. Studies also indicate that physical activity reduces the influence of genetic factors to develop high BMI and waist circumference (Mustelin *et al.*, 2009; Li *et al.*, 2010). As with the **prevention** of increased BMI, physical activity is an important part of the management and reduction of obesity. Aerobic exercise training increases energy expenditure by the activation of lipolysis and affects the reduction of body weight and body fat percentage (Chaudhary, Kang & Sandhu, 2010). The literature indicated that BMI increases with aging (Meeuwssen, Horgan & Elia, 2010). It is therefore important to implement preventative strategies like physical activity from an early age.

The average means for **cholesterol** in all groups are categorised as low risk. No significant differences are seen between the women groups as well as between the different men's groups (Table 3.4). It is important to note that only a random total cholesterol concentration was obtained in this study, and risk can thus not be ruled out. The average age of the study group is relatively young ( $\bar{x}$  = 35.3 years) and therefore you do not expect to find elevated cholesterol

levels. Even with favourable blood lipids it is essential to be aware that regular physical activity has positive, longitudinal effects on plasma lipid levels associated with the risk of cardiovascular disease and can reduce cardiovascular disease (Teramota & Golding, 2009). Several studies indicated the positive effect of physical activity on lipids (Halverstadt, Phares, Wilund, Goldberg & Hagberg, 2007; Teramota & Golding, 2009; Carvalho, Marques, Ascensao, Magalhaes, Marques & Mota, 2010). Kelley and Kelley (2006) indicated that aerobic exercise is efficacious for an increase in HDL-C and decreasing TC, LDL-C and TG in women. According to Kelley and Kelley (2006), aerobic exercise can also increase HDL<sub>2</sub>-C independent of changes in body weight. Halverstadt *et al.* (2007:448) found that a 24-week endurance exercise program resulted in a significant increase in the HDL subfractions HDL<sub>2</sub>-C and HDL<sub>3</sub>-C, as well as a significant decrease in TC, TG and LDL-C, independent of diet and baseline and changes in body fat. Carvalho *et al.* (2010:3) found that after an 8-month exercise program of moderate intensity, there is an improvement in blood lipid profile which include a significant decrease in TG and TC/HDL ratio and a significant increase in HDL-C.

The results show that men have a higher **cardiovascular risk** than women (Table 3.5). One should also consider the average age of the men in the study group, due to the fact that at this stage of their lives, men are more prone to cardiovascular disease than pre-menopausal women (Wilders, 2002). This finding is concurrent with the literature, which indicates that men are more prone to cardiovascular disease (ACSM, 2010). The literature also states that cardiovascular risk can be reduced by participation in physical activity (Sundquist, Ovist, Johansson & Sundquist 2005; Rothenbacher, Koenig & Brenner, 2006). According to Sundquist *et al.* (2005:222), women and men who participate in physical activity at least twice a week have a 41% lower risk for developing CAD. In this regard, the results show no statistically significant differences between the PA categories of the women, however all three women groups show statistical significant differences with all three men groups. There are also moderate practical significant differences between the women and men groups. Therefore, in this study, physical activity does not seem to have a significant effect on the cardiovascular disease risk of the women groups. However, regarding the men groups, the low physical active men group show significant differences with the high physical active men group. Thus, in this study it appears that the men participating in high levels of physical activity show the lowest risk for cardiovascular disease and therefore appears to be influenced by physical activity. A study by Swain and Franklin (2006) showed that moderate physical activity is beneficial for protection against cardiovascular disease, but indicated that high intensity physical activity appears to convey greater cardio-protective benefits. Therefore, as stated, physical activity is important in the prevention and reduction of cardiovascular disease (Sundquist *et al.*, 2005:224; Rothenbacher *et al.*, 2006:1320; ACSM, 2010). An increase in physical activity participation in individuals who have or are at risk to for CAD, can reduce their cardiovascular risk as well as

certain risk factors (ACSM, 2010). Due to this cardio-protective effect of physical activity, consequently, physical inactivity or low participation in physical activity has been identified as a major risk factor for the development of cardiovascular disease and the development of certain risk factors for cardiovascular disease, which include hypertension, diabetes, cholesterol and increased BMI (ACSM, 2010; Widmaier, Raff & Strang, 2011). Changing from a sedentary to a more active lifestyle even later in adulthood can strongly decrease CAD risk (Rothenbacher *et al.*, 2006:1320). D'Amore and Samia (2006:284) stated that 30 minutes of physical activity most days of the week have been associated with a 30-50% reduction in coronary events and coronary mortality. According Grace *et al.* (2007) the majority of the executive's physical health indicators, within the South African Colliery industry, falls into the category that will influence their functional capacity negatively and could lead to undesirable productivity levels.

## **4. Conclusion**

A risk for the development of cardiovascular risk factors was reported by employees of a financial institution due to the low levels of physical activity reported. Inactivity or low levels of physical activity are considered a risk factor for the development of cardiovascular diseases (ACSM, 2010). The results from the study also indicated that the study group show an increased risk for the development of diabetes and obesity. Both of these conditions are also considered primary risk factors for the development of cardiovascular disease (ACSM, 2010). Cholesterol is also considered a primary contributing risk factor for the development of cardiovascular disease, but this study group shows low levels of total cholesterol.

With regards to physical activity and chronic disease, both men and women that participate in high levels of physical activity, show a decreased risk in diabetes. Men that participate in high levels of physical activity also show a lower risk for the development of cardiovascular disease. No effect was noticed between physical activity and cholesterol or the risk for obesity (increased BMI). It is therefore important to move to a more preventative approach within health promotion. In this regard, intervention strategies should focus on the younger generation (18-28). Further research should include dietary patterns, stress management as well as other risk factors preventing optimal health.

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# Chapter 4

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## Article 2

**The relation between physical activity with regards to selected psychological health components and absenteeism in employees of a financial institution**

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# **The relation between physical activity with regards to selected psychological health components and absenteeism in employees of a financial institution**

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## **Abstract**

**Objectives:** The aim of the study is to determine the relationship between stress and depression as well as the role physical activity play, in a South African corporate environment. Secondly, the study aims to determine the relationship between physical activity, stress and days absent from work (absenteeism) in a South African financial institute workforce.

**Method:** A total of 9 860 employees of the same financial institution in South Africa, between the ages 18 and 64 ( $\bar{x} = 35.3 \pm 10.7$ ) years, voluntary participated in the study. No differentiation was made between race groups. The assessment of selected health risk factors and physical activity was done by using the Health Risk Assessment (HRA) methodology developed by the company, Monitored Health Risk (MHM). Assessment included physical activity, stress, depression score and days absent from work questionnaire. Physical activity participation was categorised in three groups – low, moderate and high physical activity participation.

**Results:** The majority of the study group is shown to be in the high self-perceived stress (55.48%). This prevalence of high stress is more prone in women than in men (57.11% vs. 52.31%). Women also show higher depression scores than men. The results show that increased stress scores are associated with increased depression scores. With regards to physical activity, both men and women show high physical activity levels which are associated with lower stress and depression levels. The data also shows that the majority of women and men are inactive or participate in low levels of physical activity. Absenteeism rates for women in the study group are relatively higher than absenteeism for men. With regards to the relationship between self-perceived stress, physical activity and days absent, no moderate or high practically significant difference was found between the groups. In the women's groups a statistically significant difference with regards to days absent from work was found between low physical active groups, in the various stress score category groups.

**Conclusion:** Physical activity should be considered when designing a health promotion programme due to its advances with regards to psychological health.

**Keywords:** Physical activity, stress, depression, psychological health, emotional health

## 1. Introduction

A growing scientific literature indicates that physical activity can provide psychological benefits for healthy individuals as well as those suffering from mild to moderate emotional illnesses like stress and depression (1-4). The following discussion will focus mainly on physiological stress and depression.

Stress is defined as a state of physical and mental tension in response to a situation that is perceived as a threat or challenge (5). Therefore, Hans Selye, the originator of the concept of stress wrote that stress is essentially the rate of wear and tear in the body and the nonspecific response of the body to any demand (6). According to Selye (6) not all stress is harmful and stress, applied in moderation is necessary for life. It appears that humans need some degree of stress to stay healthy. However, chronic activation of the stress response can result in several health adverse effects and can contribute to poor quality of life (7). Stress can decrease the activity of the immune system to such extent that it can reduce the body's resistance to infection and it could also lead to the clinical expression of a number of comorbidities including central obesity, hypertension, dyslipidemia and endothelial dysfunction, all components of the metabolic syndrome and cardiometabolic risk factors (5; 8). Moreover, chronic stress has deleterious effects on the brain and in particular affects hippocampal structures and functions leading to cognitive and mood disturbances (9). Stress, therefore can also contribute the depression and depression-like symptoms (5; 10).

Depression, as mentioned above can occur secondary to other disorder like stress, or it can occur on its own (8). Depression can be caused by diseases that have biological consequences for the brain, psychological or catastrophic events or even stem from loss of self-esteem. It can also be caused by overstimulation of the sympathetic nervous system and the hypothalamic-pituitary-adrenal cortical system resulting from persistent anxiety or other forms of emotional stress (7). Therefore, it is not unexpected that depression has been linked to greater healthcare utilization and decreased quality of life (11).

Physical activity has been promoted as a means to enhance various aspects of mental health (12). However, there is far less research on the mental benefits of exercise compared with its physical consequences (12). Regular physical activity is considered one of the most important habits an individual can acquire to improve mood and manage stress (10). This is because regular, moderate physical activity minimizes the effects of stress and can offset negative stress emotions (13; 14). According to Lavie *et al.* (4), marked improvements in psychological stress and psychological stress related mortality were demonstrated after a formal exercise program. Physical activity is also associated with reduced concurrent depression symptoms (15). Studies

suggest that an inverse association between physical activity or more precise exercise and depression or the prevention of depression symptoms and that this association between exercise and reduced depression scores are observed in individuals of all ages (1-3).

Despite the negative effects that stress and depression has on health, it is also related the increase levels of absenteeism (16-19). According to Jacobson *et al.* (18), individuals with high stress levels are more likely to be absent 5 days and more per year than those with low stress levels. Individuals with symptoms of depression are 2,17 times more likely to take sick leave (16; 17). According to Druss *et al.* (19) depressed workers have 1.5 to 3.2 short-term disability days, in a 30 day period. Therefore, 50% of the loss of work productivity is due to absenteeism and short-term disability (20).

Physical activity is also one of the best components of an intervention to reduce an individual's risk factors and thus reduce absenteeism. Serxner *et al.* (21) indicated that behavioral health risks which include physical activity and exercise are linked to a reduction in health risk and a reduction in absenteeism (21). According to Pelletier *et al.* (22) an individual can reduce absenteeism by 2% if they reduce their health risks.

Thus, the aim of the study is to determine the relationship between stress and depression as well as the role physical activity play, in a South African corporate environment. Secondly, the study aims to determine the relationship between physical activity, stress and days absent from work (absenteeism) in a South African financial institute workforce. Information in this regard can be used to improve the health of the participating financial institute by creating a health promotion program and simultaneously help reduce the absenteeism rate and productivity loss of the institute.

## **2. Method and procedure**

### **2.1. Research design**

The study is a once-off cross-sectional observation study. Participants were part of a non-random availability population who voluntarily participated.

### **2.2. Study population**

A total of 9860 (men=3 336; women=6 524) employees of the same financial institution in South Africa, voluntary participated in the study. Their ages were between 18-64 years ( $\bar{x}=35.3 \pm 10.7$ ) and no differentiation was made between race groups.

## 2.3. Measurements

The assessment of selected health risk factors and physical activity was done by using the Health Risk Assessment (HRA) methodology developed by the company, Monitored Health Risk (MHM). It was developed for the medical aid of a financial institution.

### 2.3.1 Health risk assessment (HRA)

Each participant was asked to complete a Health risk assessment (HRA). The HRA consisted of several sections to determine physical and psychological health. This HRA had been used in previous studies as well as the algorithms and classification of physical activity, stress and depression (23).

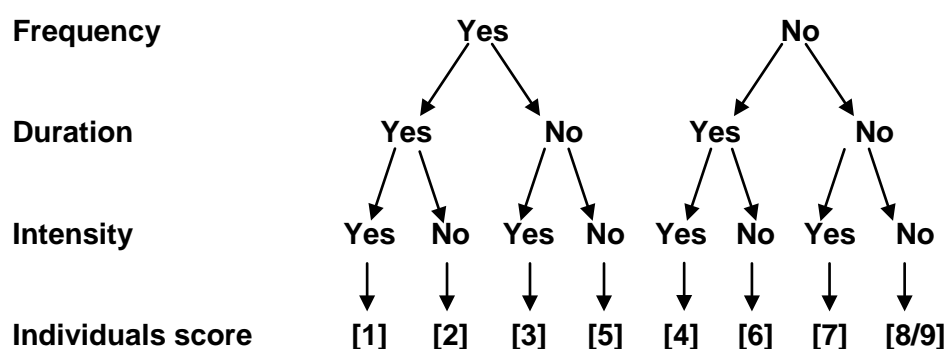
#### 2.3.1.1 Physical activity level

Physical activity levels were determined by using a questionnaire with the following questions:

- Do you participate in regular physical activity? YES / NO
  - If you answered YES to the above questions
    - Do you exercise 3 times or more per week? YES / NO
    - Does each exercise session last at least 30 minutes? YES / NO
    - Do you ever exercise at a moderate to vigorous intensity (i.e. at a level that raises a sweat and you are able to talk, but not sing)? YES / NO

The Monitored Health Risk Management (MHM) (2005) developed an algorithm by which the physical activity level is determined by using the answers gained from the above questions.

The algorithm included the following:



If an individual score classification is 1-2 it represent high physical activity, 3-4 moderate physical activity, 5-8 low physical activity and 9 represent physical inactivity (35).

### **2.3.1.2 Depression**

The depression score was determined by a questionnaire. The questions had the following answer options and each answer was given a score.

For every question answered "Not at all"	0
For every question answered "Several days"	1
For every question answered "More than half the days"	2
For every question answered "Nearly every day"	3

This score were used to determine the risk stratification for depression as follow: low is 1-9; moderate 10-19 and high 19-27 (34).

### **2.3.1.3 Perceived Stress**

The following questions (answer yes/no) were used to calculate the perceived stress at that time:

- My life is currently very stressful and I am not coping at all well (high risk; score 5)
- My life is currently very stressful, but I am coping adequately (moderate risk; score 4)
- My life is somewhat stressful but my coping attempts are not effective (moderate risk; score 3)
- My life is not currently very stressful, but I am not coping nonetheless (moderate risk; score 2)
- My life is not stressful and I am coping very well (low risk; score 1)

The perceived stress category was categories as follow: Score 1: low perceived stress; score 2-4: perceived stress and score 5: perceived stress.

## **2.4 Test procedure**

Tests were performed by registered Biokineticists. The Biokineticists received the necessary training and was fully informed of the correct procedures and protocols as specified by Bankmed.

### **2.4.1 Ethical approval**

Ethical approval was granted by Bankmed ethical committee. The ethical application number of the North-West University is NWU.00109-12-S1.

## 2.4.2 Informed consent

The test procedures were explained to each participant and they were asked to sign a document giving informed consent before the assessment.

## 2.5 Statistical analysis

The CSS:STATISTICA computer software that is used by the North-West University (Potchefstroom campus) will be used for the statistical analysis of the data (24). For the purpose of this study a one-way analysis of variance was computed (25). In the statistical analysis, the 95% level of confidence ( $p \leq 0,05$ ) was applied as the minimum to interpret significant differences among sets of data. Profiles were determined by frequency variance. One way analysis of variance statistics was used. The *post hoc* test was implemented to determine the significant differences (25). Practical significance was determined by means of Cohen's effect size (ES) calculations (26).

## 3. Results and discussion

### 3.1 Results

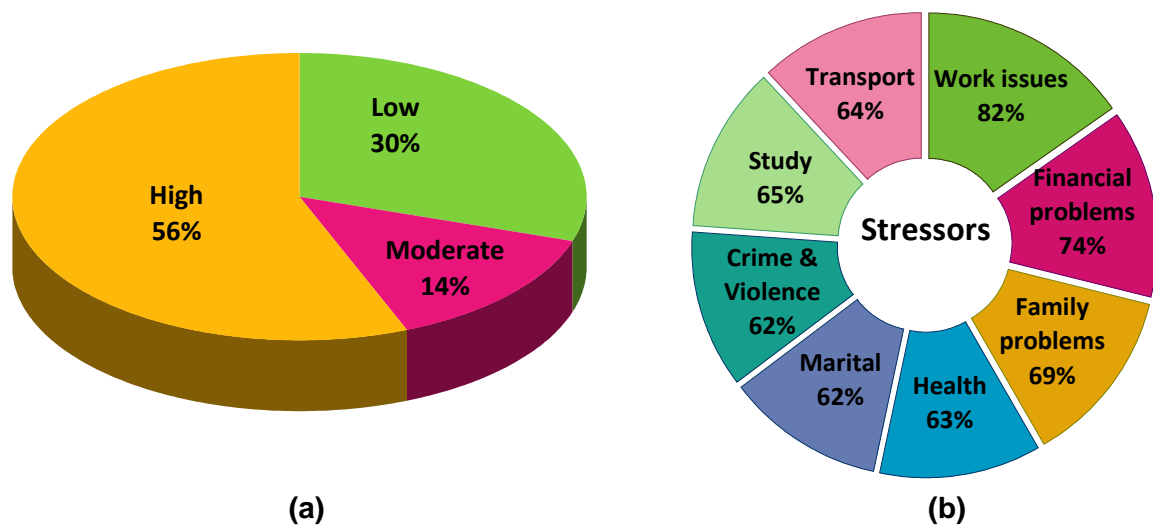
The study group are between the age of 18 and 64 and comprise of 9860 ( $\bar{x}$ :  $35.3 \pm 10.7$ ) individuals, which include 6524 ( $\bar{x}$ :  $35.1 \pm 10.6$ ) women and 3336 ( $\bar{x}$ :  $35.9 \pm 10.9$ ) men. Table 4.1 shows the perceived stress and depression scores of each group.

**Table 4.1: Descriptive statistics of perceived stress and depression scale**

	Perceived Stress					Depression				
	N	$\bar{x}$	Min	Max	SD	N	$\bar{x}$	Min	Max	SD
<b>Women</b>	6511	3.01	1.00	5.00	1.41	6517	4.84	0.00	27.00	4.94
<b>Men</b>	3330	2.87	1.00	5.00	1.41	3334	3.34	0.00	27.00	3.99
<b>Total group</b>	9841	2.96	1.00	5.00	1.41	9851	4.33	0.00	27.00	4.70

Figure 4.1 (a) indicated the percentage of the study group in the various categories of perceived stress and the results show that the majority of the study group, experience high levels of perceived stress. The main self-perceived contributing factors to perceived stress are indicated in Figure 4.1 (b). It appears that work related issues (82%) are the most contributing factor to stress in the study group, followed by financial issues (74%) and family issues (69%).





**Figure 4.1: Perceived Stress (a) and Self-perceived contributing factors to stress (b)**

The relationship between physical activity and selected emotional health components is represented in Table 4.2.

**Table 4.2: Physical activity and selected emotional health components**

			Perceived Stress		Depression	
	Physical Activity	N	$\bar{x}$	SD	$\bar{x}$	SD
Women	Low (a)	3152	3.04	1.41	4.99 f+	4.97
	Moderate (b)	141	3.21 c+	1.33	4.11	4.48
	High (c)	594	2.90 b+	1.42	3.90	4.44
Men	Low (d)	1346	2.93	1.41	3.66	4.24
	Moderate (e)	131	2.98	1.32	2.92	3.77
	High (f)	496	2.80	1.42	2.32 a+	3.16

Practical significances with groups were indicated under the average means of each group by a group code of that group where the significance appears

- Practical significances are indicated as follow: Moderate practical significance + = ( $ES \geq 0.5$ ) and highly practical significance ++ = ( $ES \geq 0.8$ ).

Table 4.3 represents the relationship between perceived stress, depression and physical activity.

**Table 4.3: Physical activity relation to perceived stress and depression**

Depression					
	Stress index	Physical activity	N	$\bar{x}$	SD
Women	Low	Low (a)	1508	2.39 d***+, e+ f***+, g***+, h***+, i***+, l*, m***+, o*, p***+	3.00
		Moderate (b)	54	1.91 d***+, e+ f*+, g***+, h*+, i***+, m***+, n+; o+ p***+	2.60
		High (c)	317	1.82 d***+, e+, f***+, g***+, h***+, i***+, m***+, n+ o**+, p***+	2.76
	Moderate	Low (d)	771	5.84 a***+, b***+, c***+, j***+, k***+, l***+, o**, p***, q***+, r***+	4.85
		Moderate (e)	18	5.44 a+, b+, c+, j*+, k+, l*+, r+	4.88
		High (f)	107	4.70 a***+, b*+, c***+, j***+, k**+, l***+, r*+	4.05
	High	Low (g)	3053	6.12 a***+, b***+, c***+, i***, j***+, k***+, l***+, m***, o***, p***, q***+, r***+	5.35
		Moderate (h)	145	4.99 a***+, b***+, c***+, j***+, k***+, l***+, r***	4.86
		High (i)	500	5.06 a***+, b***+, c***+, g***, j***+, k***+, l***+, q*, r***	4.94
Men	Low	Low (j)	713	1.71 d***+, e*+, f***+, g***+, h***+, i***+, m***+, n+, o***+, p***+, q*, r***	2.45
		Moderate (k)	66	1.67 d***+, e+, f**+, g***+, h***+, i***+, m***+, n+, o+, p***+	2.78
		High (l)	296	1.32 a*, d***, d+++, e*+, f***+, g***+, h***+, i***+, m***+, n+, o***+, p***+, q***+, r***	2.31
	Moderate	Low (m)	362	4.93 a***+, b***+, c***+, g***, j***+, k***+, l***+, r***+	4.40
		Moderate (n)	36	3.89 b+, c+, j+, k+, l+	4.21
		High (o)	107	4.01 a*, b+, c**+, d***, g***, j***+, k+, l***+	4.20
	High	Low (p)	1206	4.52 a***+, b***+, c***+, d***, g***, j***+, k***+, l***+, r***	4.50
		Moderate (q)	113	3.31 d***+, g***+, i*, j*, l**+	3.83
		High (r)	414	2.84 d***+, e+, f*+, g***+, h***, i***, j**, l***, m***+, p***	3.39

Significant differences and practical significances with groups were indicated under the average means of each group by a group code of that group where the significance appears

- Statistical significance ( $p < 0.05$ ) were indicated with a \*, ( $p < 0.01$ ) with \*\* and ( $p < 0.001$ ) with \*\*\*
- Practical significances are indicated as follow: Moderate practical significance + = ( $ES \geq 0.5$ ) and highly practical significance ++ = ( $ES \geq 0.8$ ).

Table 4.4 indicates that days the employees were absent form work in 6 months in relation to the stress index categories and physical activity.

**Table 4.4: The relationship between perceived stress, physical activity and days absent form work in the past 6 months**

			Days absent		
	Perceived Stress	Physical activity	N	$\bar{x}$	SD
Women	Low	Low (a)	1510	0.83 d*; g**	1.29
		Moderate (b)	54	0.67	1.01
		High (c)	317	0.85	1.33
	Moderate	Low (d)	769	1.02 a*; j*; l***; p***; r***	1.25
		Moderate (e)	18	1.33	1.71
		High (f)	107	1.07	1.33
	High	Low (g)	3050	0.98 a**; j*; l***; p***; r***	0.99
		Moderate (h)	145	0.81	1.05
		High (i)	500	0.92 r*	1.22
Men	Low	Low (j)	713	0.80 d*; g*	1.36
		Moderate (k)	66	0.67	1.17
		High (l)	297	0.61 d***; g***	1.70
	Moderate	Low (m)	361	0.87	1.29
		Moderate (n)	36	0.83	1.34
		High (o)	107	0.76	1.00
	High	Low (p)	1206	0.71 d***; g***	1.05
		Moderate (q)	113	0.69	1.09
		High (r)	414	0.60 d***; g***; j*	1.02

Significant differences and practical significances with groups were indicated under the average means of each group by a group code of that group where the significance appears

- Statistical significance ( $p < 0.05$ ) were indicated with a \*, ( $p < 0.01$ ) with \*\* and ( $p < 0.001$ ) with \*\*\*
- Practical significances are indicated as follow: Moderate practical significance + = ( $ES \geq 0.5$ ) and highly practical significance ++ = ( $ES \geq 0.8$ ).

### 3.2 Discussion

The majority of the study group is shown to be in the high perceived stress category (Figure 4.1a). Women are in fact more prone to perceived stress than men (Table 4.1). Women also seem to have slight higher depression scores than men (Table 4.1). These high levels of perceived stress can have a negative effect on an individual's health and are associated with selected conditions like central obesity, hypertension, dyslipidemia and endothelial dysfunction,

all components of the metabolic syndrome and cardiometabolic risk factors (5; 8). Thus, it is important to address these factors that could result in affecting the employee's health negatively. In this study the main cause of stress was identified as; work issues followed by financial problems and family problems (Figure 4.1b). These same issues were identified in a previous study by Jacobson *et al.* (1996)<sup>18</sup>, to be the main causes of perceived stress in a group of employees. This information is important for the company due to the fact that it can give the employer a good understanding and guidelines in the designing of an intervention plan for the wellbeing of its employees, and it is clear that the work environment are a factor to consider.

Physical activity should be incorporated in the health promotion programs. Physical activity has been identified as way to reduce stress and depression (13; 14). According to Lavie *et al.* (2011)<sup>4</sup>, marked improvements in psychological stress and psychological stress related mortality were demonstrated after a formal exercise program. With regards to depression, Augestad *et al.* (2008)<sup>1</sup> concluded that men and women who exercise are less likely to have high depression scores, compared with physically inactive individuals. In this regard, Table 4.2 shows for both men and women, high physical activity levels are associated with lower perceived stress and depression levels. Practical significant differences were only identified between the women's perceived stress group. Table 4.2 also show that the majority of both women and men are inactive or participate in low levels of physical activity. These low levels of physical activity can contribute to health problems, not only psychological conditions, but chronic non-communicable disease as well (27; 28). Research have shown that participating in regular moderate physical activity reduce the prevalence of certain chronic non-communicable disease (28-31).

Table 4.3 represent the relationship between perceived stress, physical activity and depression scores in this study. The results show that increased stress scores are associated with increased depression scores. In each perceived stress category, low physical activity show the highest depressions scores. The literature has shown that increased levels of stress can contribute to increase levels of depression. Stress is also a contributing factor to depression symptoms and therefore can also affect psychological health (5; 10). Physical activity has been known to help with the reduction of psychological stress and depression. Lavie *et al.* (2011)<sup>4</sup> concluded that, exercise training and improvements in cardiovascular fitness may be highly beneficial in the management of individuals with high levels of psychological stress. With regards to depression, Lee and Park (2008)<sup>31</sup> indicated that the effect of physical activity pertains to at least a moderate amount of activity and is prominent in individuals with high initial levels of depressive symptoms.

Conditions like stress and depression are factors that not only affect an individual's physical and emotional health but, it can increase the number of days absent from work also known as absenteeism (16; 17; 18; 33). Absenteeism can contribute to great productivity and financial loss and thus must be considered when evaluating a group of employees. With regards to the absenteeism rates for women and men in the study group the results indicates that women tend to show relative higher absenteeism than men (0.94 days vs. 0.73 days). The relationship between stress, physical activity and days absent are shown in Table 4.4. No moderate or high practical significant difference was found between the groups. In the women's groups, a statistical significant difference with regards to days absent from work, were found between low physical active groups, in the various stress score category groups. According to the results of a study done by Jacobson *et al.* (1996)<sup>18</sup>, individuals with high stress levels are more likely to be absent 5 days and more per year than those with low stress levels. Individuals with symptoms of depression are 2,17 times more likely to take sick days (16; 17).

## 4. Conclusion

It is indicated in the literature that stress and depression can lead to a reduction in quality of life and increase prevalence of absenteeism. Physical activity is a well-known method to help with psychological stress and depression, and in turn with absenteeism. However, in this study, the results were inconclusive with regards to physical activity and absenteeism. Nonetheless, physical activity should be considered when designing an intervention program for a corporate environment due to the fact that it has a positive effect on perceived stress and depression. Physical activity is also considered a method to fight selected chronic diseases.

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# Chapter 5

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## Article 3

### **The influence of physical activity on pharmaceutical and general medical practitioners' claims in employees of a financial institution**

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# **The influence of physical activity on pharmaceutical and general medical practitioners' claims in employees of a financial institution**

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## **Abstract**

The aim of this study is to determine the physical activity profiles and the influence physical activity has on pharmaceutical and GP costs in a population of South African employees. A total of 9 860 employees of the same financial institution in South Africa, between the ages of 18 and 64 ( $\bar{x} = 35.3 \pm 18.6$ ) years, participated in the study and participation was voluntary. No differentiation was made between race groups. The assessment of selected health risk factors and physical activity was done by using the Health Risk Assessment (HRA) methodology developed by the company, Monitored Health Risk (MHM). Medical expenditure data was obtained from 'Monitored Health Risk Management Pty (Ltd)'. Pharmaceutical and general practitioners (GP's) claim included all costs incurring during a six-month period. The results show that a minority of the sample group participates in moderate to high levels of physical activity (moderate= 4.42% and high=17.80%). In the women's group, only 14.26% show high physical activity participation, whereas the men show a greater percentage of high physical activity participation of 24.72%. The results show statistically and practically significant differences between the groups that do not use chronic medication and the groups that use chronic medication. The women that use chronic medication show an increase in pharmaceutical costs with an increase in physical activity. However, when investigating the GP costs of women that use chronic medication, there is only a small difference in GP costs in the different physical activity participation categories. The data shows that men have higher pharmaceutical costs than women in all the physical activity categories. The results also indicate that men that use chronic medication, participating in low levels of physical activity do show higher pharmaceutical and GP costs. In conclusion, several unexpected associations were noted that require further investigation. Physical activity cannot be dismissed as a possible intervention to reduce medical costs, due to the fact that the result does not indicate whether the medical costs are associated with conditions that can be influenced by physical activity or not.

**Keywords: Physical activity, medical claims, general practitioner, doctor, pharmacy, cost**

# 1. Introduction

The burden of disease and associated medical care is an enormous economic burden on any population (Oldridge, 2008). Chronic non-communicable diseases are a major contributor to the burden of chronic diseases in developed countries and are increasing rapidly in developing countries (Puoane *et al.*, 2008). In South Africa, non-communicable diseases account for more than one-third of all deaths (Kolbe-Alexander *et al.*, 2008).

Physical activity has been identified as a way to reduce these health-care costs due to the fact that the vast majority of studies has indicated that physical activity can reduce the prevalence and severity of selected non-communicable diseases (Steyn, 2006; Matfin, 2009; ACSM, 2010). Thus, physical activity can directly or indirectly help to reduce the economic burden of disease. Studies have shown that an increase in a physically active lifestyle is linked to reduced medical costs (Katzmazyk *et al.* 2000; Andreyeva & Sturm, 2006; Sari, 2009; Cho & Cho, 2011). It is recommended that an individual participates in physical activity of moderate intensity for at least 150 minutes per week to gain these advantages (ACSM, 2010). However, in South African, the majority of the population does not participate in the recommended level of physical activity (WHO, 2005; SADHS, 2007). Thus, it is necessary to gain a clear picture of the physical activity profiles of the South African population as well as its association with medical costs.

Studies with regards to the association between physical activity and medical costs related to pharmaceutical and general medical practitioners (GP's) costs are rare, especially in a South African population. Therefore, the aim of this paper is to determine the physical activity profiles and the average pharmacy and GP costs of a population of South African employees. This information can be used to help design a health promotion program that fits the South African market and can possibly be a way to reduce medical costs.

## 2. Method and procedure

### 2.1. Research design

The study is a once-off cross-sectional observation study. Participants were part of a non-random availability population who voluntarily participated.

## **2.2. Study population**

A total of 9 860 employees of the same financial institution in South Africa participated in the study and participation was voluntary. Their ages were between 18 and 64 years and no differentiation was made between race groups.

## **2.3. Measurements**

The assessment of selected health risk factors and physical activity was done by using the Health Risk Assessment (HRA) methodology developed by the company, Monitored Health Risk (MHM). It was developed for the medical aid of a financial institution.

### **2.3.1 Health Risk Assessment (HRA)**

Each participant was asked to complete a Health Risk Assessment (HRA). The HRA consisted of several sections to determine physical and psychological health as indicated in previous studies as well as the algorithms and classification of physical activity (Marais, 2008).

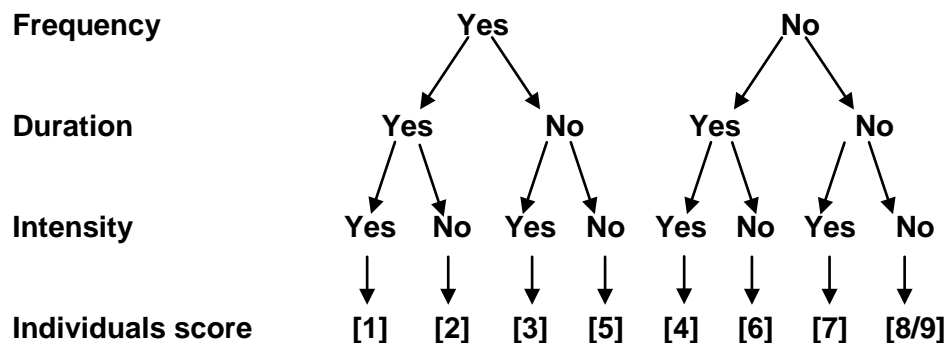
#### **2.3.1.1 Physical activity level**

Physical activity levels were determined by using a questionnaire with the following questions:

- Do you participate in regular physical activity? YES / NO
  - If you answered YES to the above questions
    - Do you exercise three times or more per week? YES / NO
    - Does each exercise session last at least 30 minutes? YES / NO
    - Do you ever exercise at a moderate to vigorous intensity (i.e. at a level that raises a sweat and you are able to talk, but not sing)? YES / NO

The Monitored Health Risk Management (MHM) (2005) developed an algorithm by which the physical activity level is determined by using the answers gained from the above questions.

The algorithm included the following:



If an individual score a classification is 1-2 it represents high physical activity, 3-4 indicates moderate physical activity and 5-9 (low physical activity) indicates physical inactivity. The classification was used in the study of Marias (2008).

### 2.3.2 Medical expenditures

The medical expenditure data was obtained from 'Monitored Health Risk Management Pty (Ltd)', a company that collects data on behalf of the medical aid of the financial institution. General practitioners (GP's) and pharmaceutical costs were all the claim related to GP visits and pharmaceutical claims for a period of six-months. Respondents were divided into two groups. One group were those who do not use chronic medication and the second group uses chronic medication. The medical expenditure was calculated over a period of 12 months.

## 2.4 Test procedure

Tests were performed by registered biokineticists. The biokineticists received the necessary training and were fully informed of the correct procedures and protocols as specify by Bankmed.

### 2.4.1 Ethical approval

Ethical approval was granted by Bankmed ethical committee. The ethical application number of the North-West University is NWU.00109-12-S1.

### 2.4.2 Informed consent

The test procedures were explained to each participant and they were asked to sign a document giving informed consent before the assessment.

## 2.5 Statistical analysis

The CSS:STATISTICA computer software (Statsoft, Inc. 2004) that is used by the North-West University (Potchefstroom campus) will be used for the statistical analysis of the data. For the purpose of this study, a one-way analysis of variance was computed (Thomas *et al.*, 2011). Profiles will be determined by frequency variance. One-way analysis of variance statistics will be used. Practical significance was determined by means of Cohen's effect size (ES) calculations (Steyn, 2002)

## 3. Results and discussion

### 3.1 Results

Table 5.1 represents the descriptive statistics of the population group. The medical cost sample shows a large margin of variability as seen in the large standard deviation measured.

**Table 5.1. Descriptive statistics with regards to age, physical activity level, pharmaceutical and general practitioners (GP's) cost**

	N	Mean	Minimum	Maximum	SD
Age	9 860	35.34	18.57	64.00	10.69
Physical activity level	9 860	7.19	1.00	9.00	3.05
Pharmaceutical cost (R)	9 860	212.43	0.00	14990.30	593.67
General practitioners' cost (R)	9 860	324.59	0.00	14990.30	728.11

The majority of the men (68.80%) and women (82.38%) show no or low physical activity. Only a small percentage participates in high physical activity (men=24.72% and women= 14.26%).

Eighty four percent (84%) of the sample group does not use chronic medication, thus 16% of the sample group uses chronic medication. Table 5.2 and 5.3 represent the medical cost associated with pharmaceutical and GP costs in the various physical activity categories.

Figure 5.1 and 5.2 show a schematic representation of the medical claims with regard to pharmaceutical and GP costs in the various physical activity groups.

**Table 5.2 Physical activity index (PAI) and pharmaceutical cost**

Pharmaceutical cost								
	PAI	Non-chronic medication			Chronic medication			
		N		$\bar{x}$	SD	N	$\bar{x}$	SD
Female	Low	4510	a	96.47 g***+, h***++, i***+, j***+, k***+, l***+	274.83	856	g 784.25 a***+, b***+, c***+, d***+, e***+, f***+, i +, j***, l*	994.13
	Moderate	178	b	91.73 g***+, h***++, i***+, j***+, k***+, l***+	192.71	41	h 753.92 a***+, b***+, c***+, d***+, e***+, f***+	771.91
	High	727	c	122.74 g***+, h***++, i***+, j***+, k***+, l***+	287.23	202	i 863.02 a***+, b***+, c***+, d***+, e***+, f***+, g+, j*	1068.75
Male	Low	1960	d	62.89 g***+, h***++, i***+, j***+, k***+, l***+	217.96	334	j 1018.64 a***+, b***+, c***+, d***+, e***+, f***+, g***, i*, k***	1583.00
	Moderate	186	e	101.62 g***+, h***++, i***+, j***+, k***+, l***+	370.18	30	k 632.88 a***+, b***+, c***+, d***+, e***+, f***+, j***	635.24
	High	697	f	71.41 g***+, h***++, i***+, j***+, k***+, l***+	240.08	127	l 963.96 a***+, b***+, c***+, d***+, e***+, f***+, g*	1130.20

Significant differences and practical significances with groups (women and men groups) were indicated under the average means of each group by a group code of that group where the significance appears

- Statistical significance ( $p < 0.05$ ) were indicated with a \*, ( $p < 0.01$ ) with \*\* and ( $p < 0.001$ ) with \*\*\*
- Practical significances are indicated as follow: Moderate practical significance + = ( $ES \geq 0.5$ ) and highly practical significance ++ = ( $ES \geq 0.8$ ).

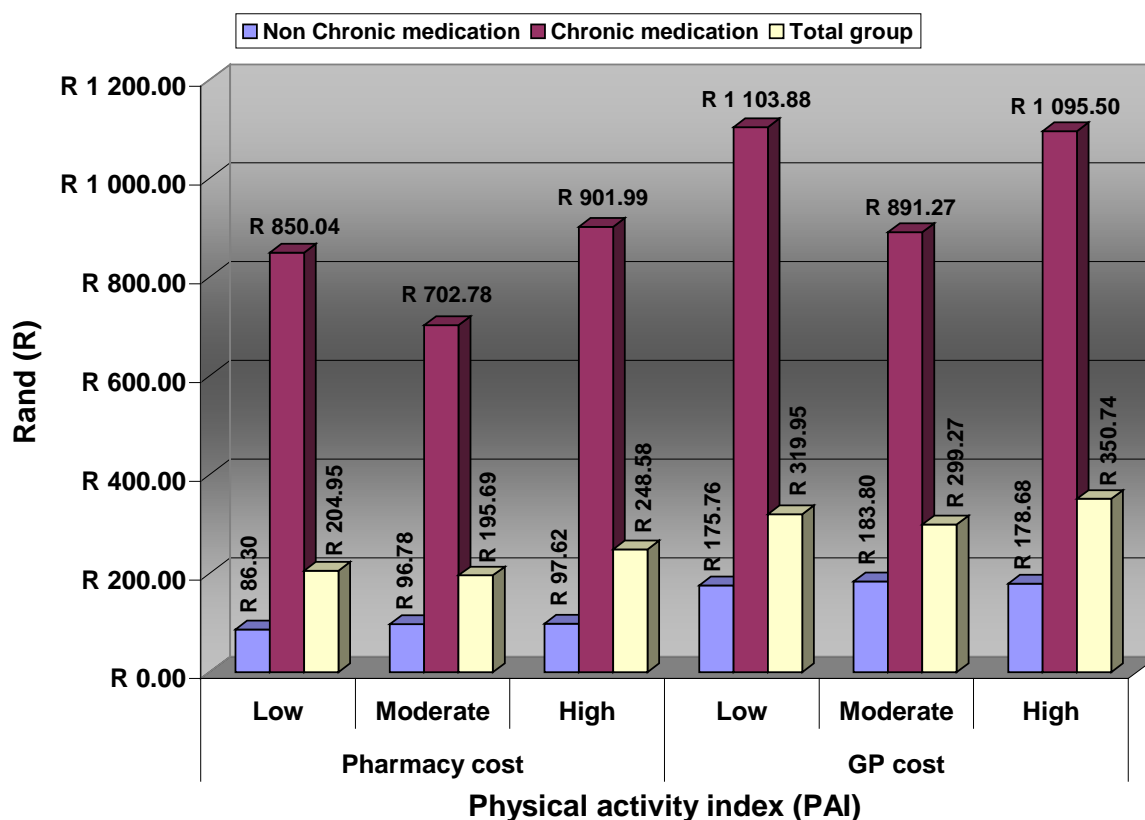
**Table 5.3 Physical activity index (PAI) and general practitioners cost**

GP cost									
	PAI	Non Chronic medication				Chronic medication			
		N		$\bar{x}$	SD	N		$\bar{x}$	SD
Female	Low	4510	a	194.97 d*, g***+, h***+, i***+, j***+, k***+, l***+	437.66	856	g	1048.53 a***+, b***+, c***+, d***+, e***+, f***+	1186.41
	Moderate	178	b	191.06 g***+, h***+, i***+, j***+, k***+, l***+	382.38	41	h	981.98 a***+, b***+, c***+, d***+, e***+, f***+	937.24
	High	727	c	213.15 d*, g***+, h***+, i***+, j***+, k***+, l***+	448.86	202	i	1071.07 a***+, b***+, c***+, d***+, e***+, f***+	1207.53
Male	Low	1960	d	131.57 a*, c*, g***+, h***+, i***+, j***+, k***+, l***+	342.08	334	j	1245.72 a***+, b***+, c***+, d***+, e***+, f***+, g***+, k***	1681.90
	Moderate	186	e	176.85 g***+, h***+, i***+, j***+, k***+, l***+	485.13	30	k	767.29 a***+, b***+, c***+, d***+, e***+, f***+	832.52
	High	697	f	123.94 g***+, h***+, i***+, j***+, k***+, l***+	353.10	127	l	1134.34 a***+, b***+, c***+, d***+, e***+, f***+	1236.93

Significant differences and practical significances with groups (women and men groups) were indicated under the average means of each group by a group code of that group where the significance appears

- Statistical significance ( $p < 0.05$ ) were indicated with a \*, ( $p < 0.01$ ) with \*\* and ( $p < 0.001$ ) with \*\*\*
- Practical significances are indicated as follow: Moderate practical significance + = ( $ES \geq 0.5$ ) and highly practical significance ++ = ( $ES \geq 0.8$ ).





**Figure 5.1: Medical claim associated with pharmaceutical and GP costs and its relation with different physical activity categories**

### 3.2 Discussion

In the study the minority of the sample group participates in moderate to high levels of physical activity (moderate= 4.42% and high=17.80%). In the women's group only 14.26% show a high physical activity participation, whereas the men show a greater percentage of high physical activity participation of 24.72%. Research has shown that being physically active reduces the likelihood of the development of certain non-communicable chronic diseases and can even reduce the severity of the condition (Jackson *et al.*, 2004; Nieman, 2007; Matfin, 2009; ACSM, 2010). Physical inactivity and even low physical activity are considered risk factors for development of cardiovascular disease as well as other non-communicable diseases (Blair, 2009; ACSM, 2010). This is why it is concerning to see that the majority of the study group shows low physical activity participation (78.80%). This low physical activity participation can lead to serious health consequences. Studies have shown that low physical is associated with an increased prevalence and development of certain chronic diseases such as cardiovascular disease, hypertension, obesity, diabetes and some cancers (Blair, 2009; ACSM, 2010). A low level of physical activity is also associated with loss of functional capacity and premature mortality (Bouchard *et al.*, 2007).

On investigating the relationship between physical activity and pharmaceutical and GP costs, as expected, the groups on chronic medication show higher average pharmaceutical costs, therefore this discussion will mainly focus on the study group that uses chronic medication. People on chronic medication do often obtain health benefits from being physical active.

Considering the pharmaceutical costs with regards to the different physical activity categories, the data shows that the women's pharmaceutical costs indicate an increase in costs with an increase in physical activity. This is unexpected due to the fact that physical activity is known to reduce the severity and prevalence of selected chronic non-communicable conditions and previous research has indicated that physical activity is prone to reduce medical cost (Katzmarzyk *et al.*, 2000; Pratt *et al.*, 2000; Garrett *et al.*, 2004; Wang *et al.*, 2004; Andreyeva & Sturm, 2006; Bland *et al.*, 2009). However, women tend to report illness more than men (Ladwig *et al.*, 2000; Case & Paxson, 2005). Research has also shown that women are more likely to use more medicine than men (Eggen, 1994; Millar, 1998; Roe *et al.*, 2002). Another possibility for the increased medication use can be as a result that women visit physicians more than men do and so this can contribute to the higher medication cost (Mustard *et al.*, 1998; Bertakis *et al.*, 2000). It is also known that, in general, women are more sensitive and aware of health issues and therefore have better health-seeking behaviours (Verbrugge, 1985; Corney, 1990). However, when investigating the GP cost of women that use chronic medication, there is only a small difference in GP cost in the different physical activity participation categories (see Figure 5.1), which is also contradictory to previous studies that indicated that physical activity reduces medical cost (Cho & Cho, 2011; Nagai *et al.*, 2011). However, it must be kept in mind that women are more prone to utilise medical services than men (Eggen, 1994; Stoverinck *et al.*, 1996; Ladwig *et al.*, 2000). Stoverinck *et al.* (1996) found that women who have a higher overall use of secondary medical care are more prone to preventative health care. Studies have also indicated that women visit doctors more than men do (Eggen, 1994; Ladwig *et al.*, 2000). They also use more medication than men (Eggen, 1994; Millar, 1998; Roe *et al.*, 2002), as well as more classes of medication (Roe *et al.*, 2002). A possible explanation for the increased medication use can be as a result from the higher doctors' visits (Mustard *et al.*, 1998; Bertakis *et al.*, 2000). Consequently, even if women are physical active it is likely that they access health care on a regular basis, and that can result in the higher medical cost due to pharmacy claims.

Due to the fact that the women in this study have higher prevalence on low physical activity participation, the presumption that women are more likely to take medicine and have better health-seeking behaviours, it is surprising that the data shows that men have higher pharmaceutical costs than women in all the physical activity categories. However, research has shown that men are prone to more serious health conditions; this can account for the increase

in pharmaceutical cost (Gold *et al.*, 2002; Case & Paxson, 2005). They also tend to report health conditions only when they are at more severe or more advanced stages of these conditions (Case & Paxson, 2005). The results also indicate that men participating in low levels of physical activity and use chronic medication, do show higher pharmaceutical and GP costs. This finding is consistent with previous studies. Research has shown that low physical activity participation or even physical inactivity is associated with an increase in direct medical cost (Katzmarzyk *et al.*, 2000; Pratt *et al.*, 2000; Garrett *et al.*, 2004; Wang *et al.*, 2004; Andreyeva & Sturm, 2006; Bland *et al.*, 2009). Bertoldi *et al.* (2006) concluded that levels of physical activity are inversely associated with the number of medicines used. Therefore, even if men have more serious health problems it appears to be influenced by increased physical activity participation

## **4. Conclusion**

This paper represents a step in examining the association between pharmaceutical and GP costs and physical activity in South African employees in a financial institution. Although results indicate some associations between pharmaceutical cost and physical activity, several unexpected associations were noted that require further investigation. This information provides a foundation for the possibility to develop health promotion programs that aim to reduce medical cost through physical activity.

Physical activity cannot be dismissed as a possible intervention to reduce medical costs due to the fact that the result do not indicate whether the medical costs are associated with conditions that can be influenced by physical activity or not. Conditions that can be influenced by physical activity include hypertension, cholesterol, diabetes, obesity and cardiovascular disease, to name a few (Nieman, 2007; ACSM, 2010). A more clear distinction must be made with regards to the medical claim to indicate the influence of physical activity on medical costs. Indirect medical cost like absenteeism and presenteeism must be included in such a strategy.

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# Chapter 6

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## Article 4

### Physical activity in relation to hospital claims in a group of employees in a financial institution

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# **Physical activity in relation to hospital claims in a group of employees of a financial institution**

**Smit, M., Wilders, C.J. & Moss, S.J.**

## **Abstract**

The aim of this study is to determine the physical activity profiles and physical activity relation to hospital costs of a population of South African employees. A total of 9 860 employees of the same financial institution in South Africa, between the ages 18 and 64 ( $\bar{x} = 35.3 \pm 18.6$ ) years, voluntary participated in the study. No differentiation was made between race groups. The assessment of selected health risk factors and physical activity was done by using the Health Risk Assessment (HRA) methodology developed by the company, Monitored Health Risk (MHM). Medical expenditure data was obtained from 'Monitored Health Risk Management Pty (Ltd)'. Hospital claims included all costs incurring during admission to a hospital. Regarding medical costs associated with hospitalisation, those on chronic medications show an average higher medical cost (R231.72 versus R672.71) compare to those who do not use chronic medication. The women who are on chronic medication show about two and a half times higher hospitalisation cost (R253.97 versus R650.82) and the men almost four times higher cost (R189.34 versus R721.71) compare to those who do not use chronic medication. No practically significant difference was found between the groups. The majority of the study group (chronic and non-chronic medication use), shows low physical activity participation (average of 78.80%). The women show an increased in incidence of low physical activity participation (82.38%), whereas 68.80% of the men show low physical activity participation. Women who use chronic medication and participate in moderate physical activity show lower hospital cost. The women in this study group who use chronic medication and participate in high levels of physical activity show the highest hospital costs. The men's profile indicates that medical costs due to hospital claims rise with the higher levels of physical activity. In conclusion, a more in-depth analysis is necessary on the subject. Hospitalisation costs should also be analysed according to conditions.

**Keywords: Physical activity, chronic medication use, medical cost, hospital claim**

## **1. Introduction**

Physical activity is part of every person's daily life. Physical activity can be due to leisure, exercise, sport or even occupational. The amount varies considerably from person to person and is largely subject to personal choice (Nieman, 2007). Physical activity is associated with health, and a vast amount of research has already established a positive correlation between physical activity and health (Plowman, 2005; Rothenbacher *et al.*, 2006; Durstine *et al.*, 2009; ACSM, 2010). It is recommended that a person participates in physical activity of moderate intensity for at least 150 minutes per week to gain the desirable health advantages (WHO, 2011). According to the WHO (2012) 31% of adults were insufficiently active in 2008, which can contribute to the increased incidence of non-communicable diseases. This increased incidence of physical inactivity does not only have negative effects on the health status of the population, but it can have a considerable economic burden on countries (Oldridge, 2008).

Research has shown that physical inactivity can lead to an increase in medical cost (Pratt *et al.*, 2000; Garrett *et al.*, 2004; Wang & Brown, 2004; Wang *et al.*, 2006; Anderson *et al.*, 2005; Brown *et al.*, 2005; Andreyeva & Sturm, 2006). According to Katzmarzyk *et al.* (2000), even modest reduction in inactivity levels can result in substantial cost savings. One average, active person uses significantly fewer health care services compared to inactive people (Sari, 2009). It is important to remember that health care savings do not always occur immediately, but after reduction in the level of inactivity, because of the physical active lifestyle occur over a lifetime (Katzmarzyk *et al.* 2000).

Studies with regards to the association between physical activity and medical cost related to hospital claims are very few. Therefore, the aim of this study is to determine the physical activity profiles and whether there is a relation between physical activity and the average hospital cost of a population of South African employees. This information can be used to help design a health promotion program that fit the South African market and can possibly be a way to reduce medical cost.

## **2. Method and procedure**

### **2.1. Research design**

The study is a once-off cross-sectional observation study. Participants were part of a non-random availability population who voluntarily participated.

## **2.2. Study population**

A total of 9 860 (men=3 336; women=6 524) employees of the same financial institution in South Africa participated in the study and participation was voluntary. Their ages were between 18 and 64 ( $\bar{x}=35.3 \pm 10.7$ ) years and no differentiation was made between race groups.

## **2.3. Measurements**

The assessment of selected health risk factors and physical activity was done by using the Health Risk Assessment (HRA) methodology developed by the company, Monitored Health Risk (MHM). It was developed for the medical aid of a financial institution. This HRA had been used in previous studies as well as the algorithms and classification of physical activity (Marais, 2008).

### **2.3.1 Health risk assessment (HRA)**

Each participant was asked to complete a Health risk assessment (HRA). The HRA consisted of several sections to determine physical and psychological health.

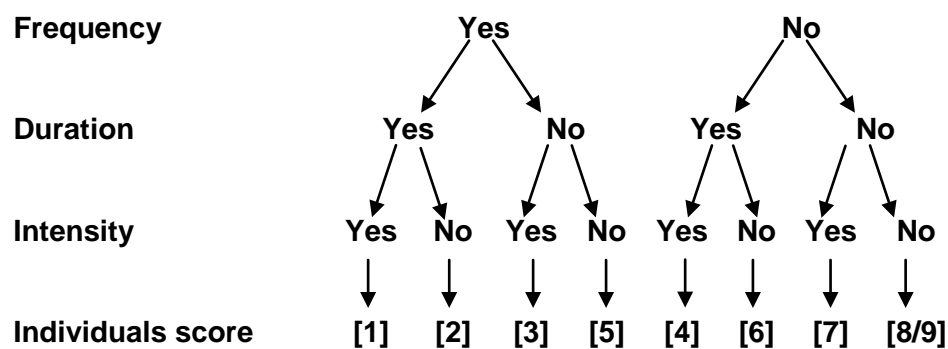
#### **2.3.1.1 Physical activity level**

Physical activity levels were determined by using a questionnaire with the following questions:

- Do you participate in regular physical activity? YES / NO
  - If you answered YES to the above questions
    - Do you exercise three times or more per week? YES / NO
    - Does each exercise session last at least 30 minutes? YES / NO
    - Do you ever exercise at a moderate to vigorous intensity (i.e. at a level that raises a sweat and you are able to talk, but not sing)? YES / NO

The Monitored Health Risk Management (MHM) (2005) developed an algorithm by which the physical activity level is determined by using the answers gained from the above questions.

The algorithm included the following:



If an individual score a classification is 1-2 it represents high physical activity, 3-4 indicates moderate physical activity and 5-9 (low physical activity) indicates physical inactivity. The classification was used in the study of Marias (2008).

### 2.3.2 Medical expenditures

Medical expenditure data was obtained from 'Monitored Health Risk Management Pty (Ltd)'. This is a company that collects data on behalf of the medical aid of the financial institution. Hospital claims included all costs incurring during admission to a hospital over a period of 6 months. The medical expenditure was calculated over a period of 12 months.

## 2.4 Test procedure

Tests were performed by registered biokineticists. The biokineticists received the necessary training and were fully informed of the correct procedures and protocols as specify by Bankmed.

### 2.4.1 Ethical approval

Ethical approval was granted by Bankmed ethical committee. The ethical application number of the North-West University is NWU.00109-12-S1.

### 2.4.2 Informed consent

The test procedures were explained to each participant and they were asked to sign a document giving informed consent before the assessment.

## 2.5 Statistical analysis

The CSS:STATISTICA computer software (Statsoft, Inc. 2004) that is used by the North-West University (Potchefstroom campus) will be used for the statistical analysis of the data. For the purpose of this study, a one-way analysis of variance was computed (Thomas *et al.*, 2011). Profiles will be determined by frequency variance. One-way analysis of variance statistics will be used. Practical significance was determined by means of Cohen's effect size (ES) calculations (Steyn, 2002).

## 3. Results and discussion

### 3.1 Results

Table 6.1 shows the descriptive statistics of the population with regards to physical activity and hospital claims.

**Table 6.1. Descriptive statistics with regards to age, physical activity index and hospital cost**

	<b>N</b>	<b>Mean</b>	<b>Minimum</b>	<b>Maximum</b>	<b>SD</b>
<b>Age</b>	9 860	35.34	18.57	64.00	10.69
<b>Physical activity index</b>	9 860	7.20	1.00	9.00	3.05
<b>Hospital Claims (R)</b>	9 860	302.62	0.00	83484.50	2626.71

The majority (78.80%) of the study group shows no or low physical activity participation levels and within this group an estimated 73.80% of the men and 84.54% of the women participate in no or low physical activity. Only 14.26% of the women participate in high levels of physical activity. The men show a slight higher participation in high physical activity which is 24.72%.

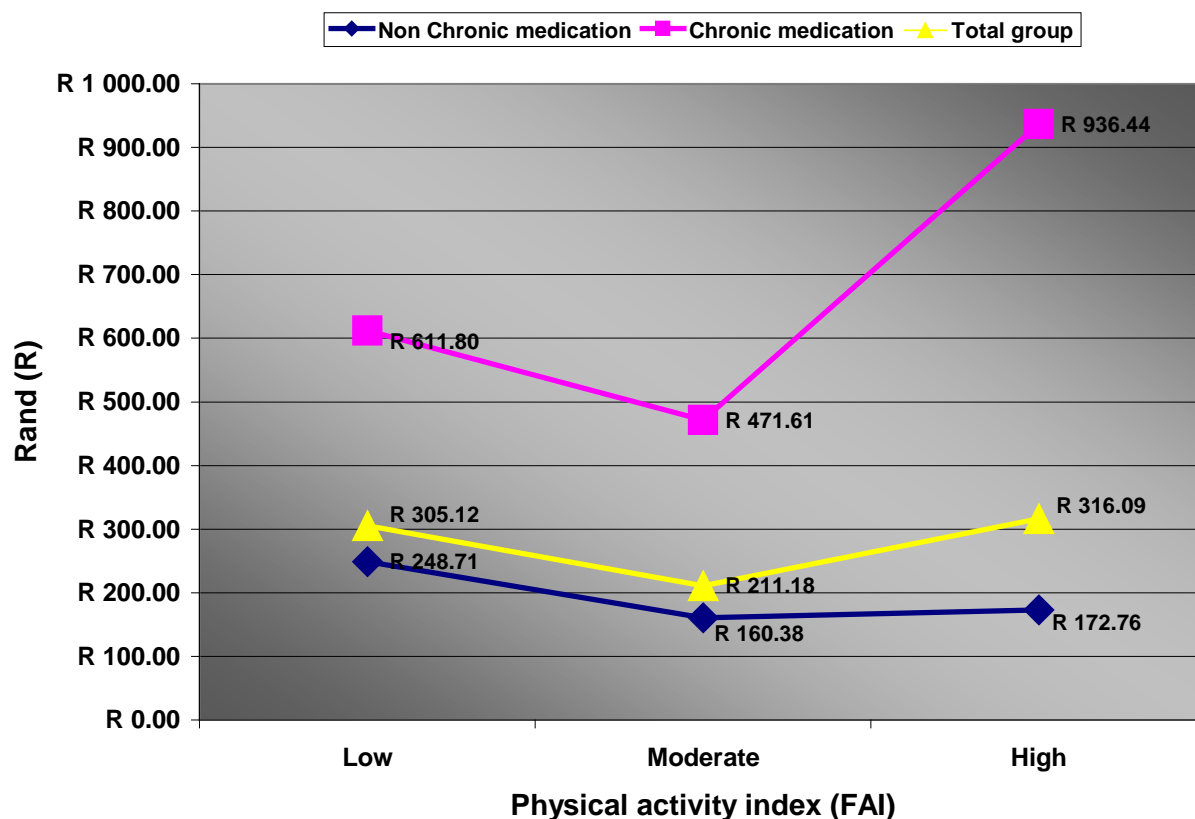
Table 6.2 shows the medical cost associated with hospital claims in the various physical activity and medication use categories. Figures 6.1, 6.2 and 6.3 schematically illustrate the medical costs associated with hospital claims in the different physical activity categories.

**Table 6.2 Physical activity index (PAI) and hospital costs in Rand (R)**

Hospital cost									
FAI		Non chronic medication				Chronic medication			
		N		$\bar{x}$	SD	N		$\bar{x}$	SD
Women	Low	4510	a)	266.15 g**,  ***	1940.43	856	g)	677.32 a**,c**,d***,f**	4325.23
	Moderate	178	b)	254.32  **	1604.26	41	h)	119.49	557.88
	High	727	c)	178.32 g**,  ***	1721.40	202	i)	646.39	4307.33
Men	Low	1960	d)	208.58 g***,  ***	2532.25	334	j)	443.88  *	3424.41
	Moderate	186	e)	70.44  ***	859.83	30	k)	952.83	4034.58
	High	697	f)	166.96 g**,  ***	1866.91	127	l)	1397.80 a***, b**, c***, d***, e***, f***, j*	8368.86

Significant differences and practical significances with groups (women and men groups) were indicated under the average means of each group by a group code of that group where the significance appears

- Statistical significance ( $p < 0.05$ ) were indicated with a \*, ( $p < 0.01$ ) with \*\* and ( $p < 0.001$ ) with \*\*\*
- Practical significances are indicated as follow: Moderate practical significance + = ( $ES \geq 0.5$ ) and highly practical significance ++ = ( $ES \geq 0.8$ ): (No practical significance differences were found between groups)



**Figure 6.1: Medical claim associated with hospitalization and its relation with the different physical activity categories**

### 3.2 Discussion

Table 6.2 represents the medical costs associated with hospitalisation and, as expected, those on chronic medication show an average higher medical cost (R231.72 versus R672.71). The amount is almost twice as high. The women who are on chronic medication show about two and a half times higher hospitalisation costs (R253.97 versus R650.82) and the men almost four times higher cost (R189.34 versus R721.71). No practical significant difference was found between the groups. Due to this difference in cost between chronic and non-chronic medication and the small amounts of medical cost associated with the group that do not use chronic medication, the discussion will mainly focus on the study group that uses chronic medication.

Table 6.2 shows the physical activity categories of the study group and it indicates that the majority of the study group, those using chronic medication, as well as those who do not use chronic medication, show low physical activity participation (average of 78.80%). The women show an increase in incidence of low physical activity participation (82.38%), whereas the 68.80% of the men show low physical activity participation. This low physical activity participation can have serious health consequences due to the fact that low physical activity and physical inactivity are associated with the increased risk and prevalence of selected chronic non-communicable diseases (Blair, 2009; ACSM, 2010). Steyn (2006) indicated lack of regular physical activity as one of the most relevant elements of an unhealthy lifestyle that predisposes one to the development of any chronic non-communicable disease. Thus, addressing physical inactivity, the burden of disease can be reduced (Kolbe-Alexander *et al.*, 2008). Research has shown that participating in regular moderate physical activity reduces the prevalence of certain chronic non-communicable diseases (Plowman, 2005; Rothenbacher *et al.*, 2006; Durstine *et al.*, 2009; ACSM, 2010).

Table 6.2 represents the hospital costs of the women and it shows that women who use chronic medication and participate in moderate physical activity show lower hospital cost. Previous studies have also confirmed this finding that an increase in physical activity reduces hospital costs (Lambert *et al.*, 2009; Patel *et al.*, 2011). However, the women in this study group who use chronic medication indicated an unexpected result which shows that hospital claims rise with higher physical activity. This result is contradicted by previous research, which indicated that physical activity reduces medical costs and hospital claims (Pratt *et al.*, 2000; Andreyeva & Sturm, 2006; Bland *et al.*, 2009; Lambert *et al.*, 2009; Patel *et al.*, 2011). Swan and Franklin (2006) suggested that even higher physical activity can obtain even better health outcomes, which in this study can explain why the women not using chronic medication, that show high physical activity levels, show lower hospital claims (Table 6.2). However, research has shown that women tend to report illness more than men (Ladwig *et al.*, 2000; Case & Paxson, 2005).

Conversely, the men's group shows a completely different profile with regards to hospital claims and physical activity (Table 6.2). The men's profile indicates that medical cost due to hospital claims rise with the higher levels of physical activity. A possible explanation for this occurrence is that men are less likely to report illness, but when it is reported, it is prone to be more serious health conditions (Gold *et al.*, 2002; Case & Paxson, 2005). Another possibility is that individuals on chronic medication are usually more aware of the destructive lifestyle behaviours and are more like to accept self-responsibility for their health (Labuschangne *et al.*, 2006).

## 4. Conclusion

It is clear from the discussion that a more in-depth analysis is necessary on the subject. Previous research in South Africa has shown that physical activity reduces the prevalence of hospital admissions and reduces hospital costs (Lambert *et al.*, 2009; Patel *et al.*, 2011). Lambert *et al.* (2009) conducted a study to determine the effect of fitness-related activities on hospital claims and admission among members of a major health insurer in South Africa. Hospitalisation costs per member were lower in each activity group (low, moderate and high) when compared with the inactive group, and the same pattern was demonstrated for admission rates. Patel *et al.* (2011) gained similar results in a study and found that individuals who were highly active had a lower probability of hospital admission and thus cost compared to those who were inactive.

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# Chapter 7

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## Summary, conclusion, limitations and recommendations

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1. Summary
  2. Conclusions
  3. Limitations & recommendations
  4. References
- 

### 1. Summary

Regular physical activity is a major component in the prevention of chronic diseases (ACSM, 2010:72; Durstine *et al.*, 2009:23). Not only does it prevent chronic diseases, but it can also be a cost-effective way to improve an individual's health and in turn help to reduce the economic burden of disease (Brown *et al.*, 2005; Andreyeva & Sturm, 2006; Bland *et al.*, 2009). It also helps in the reduction of productivity loss that is related to an increased prevalence of certain chronic diseases (Jacobson & Aldana, 2001:1022; Serxner *et al.*, 2001:351).

However, the majority of the South African population has shown low physical activity participation patterns (WHO, 2005:5 ;SADHS, 2007:292). Physical inactivity has been linked to the increased prevalence of chronic diseases (Jackson *et al.*, 2004:180; Bouchard *et al.*, 2007:4; Nieman, 2007:380; Matfin, 2009:484; ACSM, 2010:7-8). Chronic diseases affect individuals of all ages, thus have a major economic impact on individuals, families, the health system and society at large (Puoane *et al.*, 2008:79).

It is clear that physical activity influences several factors and areas of an individual's life. Therefore it is important to consider it as part of a healthy lifestyle and as part of an intervention to reduce certain chronic diseases and help to reduce the financial burden of disease.

This study attempted to answer the following questions:

- What is the relationship of physical activity with diabetes risk, obesity risk, cholesterol and cardiovascular disease?
- What is the relationship between physical activity, stress and depression? Do any of these variables have an influence on absenteeism?
- What is the relationship between physical activity and medical costs associated with pharmacy and general practitioners claims?
- Does physical activity have an effect on the medical costs associated with hospital claims?

Answers to these questions can provide vital information to help when certain intervention programs are planned. It is also important to remember that the South African population is diverse and is faced with changing economic circumstances, which in turn can significantly influence the work environment.

With regards to the above questions the aims of the study were to determine the following:

- What is the relationship between physical activity and diabetes risk, obesity risk, cholesterol and cardiovascular disease?
- What is the relationship between physical activity, stress and depression? Does any of these variables have an influence on absenteeism?
- What is the relationship between physical activity and medical costs associated with pharmaceutical and general practitioners' claims?
- Does physical activity have an effect on the medical costs associated with hospital claims?

**Chapter 2** examined selected definitions of physical activity, physical fitness and exercise as well as health and wellness. Secondly, the interaction between physical activity, physical fitness, genetics and health and the physical activity participation of the South African population were discussed. Further, physical activity was discussed with regards to its influence on selected physical and psychological health components. Lastly, the influence of physical activity on medical cost was summarised.

**The findings from the investigation (Chapter 3, 4, 5 and 6)** are presented in the form of research manuscripts. Each chapter clearly indicates the method and procedure, research design, results and conclusion. The description of the chapters is as follows:

- In *Chapter 3 – Article 1* investigated the relation between physical activity and health components that include diabetes, BMI, cholesterol and cardiovascular disease.
- In *Chapter 4 – Article 2* determined the influence of physical activity on stress, depression and absenteeism.
- In *Chapter 5 – Article 3* investigated the influence of physical activity on general pharmacy and medical practitioners' costs.
- In *Chapter 6 – Article 4* examined the relationship between hospital costs and physical activity.

## **2. Conclusions**

The conclusion of this research is dealt with on the basis of the hypotheses that were set:

### **2.1 There is a significant negative relation between physical activity and health components of employees in a financial institution**

Results from the one-way analysis of variance indicate physical activity has a statistical and practical influence on diabetic risk, cardiovascular risk and total cholesterol of male and female within the low physical activity category. Practical significant differences were found among the high and low levels of physical activity of men and women in relation to diabetes risk as well as cardiovascular risk.

The lack of significant differences with regards to BMI could be that the average age is very young, while the literature stated the BMI increase with the increase of age. Therefore, we reject this hypothesis.

### **2.2 A highly significant negative relation between physical activity and selected psychological health components will exist in employees at a financial institution.**

It seems that work issues (82%), financial problems (74%) and family problems (69%) contribute the most to the fact that 56% of the population experience high stress levels and depression. Physical activity index (PAI) in relation to stress only shows practical significance in

moderate and high physically active women. PAI and stress-related indexes report statistically ( $p \leq 0.05$ ; 0,001) significant and practically significant differences within the population. There was also a statistically significant ( $p \leq 0.05$ ) relation between self-perceived stress and physical activity in relation to days absent. Although high levels of stress and low levels of physical activity are present in the population, the relation reached statistical significance in relation to depression. This hypothesis is partially accepted.

### **2.3 Physical activity will show a significant negative relation to medical cost related to pharmaceutical and general medical practitioners' claims of employees in a financial institution**

Physical activity contributes statistically significantly as well as practically significantly to pharmaceutical and general practitioners' costs within the population that uses chronic medication as well as those who do not. This hypothesis is rejected.

### **2.4 Physical activity will be significantly negative related to medical cost as represented by hospital claims of employees at a financial institution**

There is a statistical as well as a practical significance to hospital costs within the population that uses chronic medication as well as those who does not. This hypothesis is accepted.

The South African population is very diverse and therefore cannot always be compared with other global populations. South African is also affected by changing economic factors. All of these aspects can influence the work environment and even to some extent the health of the employees due to the fact that higher stress levels are experienced and a more sedentary lifestyle is noticeable in the corporate environment. In this study a financial institution was used and it did show that the majority of the employees was prone to a sedentary lifestyle and experienced high stress levels as well as high depression scores. The sedentary lifestyle already increases their risk to develop certain chronic diseases. They identified work issues as their major contributor to stress, followed by financial and family problems. They also show a tendency of increased prevalence of risk for the development of certain pathologies such as stress, depression, diabetes, cardiovascular disease and obesity. Due to the tendency of an increased prevalence of risk to develop certain pathologies as well as their sedentary lifestyle, it is certain that it will contribute to higher financial burdens. Not only can it lead to an increase in medication uses and medical cost, it can also contribute to absenteeism and even presenteeism. Absenteeism and presenteeism in turn place a financial burden on the employer due to decreased productivity. In this study physical activity has shown to reduce certain

pathological conditions and influence medical cost; it therefore is an important factor to include when planning intervention programs.

Studies with regard to physical activity related to health and medical cost in employees in the South African corporate environment are rare and limited, especially information on financial institutions. Therefore, this study provides a step in establishing a profile with regards to selected health conditions and medical costs, on the unique South African population. This could help design an intervention program that includes health promotion strategies as well as physical activity that are unique to a South African workforce. The contribution of this study stated clearly that it is not always clear whether a younger population do have pathology tendencies such as diabetes risk, cardiovascular disease risk, elevated BMI, cholesterol, stress and depression that could develop in serious health problems as well as chronic medication use. In this regard intervention programs should be started at a much younger age.

### **3. Limitations and recommendations**

Some limitations were identified in the study. Firstly, no information is given to the reason for the low physical activity participation. Secondly, the financial burden of indirect medical costs in relation to absenteeism and presenteeism was not determined. Thirdly, there is not a clear distinction with regard to the conditions related to medical cost.

It appears from this study that there is a need for further research regarding the following:

- Reasons for the low physical activity participation in South African.
- The influence of an intervention program on chronic medication use in a South African population.
- The effect a physical intervention program can have on the stress and depression score of individuals in a South African population and, in turn, the effect it will have on absenteeism.
- The effect of physical activity on indirect medical cost in a South African population.
- A more detailed description of medical cost with regards to how much is related to physical activity-influenced conditions.



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SADHS see Department of Health & Medical Research Council

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WHO see World Health Organization

World Health Organization. 2005. South Africa.

[http://www.afro.who.int/dnc/infobase/South\\_Africa.pdf](http://www.afro.who.int/dnc/infobase/South_Africa.pdf) Date used: 5 April 2007.

# Appendix A

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1. **Author Guidelines for African Journal for Physical, Health Education, Recreation and Dance**
  2. **Author Guidelines for Journal of Occupational and environmental medicine**
  3. **Author Guidelines for Health Economics**
  4. **Author Guidelines for Journal of Health Economics**
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## **1. Author Guidelines**

### **African Journal for Physical, Health Education, Recreation and Dance**

The African Journal for Physical, Health Education, Recreation and Dance (AJPHERD) is a peer-reviewed journal established to:

- i) provide a forum for physical educators, health educators, specialists in human movement studies and dance, as well as other sport-related professionals in Africa, the opportunity to report their research findings based on African settings and experiences, and also to exchange ideas among themselves.
- ii) afford the professionals and other interested individuals in these disciplines the opportunity to learn more about the practice of the disciplines in different parts of the continent.
- iii) create an awareness in the rest of the world about the professional practice in the disciplines in Africa.

### **General Policy**

AJPHERD publishes research papers that contribute to knowledge and practice, and also develops theory either as new information, reviews, confirmation of previous findings, application of new teaching/coaching techniques and research notes. Letters to the editor relating to the materials previously published in AJPHERD could be submitted within 3 months after publication of the article in question. Such letter will be referred to the corresponding author and both the letter and response will be published concurrently in a subsequent issue of the journal.

Manuscripts are considered for publication in AJIPHERD based on the understanding that they have not been published or submitted for publication in any other journal. In submitting papers for publication, corresponding authors should make such declarations. Where part of a paper has been published or presented at congresses, seminars or symposia, reference to that publication should be made in the acknowledgement section of the manuscript.

AJIPHERD is published quarterly, i.e. in March, June, September and December. Supplements/Special editions are also published periodically.

### **Submission of Manuscript**

Three copies of original manuscript and all correspondence should be addressed to the Editor-In-Chief:

Professor L. O. Amusa Tel: +27 15 9628076  
Centre for Biokinetics, Recreation and Sport Science,  
University of Venda for Science and Technology,  
P. Bag X5050,  
Thohoyandou 0950  
Republic of South Africa  
Fax: +27 15 9628076/9628035  
E-mail: amusalbw@yahoo.com

Articles can also be submitted electronically, i.e. via e-mail attachment. However, the corresponding author should ensure that such articles are virus free. AJIPHERD reviewing process normally takes 4-6 weeks and authors will be advised about the decision on submitted manuscripts within 60 days. In order to ensure anonymity during the reviewing process authors are requested to avoid self-referencing or keep it to the barest minimum.

### **Preparation of Manuscript**

Manuscripts should be type written in fluent English (using 12-point Times New Roman font and 1½ line-spacing) on one side of white A4-sized paper justified fully with 3cm margin on all sides. In preparing manuscripts, MS-Word, Office 98 or Office 2000 for Windows should be used. Length of manuscripts should not normally exceed 12 printed pages (including tables, figures, references, etc.). For articles exceeding 10 typed pages US\$ 10.0 is charged per every extra page. Longer manuscripts may be accepted for publication as supplements or special research reviews. Authors will be requested to pay a publication charge of US\$ 350.0 to defray the very high cost of publication. The pages of manuscripts must be numbered sequentially beginning

with the title page. The presentation format should be consistent with the guidelines in the publication format of the American Psychological Association (APA) (4th edition).

#### *Title page:*

The title page of the manuscript should contain the following information:

- Concise and informative title.
- Author(s)' name(s) with first and middle initials. Authors' highest qualifications and main area of research specialisation should be provided.
- Author(s)' institutional addresses, including telephone and fax numbers.
- Corresponding author's contact details, including e-mail address.
- A short running title of not more than 6 words.

### **Abstract**

An abstract of 200-250 words is required with up to a maximum of 5 words provided below the abstract. Abstract must be typed on a separate page using single line spacing, with the purpose of the study, methods, major results and conclusions concisely presented. Abbreviations should either be defined or excluded.

### **Text**

Text should carry the following designated headings: Introduction, materials and methods, results, discussion, acknowledgement, references and appendices (if appropriate).

### **Introduction**

The introduction should start on a new page and in addition to comprehensively giving the background of the study should clearly state the problem and purpose of the study. Authors should cite relevant references to support the basis of the study. A concise but informative and critical literature review is required.

### **Materials and Methods**

This section should provide sufficient and relevant information regarding study participants, instrumentation, research design, validity and reliability estimates, data collection procedures, statistical methods and data analysis techniques used. Qualitative research techniques are also acceptable.

## Results

Findings should be presented precisely and clearly. Tables and figures must be presented separately or at the end of the manuscript and their appropriate locations in the text indicated. The results section should not contain materials that are appropriate for presentation under the discussion section. Formulas, units and quantities should be expressed in the *systeme internationale (SI)* units. Colour printing of figures and tables is expensive and could be done upon request authors' expense.

## Discussion

The discussion section should reflect only important aspects of the study and its major conclusions. Information presented in the results section should not be repeated under the discussion. Relevant references should be cited in order to justify the findings of the study. Overall, the discussion should be critical and tactfully written.

## References

The American Psychological Association (APA) format should be used for referencing. Only references cited in the text should be alphabetically listed in the reference section at the end of the article. References should not be numbered either in the text or in the reference list.

Authors are advised to consider the following examples in referencing:

Examples of citations in body of the text:

For one or two authors; Kruger (2003) and Travill and Lloyd (1998). These references should be cited as follows when indicated at the end of a statement: (Kruger, 2003); (Travill & Lloyd, 1998).

For three or more authors cited for the first time in the text; Monyeki, Brits, Mantsena and Toriola (2002) or when cited at the end of a statement as in the preceding example; (Monyeki, Brits, Mantsena & Toriola, 2002). For subsequent citations of the same reference it suffices to cite this particular reference as: Monyeki et al. (2002).

Multiple references when cited in the body of the text should be listed chronologically in ascending order, i.e. starting with the oldest reference. These should be separated with semi colons. For example, (Tom, 1982; McDaniels & Jooste, 1990; van Heerden, 2001; de Ridder et al., 2003).

## Reference List

In compiling the reference list at the end of the text the following examples for journal references, chapter from a book, book publication and electronic citations should be considered:

### *Examples of journal references:*

Journal references should include the surname and initials of the author(s), year of publication, title of paper, name of the journal in which the paper has been published, volume and number of journal issue and page numbers.

For one author: McDonald, A.K. (1999). Youth sports in Africa: A review of programmes in selected countries. *International Journal of Youth Sports*, 1(4), 102-117.

For two authors: Johnson, A.G. & O'Kefee, L.M. (2003). Analysis of performance factors in provincial table tennis players. *Journal of Sport Performance*, 2(3), 12-31.

For multiple authors: Kemper, G.A., McPherson, A.B., Toledo, I. & Abdullah, I.I. (1996). Kinematic analysis of forehand smash in badminton. *Science of Racket Sports*, 24(2), 99-112.

### *Examples of book references:*

Book references should specify the surname and initials of the author(s), year of publication of the book, title, edition, page numbers written in brackets, city where book was published and name of publishers. Chapter references should include the name(s) of the editor(s) and other specific information provided in the third example below:

For authored references: Amusa, L.O. & Toriola, A.L. (2003). *Foundations of Sport Science* (1st ed.) (pp. 39-45). Mokopane, South Africa: Dynasty Printers.

For edited references: Amusa, L.O. and Toriola, A.L. (Eds.) (2003). *Contemporary Issues in Physical Education and Sports* (2nd ed.) (pp. 20-24). Mokopane, South Africa: Dynasty Printers.

For chapter references in a book: Adams, L.L. & Neveling, I.A. (2004). Body fat characteristics of sumo wrestlers. In J.K. Manny and F.O. Boyd (Eds.), *Advances in Kinanthropometry* (pp. 21-29). Johannesburg, South Africa: The Publishers Company Ltd.

### *Example of electronic references:*

Electronic sources should be easily accessible. Details of Internet website links should also be provided fully. Consider the following example:

Wilson, G.A. (1997). Does sport sponsorship have a direct effect on product sales? *The Cyber-Journal of Sport Marketing (online)*, October, 1(4), at <http://www.cad.gu.au/cjism/wilson.html>. February 1997.

### **Proofreading**

Manuscript accepted for publication may be returned to the author(s) for final correction and proofreading. Corrected proofs should be returned to the Editor-In-Chief within one week of receipt. Minor editorial corrections are handled by AJPHERD.

### **Copyright Agreement**

The Africa Association for Health, Physical Education, Recreation, Sport and Dance (LAM Publications Ltd) holds the copyright for AJPHERD. In keeping with copyright laws, authors will be required to assign copyright of accepted manuscripts to LAM Publications Ltd. This ensures that both the publishers and the authors are protected from misuse of copyright information. Requests for permission to use copyright materials should be addressed to the Editor-in-Chief.



## **2. Author Guidelines**

### **Journal of Occupational and environmental medicine**

#### **Manuscript Submission**

All manuscripts must be submitted on-line through the new Web site at <https://joem.edmgr.com/>. Hard-copy article submissions will not be considered for publication.

First-time users: Please click the Register button from the main menu and enter the requested information. On successful registration, you will be sent an e-mail indicating your user name and password. Print a copy of this information for future reference. Note: If you have received an e-mail from us with an assigned user ID and password, or if you are a repeat user, do not register again. Just log in. Once you have an assigned ID and password, re-registration is unnecessary, even if your status changes (that is, author, reviewer, or editor).

Authors: Please click the login button from the menu at the top of the page and log in to the system as an Author. Submit your manuscript according to the author instructions. You will be able to track the progress of your manuscript through the system. If you experience any problems, please contact the Managing Editor, Marjory Spraycar (e-mail: [m.spraycar@verizon.net](mailto:m.spraycar@verizon.net); phone: 410-321-5031; fax: 410-321-1456. Requests for help and other questions will be addressed in the order received.)

#### **Review and Revision Process**

The Editor reviews all articles within 2 weeks of receipt. If provisionally accepted, articles are sent to outside reviewers who often suggest revisions before an article's final acceptance. Once those revisions are complete and approved by the Editor, the corresponding author will be notified that an article is ready for production.

#### **Compliance with NIH and Other Research Funding Agency Accessibility Requirements**

A number of research funding agencies now require or request authors to submit the post-print (the article after peer review and acceptance but not the final published article) to a repository that is accessible online by all without charge. As a service to our authors, LWW will identify to the National Library of Medicine (NLM) articles that require deposit and will transmit the post-print of an article based on research funded in whole or in part by the National Institutes of Health, Wellcome Trust, Howard Hughes Medical Institute, or other funding agencies to PubMed Central. The revised Copyright Transfer Agreement provides the mechanism.

## **Copyright Assignment**

When manuscripts are accepted for publication, it will be necessary to transfer full copyright to the American College of Occupational and Environmental Medicine and to disclose any financial support for the research being reported in the manuscript.

Authors must state all possible conflicts of interest on the title page of the manuscript, including financial, consultant, institutional and other relationships that might lead to bias or a conflict of interest. If there is no conflict of interest, this should also be explicitly stated as none declared. All sources of funding and all relevant conflicts of interest should be included on the title page of the manuscript with the heading "Conflicts of Interest and Source of Funding:". For example:

Conflicts of Interest and Source of Funding: A has received honoraria from Company Z. B is currently receiving a grant (#12345) from Organization Y, and is on the speaker's bureau for Organization X – the CME organizers for Company A. For the remaining authors none were declared.

In addition, each author must complete and submit the journal's copyright transfer agreement, which includes a section on the disclosure of potential conflicts of interest based on the recommendations of the International Committee of Medical Journal Editors, "Uniform Requirements for Manuscripts Submitted to Biomedical Journals" ([www.icmje.org/update.html](http://www.icmje.org/update.html)). The form is available on the manuscript submission page (<http://www.editorialmanager.com/joem>) and can be completed and submitted electronically. Please note that authors may sign the copyright transfer agreement form electronically. For additional information about electronically signing this form, go to <http://links.lww.com/ZUAT/A106>.

## **Manuscript Preparation**

Title page: The title page must be submitted as a separate file. Please include on the title page (a) complete manuscript title; (b) authors' full names, highest academic degrees (letters indicating membership in honor or professional societies will NOT be published), and affiliations (if an author's present affiliation is different from the affiliation under which the work was done, list both); (c) name and address for correspondence, including fax number, telephone number, and e-mail address; (d) disclosure of funding received for this work from any of the following organizations: National Institutes of Health (NIH); Wellcome Trust; Howard Hughes Medical Institute (HHMI); and other(s); (e) conflicts of interest and sources of funding; (f) address for reprints if different from that of corresponding author; and (g) all sources of support, including pharmaceutical and industry support, that require acknowledgment.

## Running Title

Authors MUST provide a short running title of no more than 50 characters, including spaces.

## Structured Abstract

Abstracts must be submitted as a separate file. JOEM has adopted a structured abstract format, as follows:

- Objective: What is the problem being addressed?
- Methods: How was the study performed?
- Results: What are the findings?
- Conclusions: What is the significance?

In no more than 135 words, authors should submit structured abstracts using the above subheadings. All papers should have structured abstracts unless an author of a non-research paper requests an exception. In those cases, the Editor will decide whether to require a structured abstract.

## Clinical Significance

Statements of clinical significance must be submitted as a separate file. Authors must submit a short statement describing the significance to clinical practice of the information being presented. These statements will be used to highlight papers in every issue that offer useful clinical information to readers. Statements should not exceed 50 words.

## References

References should be included in the main manuscript file. References must be numbered and cited CONSECUTIVELY in the text. At the end of the manuscript, references must be listed on a separate page and DOUBLE-SPACED THROUGHOUT, in the numerical order in which they are first cited in the text. Personal communications and unpublished data should not be included in the list of references. References must include the names of the first six authors. Punctuation is shown in the following examples:

*Journal Articles:* Surname and initials of author(s), title and subtitle, name of journal, year, volume number, first and last page. If there are more than six authors, give the names of the first three, followed by "et al."

1. Yu T, Roht L, Wise R, et al. Low-back pain in industry: an old problem revisited. *J Occup Med.* 1984;26:517-524.

*Books:* Surname and initials of author(s), title and subtitle, edition number (other than first). City, publishing house, year, and page(s) of specific reference.

1. Schaefer H, Zesch A, Sluttgen G. *Skin Permeability*. New York: Springer-Verlag; 1982:550-554.

*Article or Chapter in a Book:* Surname and initials of author(s), title of article or chapter, surname and initials of editor(s), title of book, edition (if other than first). City, publishing house, volume number (if any), year, pages.

1. Carrano A, Moore D. The rationale and methodology for quantifying sister chromatid exchange in humans. In: Heddle J, ed. *Mutagenicity: New Horizons in Genetic Toxicology*. New York: Academic Press; 1982:267-304.

## **Tables**

Each table must be submitted as a separate file. Tables should be self-explanatory and should supplement, not duplicate, the text. Each table must have a title and be numbered consecutively and cited in the text.

## **Figures**

Each figure must be submitted as a separate file. Figures must be created/scanned and saved and submitted as separate TIFF (tagged image file format), EPS (encapsulated PostScript), or PPT (PowerPoint) files. All other file formats are unacceptable. Artwork generated from office suite programs such as CorelDRAW and MS Word and artwork downloaded from the Internet (JPEG or GIF files) cannot be used. Line art must have a resolution of at least 1200 dpi (dots per inch), and electronic photographs, radiographs, CT scans, and so on and scanned images must have a resolution of at least 300 dpi. If fonts are used in the artwork, they must be converted to paths or outlines or they must be embedded in the files. Color images must be created/scanned and saved and submitted as CMYK files. Figures consist of all material that cannot be set in type, such as photographs, line drawings, graphs, charts, and tracings. Omit all figures that do not increase understanding or that repeat information given in the text. Each figure should be numbered consecutively and cited in the text; symbols, abbreviations, and spelling should be consistent. Lettering on the graphs should be caps and lower case, large enough to permit reduction to journal column widths. Each figure must have a descriptive legend that, generally, should not exceed 40 words in length. Legends should be included in the manuscript text and identified by number. Do not attach legends to digital art, and do not make the legend part of the illustration. A title for identification may be part of a graph, but do not include the figure number in the graphs.

## **Supplemental Digital Content**

Authors may submit SDC via Editorial Manager to LWW journals that enhance their article's text to be considered for online posting. SDC may include standard media such as text documents, graphs, audio, video, etc. On the Attach Files page of the submission process, please select Supplemental Audio, Video, or Data for your uploaded file as the Submission Item. If an article with SDC is accepted, our production staff will create a URL with the SDC file. The URL will be placed in the call-out within the article. SDC files are not copy-edited by LWW staff, they will be presented digitally as submitted. For a list of all available file types and detailed instructions, please visit <http://links.lww.com/A142>.

### **SDC Call-outs**

Supplemental Digital Content must be cited consecutively in the text of the submitted manuscript. Citations should include the type of material submitted (Audio, Figure, Table, etc.), be clearly labeled as "Supplemental Digital Content," include the sequential list number, and provide a description of the supplemental content. All descriptive text should be included in the call-out as it will not appear elsewhere in the article.

Example:

We performed many tests on the degrees of flexibility in the elbow (see Video, Supplemental Digital Content 1, which demonstrates elbow flexibility) and found our results inconclusive.

### **List of Supplemental Digital Content**

A listing of Supplemental Digital Content must be submitted at the end of the manuscript file. Include the SDC number and file type of the Supplemental Digital Content. This text will be removed by our production staff and not be published.

Example:

Supplemental Digital Content 1.wmv

### **SDC File Requirements**

All acceptable file types are permissible up to 10 MBs. For audio or video files greater than 10 MBs, authors should first query the journal office for approval. For a list of all available file types and detailed instructions, please visit <http://links.lww.com/A142>.

## **Author Responsibility**

Authors must obtain written permission from the copyright owner (usually the publisher) for the use of tables, illustrations, or extensively quoted material that has previously appeared in another publication.

## **Letters to the Editor**

Include name, degree, current position, and complete mailing address, including ZIP code. Letters to the Editor must have a title so that they can be properly indexed.

## **Page Proofs/Electronic Proofs**

Authors will receive a notice that electronic proofs of their article can be downloaded from a specific URL site. The notice will include instructions for downloading. Authors should carefully read the proofs, correct any inadequacies or inaccuracies, and answer all queries. Only minor corrections are permitted; authors will be charged for excessive changes. Within 48 hours, corrections or approval should be sent to the Journal Production Editor, as indicated in the e-mail notice; a message summarizing the corrections may be sent by e-mail or fax, or a printout of the page proofs may be sent by express mail.

## **Reprints**

Authors will receive a reprint order form and a price list with the page proofs. Fax or mail your order to Lippincott Williams & Wilkins, Author Reprint Department, 351 West Camden Street, Baltimore, MD 21201. Fax: 410-528-4434. Rapid Ordering can be accessed at <http://www.lww.com/periodicals/author-reprints>. A confirmation of your order will be e-mailed to you. Reprints are normally shipped 6 to 8 weeks after publication of the issue in which the item appears. Contact the Author Reprint Department with any questions.

## **News Items**

News items for People and Events department should be addressed to Marianne Dreger, Department Editor, American College of Occupational and Environmental Medicine, 25 Northwest Point Boulevard, Suite 700, Elk Grove Village, IL 60007-1030 or e-mailed to [mdreger@acoem.org](mailto:mdreger@acoem.org).

## **Books for Review**

Please send books for review to Jonathan Borak, MD, 234 Church Street, Suite 1100, New Haven, CT 06510.

## **Fast Track Papers**

Fast Track Papers are published within five weeks of acceptance. Papers selected for the Fast Track by editors are cutting-edge, groundbreaking, and high-impact papers that are of highest importance to the field. Fast Track articles include all the major subjects covered by JOEM; authors are encouraged to consider the JOEM Fast Track for their most important and sought-after work.

### **3. Author Guidelines**

#### **Health Economics**

#### **Author Guidelines**

##### **1. AIMS & SCOPE**

The Journal publishes articles on all aspects of health economics: theoretical contributions, empirical studies and analyses of health policy from the economic perspective. Its scope includes the determinants of health and its definition and valuation, as well as the demand for and supply of health care; planning and market mechanisms; micro-economic evaluation of individual procedures and treatments; and evaluation of the performance of health care systems.

Contributions should typically be original and innovative. As a rule, the Journal does not include routine applications of cost-effectiveness analysis, discrete choice experiments and costing analyses.

##### **2. MANUSCRIPT CATEGORIES**

*Health Economics* invites the following types of submission:

###### **Research articles**

Research articles are the Journal's primary mode of communication. Research articles should not exceed **5000** words of body text. Tables and figures should be kept to a minimum.

###### **Health Economics Letters**

The Journal encourages the submission of concise reports which are published as Health Economics Letters. These should not exceed **2000** words of body text. A summary is required. All Letters are peer-reviewed.

###### **Editorials**

Summaries of pertinent issues, commentaries on recently published papers, or freestanding pieces expressing an opinion—are typically invited. Authors who wish to submit an unsolicited Editorial should first contact one of the Editors to determine its suitability for publication in the Journal. Editorials should not exceed **1500** words of body text.



### 3. SUBMISSION OF MANUSCRIPTS

All submissions should be made online at the *Health Economics* ScholarOne Manuscripts (formerly known as Manuscript Central) site - <http://mc.manuscriptcentral.com/hec> . New users should first create an account. Once a user is logged onto the site, submissions should be made via the Author Centre.

Authors **must only** supply to the Editorial office:

- Copyright Transfer Agreement/Conflict of Interest Disclosure Form with original signature(s) - without these we are unable to accept the submission, and
- permission grants - if the manuscript contains extracts, including illustrations, from other copyright works (including material from on-line or intranet sources) it is the author's responsibility to obtain written permission from the owners of the publishing rights to reproduce such extracts using the Wiley Permission Request Form

### 4. EDITORIAL OFFICE

Mrs Frances Sharp, The Editorial Office, University of York, Centre for Health Economics, York, YO10 5DD, UK; Email: [hejournal@york.ac.uk](mailto:hejournal@york.ac.uk) ; Fax: 44 1904 321035.

### 5. PREPARATION OF MANUSCRIPTS

Manuscripts must be written in English. Text should be supplied in a word processed format such as Microsoft Word for Windows. LaTeX files may be submitted provided that a pdf file is provided in addition to the source file. Charts and tables are considered textual and should be supplied in the same format. Figures (illustrations, diagrams, photographs) should be supplied in gif, jpeg, tif or eps format. All manuscripts must be typed in 12 pt font with lines double spaced and margins of at least 2.5 cm. Abbreviations must be defined when first used, both in the abstract and in the main text. Manuscripts must be as succinct as possible. Repetition of information or data in different sections of the manuscript must be carefully avoided. Text must comply with the word limits defined in Section 2, and, where appropriate, include:

#### **Title Page**

The first page of all manuscripts (including correspondence) should contain the following information:

- the title of the paper
- a running head not exceeding 50 characters

- 2–6 article keywords
- manuscript word, table and figure count
- names of authors
- names of the institutions at which the research was conducted
- name, address, telephone and fax number, and email address of corresponding author
- a statement of all funding sources that supported the work
- any conflict of interest disclosures (see Section 5).

## **Abstracts**

Abstracts (maximum 200 words) are required for all articles. Abstracts should contain no citations to previously published work.

## **Text**

This should in general, but not necessarily, be divided into numbered sections with the headings: Introduction, Methods, Results, Discussion, Acknowledgements, References, Tables, Legends and Figures.

Headings should be numbered consecutively, e.g., 1. INTRODUCTION; 2. METHODS; 2.1 Literature search; 2.2 Study selection; 3. RESULTS

## **Tables and Figures**

Tables and figures should not be inserted in the appropriate place in the text but should be included at the end of the manuscript, each on a separate page.

Tables and figures should be referred to in text as follows: Figure 1, Figures 2–4; Table I, Table II. The place at which a table or figure is to be inserted in the printed text should be indicated clearly on a manuscript. Each table and/or figure must have a legend that explains its purpose without reference to the text.

Authors are themselves responsible for obtaining permission to reproduce previously published figures or tables.

## **References**

References should be in 'Harvard' format, i.e., names and dates in brackets in the text (Jones, 2000; Smith and Jones, 2001; Jones *et al.*, 2002), and the full reference listed at the end of the paper, in alphabetical order by first author, as follows:

Morris S, Devlin N, Parkin D. 2007. *Economic Analysis in Health Care*. Wiley: Chichester.

Moscone F, Tosetti E, Knapp M. 2007. Sur model with spatial effects: an application to mental health expenditure. *Health Economics* **16** : 1403–1408.

Health Economic Evaluations Database. <http://heed.wiley.com> [1 January 2008].

## **6. DECLARATIONS**

### **Original Publication**

Submission of a manuscript will be held to imply that it contains original unpublished work and is not being submitted for publication elsewhere at the same time. The author must supply a full statement to the Editor about all submissions and previous reports that might be regarded as redundant or duplicate publication of the same or very similar work.

### **Conflicts of Interest**

Authors are responsible for disclosing all financial and personal relationships between themselves and others that might be perceived by others as biasing their work. To prevent ambiguity, authors must state explicitly whether potential conflicts do or do not exist.

### **Ethics**

When reporting experiments on human subjects, indicate whether the procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional or regional) and with the Helsinki Declaration of 1975, as revised in 1983. Do not use patients' names, initials or hospital numbers, especially in illustrative material. When reporting experiments on animals, indicate whether the institution's or a national research council's guide for, or any national law on, the care and use of laboratory animals was followed. A statement describing explicitly the ethical background to the studies being reported should be included in all manuscripts in the Materials and Methods section. Ethics committee or institutional review board approval should be stated.

Patients have a right to privacy that should not be infringed without informed consent. Identifying information should not be published in written descriptions, photographs and pedigrees unless the information is essential for scientific purposes and the patient (or parent or guardian) gives written informed consent for publication. Identifying details should be omitted if they are not essential but patient data should never be altered or falsified in an attempt to attain anonymity. Complete anonymity is difficult to achieve and informed consent should be obtained

if there is any doubt. For example, masking the eye region in photographs of patients is inadequate protection of anonymity.

## **Authorship**

All persons designated as authors should qualify for authorship and all those who qualify should be listed. Each author should have participated sufficiently in the work to take public responsibility for appropriate portions of the content. One or more authors should take responsibility for the integrity of the work as a whole, from inception to published article. Authorship credit should be based only on 1) substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data; 2) drafting the article or revising it critically for important intellectual content; 3) final approval of the version to be published. Conditions 1, 2 and 3 must all be met. Acquisition of funding, the collection of data or general supervision of the research group, by themselves, do not justify authorship. All others who contributed to the work who are not authors should be named in the Acknowledgements section.

## **Committee on Publication Ethics (COPE)**

As a member of the Committee on Publication Ethics (COPE), adherence to these submission criteria is considered essential for publication in *Health Economics* ; mandatory fields are included in the online submission process to ensure this. If, at a later stage in the submission process or even after publication, a manuscript or authors are found to have disregarded these criteria, it is the duty of the Editor to report this to COPE. COPE may recommend that action be taken, including but not exclusive to, informing the authors' professional regulatory body and/or institution of such a dereliction.

## **4. Author Guidelines**

### **Journal of Health Economics**

#### **Submission**

Submission to this journal proceeds totally online and you will be guided stepwise through the creation and uploading of your files. The system automatically converts source files to a single PDF file of the article, which is used in the peer-review process. Please note that even though manuscript source files are converted to PDF files at submission for the review process, these source files are needed for further processing after acceptance. All correspondence, including notification of the Editor's decision and requests for revision, takes place by e-mail removing the need for a paper trail.

#### **Preparation**

##### **Use of word processing software**

It is important that the file be saved in the native format of the word processor used. The text should be in single-column format. Keep the layout of the text as simple as possible. Most formatting codes will be removed and replaced on processing the article. In particular, do not use the word processor's options to justify text or to hyphenate words. However, do use bold face, italics, subscripts, superscripts etc. When preparing tables, if you are using a table grid, use only one grid for each individual table and not a grid for each row. If no grid is used, use tabs, not spaces, to align columns. The electronic text should be prepared in a way very similar to that of conventional manuscripts (see also the Guide to Publishing with Elsevier: <http://www.elsevier.com/guidepublication>). Note that source files of figures, tables and text graphics will be required whether or not you embed your figures in the text. See also the section on Electronic artwork. To avoid unnecessary errors you are strongly advised to use the 'spell-check' and 'grammar-check' functions of your word processor.

#### **Article structure**

##### **Essential title page information**

- **Title.** Concise and informative. Titles are often used in information-retrieval systems. Avoid abbreviations and formulae where possible
- **Author names and affiliations.** Where the family name may be ambiguous (e.g., a double name), please indicate this clearly. Present the authors' affiliation addresses (where the actual work was done) below the names. Indicate all affiliations with a lower-case

superscript letter immediately after the author's name and in front of the appropriate address. Provide the full postal address of each affiliation, including the country name and, if available, the e-mail address of each author.

- **Corresponding author.** Clearly indicate who will handle correspondence at all stages of refereeing and publication, also post-publication. **Ensure that phone numbers (with country and area code) are provided in addition to the e-mail address and the complete postal address. Contact details must be kept up to date by the corresponding author.**
- **Present/permanent address.** If an author has moved since the work described in the article was done, or was visiting at the time, a 'Present address' (or 'Permanent address') may be indicated as a footnote to that author's name. The address at which the author actually did the work must be retained as the main, affiliation address. Superscript Arabic numerals are used for such footnotes.

## **Abstract**

A concise and factual abstract is required. The abstract should state briefly the purpose of the research, the principal results and major conclusions. An abstract is often presented separately from the article, so it must be able to stand alone. For this reason, References should be avoided, but if essential, then cite the author(s) and year(s). Also, non-standard or uncommon abbreviations should be avoided, but if essential they must be defined at their first mention in the abstract itself.

## **Highlights**

Highlights are mandatory for this journal. They consist of a short collection of bullet points that convey the core findings of the article and should be submitted in a separate file in the online submission system. Please use 'Highlights' in the file name and include 3 to 5 bullet points (maximum 85 characters, including spaces, per bullet point).

See <http://www.elsevier.com/highlights> for examples.

## **Keywords**

Immediately after the abstract, provide a maximum of 6 keywords, using either British or American spelling, but be consistent, and avoiding general and plural terms and multiple concepts (avoid, for example, "and", "of"). Be sparing with abbreviations: only abbreviations firmly established in the field may be eligible. These keywords will be used for indexing purposes.

## **Classification codes**

Please provide up to 6 standard JEL codes. The available codes may be accessed at JEL: <http://www.aeaweb.org/journal/elclasjn.html>.

## **Artwork**

### ***Color artwork***

Please make sure that artwork files are in an acceptable format (TIFF, EPS or MS Office files) and with the correct resolution. If, together with your accepted article, you submit usable color figures then Elsevier will ensure, at no additional charge, that these figures will appear in color on the Web (e.g., ScienceDirect and other sites) regardless of whether or not these illustrations are reproduced in color in the printed version. For color reproduction in print, you will receive information regarding the costs from Elsevier after receipt of your accepted article. Please indicate your preference for color: in print or on the Web only. For further information on the preparation of electronic artwork, please see <http://www.elsevier.com/artworkinstructions>. Please note: Because of technical complications which can arise by converting color figures to 'gray scale' (for the printed version should you not opt for color in print) please submit in addition usable black and white versions of all the color illustrations

## **References**

### ***Web reference***

As a minimum, the full URL should be given and the date when the reference was last accessed. Any further information, if known (DOI, author names, dates, reference to a source publication, etc.), should also be given. Web references can be listed separately (e.g., after the reference list) under a different heading if desired, or can be included in the reference list.

### ***Reference management software***

This journal has standard templates available in key reference management packages EndNote (<http://www.endnote.com/support/enstyles.asp>) and Reference Manager (<http://refman.com/support/rmstyles.asp>). Using plug-ins to wordprocessing packages, authors only need to select the appropriate journal template when preparing their article and the list of references and citations to these will be formatted according to the journal style which is described below.

## Reference Style

All citations in the text should refer to:

- Single Author: the Author's name (without initials, unless there is ambiguity) and the year of publication;
- Two Authors: both Authors' names and the year of publication;
- Three or more Authors: first Author's name followed by "et al." and the year of publication.  
Examples: "as demonstrated in (Allan, 1996a, 1996b, 1999; Allan and Jones, 1995). Lee et al. (2000) have recently shown"

In the references list references should be arranged first alphabetically and then further sorted chronologically if necessary. More than one reference from the same Author(s) in the same year must be identified by the letters "a", "b", "c", etc., placed after the year of publication. Examples:

### *Reference to a journal publication:*

Griffiths W, Judge G. Testing and estimating location vectors when the error covariance matrix is unknown. *Journal of Econometrics* 1992;54; 121-138 (note that journal names are not to be abbreviated).

### *Reference to a book:*

Hawawini G, Swary I. Mergers and acquisitions in the U.S. banking industry: Evidence from the capital markets. North-Holland: Amsterdam; 1990.

### *Reference to a chapter in an edited book:*

Brunner K, Melzer AH 1990. Money Supply. In: Friedman BM, Hahn FH (Eds), *Handbook of monetary economics*, vol.1. North-Holland: Amsterdam; 1990. p. 357-396.

## Submission checklist

The following list will be useful during the final checking of an article prior to sending it to the journal for review. Please consult this Guide for Authors for further details of any item.

### **Ensure that the following items are present:**

One author has been designated as the corresponding author with contact details:

- E-mail address
- Full postal address
- Phone numbers



All necessary files have been uploaded, and contain:

- Keywords
- All figure captions
- All tables (including title, description, footnotes)

Further considerations

- Manuscript has been 'spell-checked' and 'grammar-checked'
- References are in the correct format for this journal
- All references mentioned in the Reference list are cited in the text, and vice versa
- Permission has been obtained for use of copyrighted material from other sources (including the Web)
- Color figures are clearly marked as being intended for color reproduction on the Web (free of charge) and in print, or to be reproduced in color on the Web (free of charge) and in black-and-white in print
- If only color on the Web is required, black-and-white versions of the figures are also supplied for printing purposes

# Appendix B

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The manuscript presented in Chapter 3 was submitted for publication to the *African Journal for Physical, Health Education, Recreation and Dance (AJPHERD)*. Please note that the article was presented to the journal with a shortened title as specify by the guidelines of the journal. Below the conformation of submission:

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## Re: Submitting manuscript for submission

---

**From:** Lateef Amusa <amusalbw@yahoo.com>  
**To:** Madelein Smit <12384119@nwu.ac.za>  
**CC:** Abel Toriola <toriolaal@tut.ac.za>, Cilas Wilders <cilas.wilders@nwu.ac.za>  
**Date:** Friday - November 9, 2012 2:42 PM  
**Subject:** Re: Submitting manuscript for submission  
**Attachments:** Mime.822

---

Dear Smit,  
I acknowledge with thanks the receipt of your article titled "Physical activity and selected physical health components" for consideration in AJPHERD. The article will be reviewed in line with AJPHERD Guidelines and a feedback on it will be sent to you as soon as possible'  
Thank you.  
L.O.Amusa  
Editor-In-Chief, AJPHERD

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# Appendix C

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Bankmed questionnaire as used in the study:



For office use only

Form completion instructions: In order to speed up processing, this form will be computer processed.  
Please write neatly, using capital letters in black ink. Do not write outside the blocks.

MEMBERSHIP NUMBER:	<input type="text"/>	DEPENDANT CODE:	<input type="text"/>
IDENTITY NO.:	<input type="text"/>	GENDER:	M <input type="text"/> F <input type="text"/>
SURNAME:	<input type="text"/>		
FIRST NAME:	<input type="text"/>		
DATE OF BIRTH:	<input type="text"/>		
POSTAL ADDRESS:	<input type="text"/>		
	<input type="text"/>		
	<input type="text"/>	CODE:	<input type="text"/>
TELEPHONE NUMBERS:	(W) <input type="text"/>	(H) <input type="text"/>	
	(C) <input type="text"/>		
E-MAIL ADDRESS:	<input type="text"/>		
EMPLOYER:	<input type="text"/>		
BRANCH:	<input type="text"/>	BRANCH CODE:	<input type="text"/>

### 1. CHRONIC DISEASES

Do you require or do you currently receive treatment for any of the following conditions:

	Y	N
Heart attack	<input type="text"/>	<input type="text"/>
Coronary artery disease (angina)	<input type="text"/>	<input type="text"/>
Stroke	<input type="text"/>	<input type="text"/>
Diabetes	<input type="text"/>	<input type="text"/>
TIA (temporary or "mini" stroke)	<input type="text"/>	<input type="text"/>
Intermittent claudication	<input type="text"/>	<input type="text"/>
High blood pressure	<input type="text"/>	<input type="text"/>
Aortic aneurysm	<input type="text"/>	<input type="text"/>
Depression	<input type="text"/>	<input type="text"/>

### 2. CLINICAL MEASUREMENTS

To be filled in by a medical professional.

Please record the following measurements:

Current weight (with minimal clothing)	<input type="text"/>	<input type="text"/>	<input type="text"/>	to the nearest kg
Height (without shoes)	<input type="text"/>	<input type="text"/>	<input type="text"/>	cm
Blood pressure – Systolic (upper no.)	<input type="text"/>	<input type="text"/>	<input type="text"/>	mmHg
– Diastolic (lower no.)	<input type="text"/>	<input type="text"/>	<input type="text"/>	mmHg
Total cholesterol (e.g. 4,8)	<input type="text"/>	<input type="text"/>	<input type="text"/>	mmol/l
HDL cholesterol (e.g. 1,7) (optional)	<input type="text"/>	<input type="text"/>	<input type="text"/>	mmol/l
Random blood sugar (e.g. 6,4)	<input type="text"/>	<input type="text"/>	<input type="text"/>	mmol/l

### 3. CORONARY HEART DISEASE RISK

Do you smoke cigarettes, cigars or a pipe? If yes, how many a day?	Y <input type="text"/>	N <input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	Per day
If you smoked previously, have you quit within the last month?	Y <input type="text"/>	N <input type="text"/>				
How many alcoholic drinks do you consume in a typical week? (1 drink = 1 glass of wine, 1 can of beer or 1 tot of alcohol)			<input type="text"/>	<input type="text"/>	<input type="text"/>	Per week
Have any of your family (brother, sister, parent or grandparent) died from coronary heart disease before the age of 55 if male, or before 65 if female?	Y <input type="text"/>	N <input type="text"/>				

### 4. DIABETES RISK

Do you have a sister or a brother with diabetes?	Y <input type="text"/>	N <input type="text"/>
Do you have a parent with diabetes?	Y <input type="text"/>	N <input type="text"/>
If female, did you have high blood glucose (sugar) during your pregnancy, or have you given birth to a baby weighing more than 4,0 kg?	Y <input type="text"/>	N <input type="text"/>

## 5. STRESS SCREEN

Select ONE of the following statements that is most appropriate to you:

- My life is currently very stressful and I am not coping at all well ☐
- My life is currently very stressful, but I am coping adequately ☐
- My life is somewhat stressful but my coping attempts are not effective ☐
- My life is not currently very stressful, but I am not coping nonetheless ☐
- My life is not stressful and I am coping very well ☐

Possible causes for my stress are (select as many as you wish):

- Work issues ☐
- Financial worries ☐
- Ill health ☐
- Family problems ☐
- Marital problems ☐
- Crime or violence ☐
- Study ☐
- Transport ☐

## 6. DEPRESSION SCREEN

Over the past 2 weeks, how often have you been bothered by each of the following problems?

	Not at all	Several days	More than half the days	Nearly every day
Little interest or pleasure in doing things	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Feeling down, depressed or hopeless	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Trouble falling or staying asleep, or sleeping too much	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Feeling tired or having little energy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Poor appetite or overeating	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Feeling bad about yourself, or that you are a failure, or have let yourself or your family down	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Trouble concentrating on things, such as reading the newspaper or watching TV	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Moving or speaking so slowly that other people could have noticed. Or the opposite, being so fidgety or restless that you have been moving around a lot more than usual	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Thoughts that you would be better off dead, or hurting yourself in some way	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## 7. EXERCISE ASSESSMENT

- Do you participate in regular physical activity? Y ☐ N ☐
- If you answered YES to the above, please complete the following questions:
- Do you exercise 3 times or more per week? Y ☐ N ☐
- Does each exercise session last at least 30 minutes? Y ☐ N ☐
- Do you ever exercise at a moderate to vigorous intensity? (i.e. at a level that raises a sweat and you are able to talk but not sing) Y ☐ N ☐

## 8. DIETARY INDEX

Consider your dietary habits over the past 6 months. Think about what foodstuffs you eat and answer each of the following questions:

On average, do you eat at least five portions of fruit and/or vegetables each day? (1 portion = 1 cup fresh, 1/2 cup cooked, 1 medium sized fruit)	Y <input type="checkbox"/>	N <input type="checkbox"/>
Do you eat 3 meals every day with healthy snacks between meals?	Y <input type="checkbox"/>	N <input type="checkbox"/>
Do you consciously try to reduce the amount of fat in your diet by choosing low fat dairy products?	Y <input type="checkbox"/>	N <input type="checkbox"/>
Do you eat red meat less than 3 times per week?	Y <input type="checkbox"/>	N <input type="checkbox"/>
Do you eat fish at least once a week?	Y <input type="checkbox"/>	N <input type="checkbox"/>
Do you usually choose whole-wheat products (e.g. whole-wheat bread and pasta, brown rice, oatmeal porridge, high fibre cereals) instead of refined products (e.g. white bread and rolls, white rice, typical breakfast cereals, cakes)?	Y <input type="checkbox"/>	N <input type="checkbox"/>
Do you consciously limit the amount of salt you ingest?	Y <input type="checkbox"/>	N <input type="checkbox"/>
Do you eat take-aways/fast foods less than twice a week?	Y <input type="checkbox"/>	N <input type="checkbox"/>
Do you avoid fried foods?	Y <input type="checkbox"/>	N <input type="checkbox"/>
Do you remove the visible fat/skin from meat and chicken?	Y <input type="checkbox"/>	N <input type="checkbox"/>

## 9. QUALITY OF LIFE

How many days' work did you miss in the last 6 months due to ill health or injury?

<input type="checkbox"/> None	<input type="checkbox"/> 1 - 3	<input type="checkbox"/> 4 - 7	<input type="checkbox"/> 8 - 10	<input type="checkbox"/> > 10	<input type="checkbox"/> Not applicable
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In the last month, has your physical health adversely affected your work/daily activities in any way? Y ☐ N ☐

In the last month, has your emotional health adversely affected your work/daily activities in any way? Y ☐ N ☐

## 10. STAGES OF CHANGE

Are you interested in making a change in the following lifestyle areas? Indicate below where you are on the path to good health in each area:

	Not interested	Thinking about it	Planning it	Making the change	I changed > 6 months ago
Alcohol use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Weight management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Healthy nutrition	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Physical activity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Stress	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Smoking	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

On a scale of 0 to 10, how ready are you to address those lifestyle behaviours that impact on your health? (0 = Totally unwilling and 10 = Will do everything I can to become healthier) e.g. 8

## 11. CONSENT AND SIGNATURE

"I exercise my own judgement in participating in this assessment with the understanding that it cannot take the place of a medical consultation with my doctor. I hereby give consent for a registered medical professional to contact me to discuss health-related issues identified in this report should the need arise. The relevant Bankmed insured benefit will cover the cost of performing the PHA. Subsequent follow-up consultations (if required) will be subject to available benefits."

Member:

Signature \_\_\_\_\_ Date \_\_\_\_\_

Medical Professional: (Assisting in the completion of this form)

Name \_\_\_\_\_ Address \_\_\_\_\_ Signature \_\_\_\_\_

Usual General Practitioner: (if different to above)

Name \_\_\_\_\_ Address \_\_\_\_\_ Tel \_\_\_\_\_