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Risk factors for non-communicable disease and  
healthcare expenditure in South African employees with  
private health insurance presenting for health risk  
appraisal

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University of Cape Town

*I dedicate this thesis to my husband, Hugh, and four children, Lesleigh, Charne, Jared and Thomas. Thank you for all your support and patience in all my endeavors, be it at home, at work or at play. You are a continued reminder of God's grace and favor towards me.*

## DECLARATION

### MPH Mini-Dissertation

I, *Tracy Kolbe-Alexander (KLBTRA002)* hereby declare that the work on which this dissertation/thesis is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

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**Date:** 21 February 2013

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## STRUCTURE OF THE MINI-DISSERTATION

An abstract of the min-dissertation provides a brief summary of the research study which was conducted and is presented prior to the three main sections.

**Part A**, is the research proposal which was submitted to the University of Cape Town and outlines the aims, methods and ethical considerations for the research study.

**Part B** is a literature review that examined current evidence for the role of worksite health promotion programs' role in the prevention of non-communicable diseases. This review includes a discussions related to the prevalence of risk factors for non-communicable diseases among employees, with a focus on physical activity. In addition, the economic consequences of NCD's and possible benefits of worksite intervention programs are briefly addressed.

**Part C** concludes the dissertation and is presented in the format required for manuscript submission to the Journal of Occupational and Environmental Medicine.

The final component of the dissertation includes three **appendices**, namely, UCT ethics approval, the health risk assessment and the author guidelines for the Journal of Occupational and Environmental Medicine.

## ABSTRACT

### **Background:**

The worksite setting has been shown to be a favorable setting to implement intervention programs aiming to reduce the risk and prevalence of NCD's, as many adults can be reached at the same time. These programs have been shown to play a role in improving health status and lifestyle behaviors such as increased physical activity and reduced dietary fat intake among employees.

### **Aim:**

The main aims of this research study were to determine the extent to which insufficient physical activity clustered with other risk factors for non-communicable disease (NCD), with specifically cardiovascular and metabolic disease, and whether these risk factors were associated with higher healthcare costs.

### **Methods:**

Employees (n=6531) from 70 companies voluntarily participated in worksite wellness days, that included an assessment of self-reported health behaviors and clinical measures, such as: blood pressure (BP), Body Mass Index (BMI), as well as total cholesterol concentrations from capillary blood samples. Healthcare cost data were obtained for employees (n=2789), of whom 409 made at least one claim.

**Results:**

Participants were  $36 \pm 10$  years and the most prevalent risk factors were insufficient PA (68%) and BMI > 25 (67%). Those employees who were insufficiently active, also had a greater number of other NCD risk factors, compared to those meeting PA recommendations ( $\chi^2 = 43.55$ ;  $p < 0.0001$ ). Moreover, employees meeting PA guidelines had significantly fewer visits to their family doctor (GP) (2.39 versus 2.85;  $p < 0.001$ ) than those who were insufficiently PA, which was associated with an average **reduced cost** of ZAR100 per year ( $p < 0.01$ ).

**Conclusions:**

Physical inactivity was associated with clustering of risk factors for NCD in SA employees. Employees with lower BMI, better self-reported health status and readiness to change were more likely to meet the PA guidelines. These employees might therefore benefit from physical activity intervention programs that could result in improved risk profile and reduced healthcare expenditure.

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*Part A:*

*Research Proposal*

University of Cape Town

## Background

Like many developing nations, South Africa has a dual burden of disease with non-communicable disease (NCD) accounting for more than a third (37%) of all deaths<sup>1</sup>. The other major causes of death are HIV/AIDS (30%) and other communicable diseases (21%)<sup>1</sup>. In addition to the increasing prevalence of NCD mortality and morbidity, there is a concomitant increase in the prevalence of contributing risk factors such as inactivity and obesity<sup>2</sup>. Subsequently, the World Health Assembly's (WHA) Resolution on Diet, Physical Activity and Health highlights the importance of reducing the risk factors for NCD's that arise primarily from inactivity and unhealthy diets. This resolution encourages member states to increase awareness of the impact of these risk factors and the potential benefits of preventative intervention programmes.

The workplace is an opportune setting for physical activity and health promotion interventions since a large number of people can be reached simultaneously<sup>3</sup> and many adults spend approximately half of their waking hours at work<sup>4</sup>. The focus of occupational health has shifted slightly in recent years in order to include non-communicable diseases and their impact on the individual's health, and also the economic costs to the company<sup>5</sup>. Aldana *et al* showed that there is a positive preventative effect on the worksite chronic diseases, using intervention programs<sup>6 7</sup>. Previous research has found that employees that were not taking part in a health promotion program had higher rates of absenteeism<sup>7</sup>. In a study by Kuriyama *et al*, it was found that physical inactivity, smoking and obesity were associated with an 8.0 %, 8.35% and 7.1 % increase in health care charges, respectively<sup>8</sup>. Subjects having a combination of all the modifiable risk factors had the highest percentage increase (42.6 %) in health care expenditure compared to their lower risk counterparts<sup>8</sup>. Further, with an increase in disease burden and absenteeism, there are indirect costs to corporations, which are largely unmeasured and often overlooked<sup>9</sup>.

Once companies are able to identify and establish employee health problems or risk profiles, targeted and relevant intervention strategies can be designed and implemented. This could result in subsequent reductions in absenteeism, enhance the company's image and improve productivity and therefore bring about a reduction in the associated costs <sup>7</sup>. However, there is a paucity of data available on the health status of the economically active population in South Africa.

### **Aim**

Therefore, the aim of this study is to determine the occurrence of risk factors among employees in the corporate sector. This study will examine self-reported health behaviour and clinical measures, obtained as part of employee wellness days conducted by a major health insurer, in persons presenting for health risk appraisal.

### **Methods**

#### **Participants**

A national South African health insurance company hosts health and wellness days as part of their offering to corporate clients. Companies (n=68) that hosted their respective wellness days, between January and June 2007, will be included in the analyses. All the employees from these companies were invited to participate in a one-day health and wellness event. Employees participated on a voluntary basis, and all information was confidential and was not made available to the management or human resource departments. There were no exclusion criteria, with the only prerequisite for participation being that the participant had to be in the employ of the respective company.

***Business Sectors:***

The participating companies were grouped into one of eight sectors. The sectors were; Engineering (ENG), Logistics (LOG), Consultants (CONS), Information Technology (ITS), Manufacturing (MAN), Academic (ACA), Financial (FIN) and Transport (TRANS).

**Process:**

The health and wellness days were advertised one week then three, two and one day prior to the event. Advertising was done by way of e-mails and the strategic placement of posters. The advertisement also emphasised that participation was voluntary and that results were confidential.

The health and wellness events took place on one day, except at one company where the event lasted 2.5 days. Employees participating in the event answered a demographic and lifestyle questionnaire, which assessed smoking status, habitual physical activity and nutrition and also self-reported health status. The health screening comprised of the pin-prick test for serum cholesterol concentration, blood pressure, height and weight measurements.

Unlinked medical claims data for the employees, who were also members of the health insurance company will be obtained directly from the insurer. Participants will be allocated a unique code by the health insurer's administrators therefore the investigators were not aware of the employee's identity. In addition, we will obtain the health-related expenditure of the non-participants at companies.

**Measures:***Health Risk Appraisal*

All the participants completed a Health Risk Appraisal Discovery Index Questionnaire, which is a composite measure comprising of demographic, health and lifestyle factors and readiness to change. The demographic variables are age and gender; while the health and lifestyle measures, include smoking status, fruit and vegetable intake, habitual alcohol consumption and weekly physical activity habits, serum cholesterol, blood pressure, height and weight.

For smoking, fruit and vegetable intake, alcohol consumption, weight and habitual physical activity, the participant reported on their readiness to change or improve their lifestyle. The questions on willingness to change are based on the Transtheoretical Model's stages of change<sup>3</sup>.

*Classification of Risk Factors:*

The cut point for fruit and vegetable servings was based on the American Dietetic Association's recommendation of 5 servings per day<sup>10</sup>. Employees were classified as being at risk using the following criteria according to American College of Sports Medicine;

- Men older than 45 years of age and women older than 55 years;
- BMI greater than 25 kg/m<sup>2</sup> (overweight) and greater than 30 kg/m<sup>2</sup> (obese);
- Blood pressure greater than 140/90 mmHg;
- Cholesterol levels greater than 5.2 mmol / l;
- Less than 150 minutes/week of moderate-vigorous intensity physical activity
- Smoking.

If employees are categorised as being at risk for one of these risk factors, they will receive a score of one. Conversely, if they are not at risk, they will be allocated a score of zero. A sum total of all the risk factors for each employee will be calculated.

*Estimation of weekly Physical Activity:*

The minimum and maximum self-reported physical activity will be calculated using the participants' reported frequency and duration of exercise.

*Clinical measures:*

Cholesterol Screening

A pin prick test using the Accutrend machines **was** used to measure serum cholesterol concentration. After pricking the employees' finger, approximately 3ml of blood was placed on the cholesterol strip, after which the Accutrend machine will calculate cholesterol.

Blood Pressure

Blood pressure **was** measured using an automated cuff. Employees will be seated for approximately three minutes before being measured.

Height and Weight:

Standing height (cm) **was** measured to the nearest 0.1 cm, using a stadiometer. Body mass was measured using a portable calibrated scale and recorded to the nearest 0.5 kg. Body mass index (BMI) was calculated as body mass (kg) divided by height (m) squared ( $\text{kg/m}^2$ ).

*Statistical Analysis:*

STATISTICA software package will be used for all the analyses (Stasoft, Inc. 184-199, Tulsa OK, USA). Descriptive statistics will be performed for the total sample, and separated by business sector and gender.

Mean, standard deviation and standard error will be calculated for all continuous variables. Because physical activity will be reported according to categories presented in the questionnaire, the median and quartile values will be calculated for minimum and maximum weekly physical activity. Frequency tables were used to determine the percentage of individuals at risk, and also for the stages of change data.

Analyses of co-variance (ANCOVA) will be used to compare risk profiles within the various sectors, after co-varying for age and percentage uptake. Bonferroni post hoc analyses were used to determine which sectors were significantly different from each other. The relationship between medical claims and risk factors as well as demographic data and self-reported health status was investigated using Spearman's correlations. Chi-square analysis was used for the categorical nonparametric data.

## **Ethical Considerations**

The results of the health and wellness day will be sent to the researchers in an unlinked format without any personal identifiers, thereby ensuring confidentiality. The employees also sign a declaration at the health and wellness day which indicates that the data can be used for research purposes provided it is unlinked. The participants will be assured that their **employer** will not have access to any of the information collected for the research study, and that all information is confidential.

All screening activities at the wellness days will be conducted by trained staff and under the auspices of the health insurer. Furthermore, the health insurer will not influence the writing and publication of manuscripts related to the research study.

### *Benefits to participant*

Employees participating in the research study will find out their level of risk for cardiovascular disease and receive related educational material.

### *Risks to participant*

The health insurer will send encoded data of employees declining to participate, in order to describe their health status and healthcare expenditure. There will be no personal identifiers, thus all information will be anonymous.

Cholesterol screening will comprise of the finger-prick for a 3ml blood sample, and forms part of the Health Risk assessment conducted by the health insurer. Despite the researchers of this study not being part of this aspect of data collection, the risks associated will be reduced by ensuring that only

trained persons will perform the test. In addition, sterile and low risk procedures will be followed which includes wearing surgical gloves, using a new lancet and strip for each individual.

This study will be conducted in accordance with the Declaration of Helsinki, Good Clinical Practice as well as the laws of the Republic of South Africa.

University of Cape Town

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*Part B:*

*Literature Review*

University of Cape Town

## 1. INTRODUCTION

### 1.1. Background:

Non-communicable diseases (NCD) are defined as being slow in onset and progression, and long in duration [1]. Diseases including heart disease, stroke, diabetes, chronic respiratory disease and some cancers form part of the definition of NCD [1, 2]. These diseases accounted for nearly two-thirds of global deaths in 2008 [3], has been steadily increasing, and impacts on most countries and people of all ages and socio-economic groups [2] [4]. This trend is evident in South Africa as well, where NCD's accounted for 28% of the total burden of disease [5]. In fact, the World Health Organization (WHO) has estimated that the NCD burden in South Africa is more than double that in some developed countries, although similar to that of other Sub-Saharan African countries [5].

Modifiable risk factors that have been shown to play a role in reducing the prevalence of NCDs include tobacco use, an unhealthy diet, excessive alcohol consumption and physical inactivity [2] [4] [5] [6] [7, 8]. Other risk factors for NCD include: age, elevated blood pressure, dyslipidemia, elevated serum cholesterol and glucose concentrations, waist circumference, Body Mass Index more than 25kg/m<sup>2</sup> [9]. Data from various studies investigating the odds of having cardio-metabolic disease is presented in Table 1. Results on this table shows that the risk of cardio-metabolic and NCD's due to physical inactivity is comparable to that of other risk factors. Yet physical activity, has been regarded as the 'Cinderella risk factor' as it receives less attention, political commitment and resources than the other risk factors [6]. If it were possible to reduce to the global pandemic of physical inactivity, it has been estimated that between 6-10% of all deaths due to NCD's may be prevented [8]. Lee and colleagues calculated that by increasing the prevalence of

physical activity by 25% it may be possible to avert 1.3 million deaths annually [8].

Furthermore, non-communicable diseases have a negative impact on the global economy [4] [2] and have been identified as one of the major threats to economic development by the World Economic Forum [3]. The reduction in economic growth is estimated at 0.5% for every 10% increase in NCD-related mortality [4]. Worksites and companies are directly affected by NCD's due to reduced employee productivity, increased absenteeism and increased likelihood of disability [2]. The loss in national income due to NCD's is substantial. The projected loss in income from 2005 to 2015 in countries with emerging economies similar to South Africa, range from 49.2 billion international dollars in Brazil to 236.6 billion international dollars in India [10]. Therefore, countries, worksites and individuals are likely to incur higher medical expenditures and reduced productivity due to NCD's. Some of the NCD's can be prevented or managed by implementing screening and intervention programs.

## **1.2. Aim of literature review**

Therefore the aim of this literature review is to examine current evidence for the role of worksite health promotion programs' role in the prevention of NCD's. The prevalence of risk factors for NCD's among employees, with a focus on physical activity, and the clustering of risk behaviors among employees will be discussed. In addition, the economic consequences of NCD's and possible benefits of worksite intervention programs are briefly addressed. The main component of the literature review reports on the role of health risk appraisals as an entry for worksite health promotion programs.

### **1.3. Search Strategy and quality criteria**

The search strategy included using the online database, Pub Med to find relevant manuscripts. Various combinations of the following terms were used when searching the Pub Med database; 'worksite health promotion programs'; 'non-communicable disease risk factors AND cluster of risk'; 'economic burden AND non-communicable diseases'; 'physical activity AND worksite'; and 'physical activity AND employee health'. The references in some of the manuscripts that were sourced were also examined for additional publications. In addition, reports from the World Economic Forum's Workplace Wellness Alliance website (<http://alliance.weforum.org/>) were obtained.

All manuscripts were included based on their ability to fulfil the objectives of the literature review. However, manuscripts that were published within the last 10 years, as well as systematic reviews and meta-analyses were given priority due to the limited scope and, in some cases, paucity of data available.

## 2. LIST OF DEFINITIONS:

### **Non-communicable disease**

Non-communicable diseases (NCD) are defined as being slow in onset and progression and long in duration [1].

### **Metabolic syndrome**

Metabolic syndrome is defined by a cluster of risk factors, and its diagnosis is based on three or more of the following criteria [11];

- Waist circumference more than 102cm for men and 88 cm for women
- Triglycerides  $\geq$  150mg/dl
- HDL  $\leq$  40mg/dl for men or  $\leq$ 50mg/dl for women
- Blood pressure  $\geq$  130/80mmHg
- Fasting glucose  $\geq$  110mg/dl

### **ATP III Criteria**

Adult Treatment Panel III Criteria [11]

This is a panel that presented a different definition of the Metabolic syndrome to the World Health Organization, by adding waist circumference, blood lipid profile and fasting glucose to the diagnostic criteria [11]

### **Worksite health promotion programs**

‘an organized employer- sponsored program that is designed to support employees as they adopt and sustain behaviors that reduce health risks, improve quality of life, enhance personal effectiveness and benefit the organization’s bottom line” [12]

### **‘Worried well’**

The worried well refers to employees who are not at high risk for non-communicable diseases, or who rate their health as excellent, but still attend health screening events.

### **3. SUMMARY OF LITERATURE**

#### **3.1: Rationale for Worksite Health Promotion Programs**

It has been estimated that more than 3.6 billion people will form part of the global workforce by 2020 [10]. Consequently, the worksite has identified as an opportune setting for health promotion programs aimed at improving employee health status and productivity since many people can be reached in this setting [13]. Employers have the opportunity to engage with employees on an ongoing basis with extensive reach and frequent interaction [14]. Indeed, the Report of the Secretary General, UN General Assembly, May 2011, recommends that the private sector play a role in promoting healthy lifestyle behaviors among employees including both health promotion policies and worksite health promotion programs [3].

Worksite health promotion programs have been shown to result in economic benefits both for the employer and employee [10]. The economic outcomes of worksite intervention programs includes increased productivity and reduced absenteeism and healthcare expenditure [12]. Evidence from a recent review of the economic benefits of these programs concluded that it is 'one of the most effective strategies for reducing medical costs and absenteeism' [15]. Consequently, more and more employers are implementing health promotion and intervention programs in their companies [12]. The economic outcomes of worksite health promotion programs will be discussed in more detail in section 2.5 of this literature review.

In addition to the economic benefits, previous research has shown that worksite health promotion programs are effective in reducing the risk for NCD's among employees [16]. Although the effect sizes of these interventions on health vary and are less than that observed in clinical trials, it has still been

advocated as it results in marginal changes [16]. Small changes in behavior and health parameters have been shown to result in a considerable impact on disease risk when observed at a population level [10].

The next section of the literature review will present data on the prevalence of NCD risk factors followed by an overview of the effectiveness of worksite health promotion programs.

### **3.2 Prevalence of NCD risk factors in the worksite**

The main risk factors for NCD's were reported in the introduction of this literature review. The risk factors that encompass lifestyle behaviors, namely, physical activity, and healthy diet (together with obesity) will be the focus of this section of the review. Indeed, the WHO identified these behaviors as among the five leading causes for global mortality [17]

Physical inactivity is widely recognized as a major risk factor for NCD's [7, 8]. If it were possible to reduce to the global pandemic of physical inactivity, it has been estimated that between 6-10% of all deaths due to NCD's may be prevented [8]. For example, approximately 21-25% of breast and colon cancer and 27% of the burden of diabetes could be reduced by reducing the levels of physical inactivity [17]. However, more than half (58%) of the world's population do not meet the physical activity guidelines, which is similar to the number of Africans who are currently insufficiently physically active (60%) [17].

Changes in dietary behaviors with increased consumption of refined starch, sugar, salt and unhealthy fats [1] has contributed to the increased prevalence global prevalence of obesity, which has more than doubled since 1980 [12]. A

recent WHO report states that four in ten people are either overweight or obese (BMI  $24.9\text{kg/m}^2$ ) [17]. The 'Workplace Wellness Alliance' reported that the prevalence of obesity in African employees is nearly 20%, and is higher than that reported for Europe and South America [12]. This prevalence is slightly less than that reported in the population average which is from WHO survey which was conducted in adults (not inly in the worksite setting) between 1996 and 2009 (Figure 1) [12]. Furthermore, the WHO reported that 41% of all deaths in Africans under the age of 60 years could be attributed to a high Body Mass Index [17].

The prevalence of NCD and cardio-metabolic disease has been investigated in the employed population, although less so in South Africa. Ker et al, 2007 described the frequency of metabolic syndrome among South African corporate executives comprising of men ( $n = 1367$ ) and women ( $n=25$ ) with a mean age of  $46 \pm 7.9$  years [18]. They found that nearly a third (31%) had metabolic syndrome as defined by ATP III criteria [18]. Furthermore, more than a third (36%) met two of the ATP III criteria for the diagnosis of the metabolic syndrome [18].

The increased prevalence of NCD is coupled with high proportion of employees having multiple risk factors. A pilot study among South African companies ( $n=18$ ) found that the employed population was at an increased risk for NCDs and that a greater proportion of employees had poor lifestyle behaviors compared to the general South African population [19]. For example, nearly 70% of employees were not meeting the recommended 30 minutes of physical activity on at least 5 days of the week based on the Centers for Disease Control's (CDC) and US Surgeon General's report. Furthermore, nearly half of the employees were overweight, defined as a Body Mass Index (BMI) more than 24.9, and nearly a quarter were current smokers [19]. These findings are supported by a more recent study in which nearly 58% of the employees were either overweight or obese and 70% were not meeting the physical activity guidelines [20]. Approximately 31% of the

employees in their survey had elevated serum cholesterol concentration while 81 and 91% had normal blood pressure and serum glucose concentrations, respectively [20]. These findings suggest that South African employees are at increased risk for NCD's and would benefit from worksite health promotion programs.

### **3.3. Clustering of NCD risk factors with physical activity**

Physical inactivity appears to cluster with other risk factors for cardiovascular disease whereby individuals who are inactive are more likely to have additional risk factors for cardio metabolic disease [9] [21]. However, there is limited data from worksite-based research studies investigating whether physical activity is associated with additional risk factors among employees.

A longitudinal study among Japanese full-time workers was conducted in 12 large scale companies in Japan whereby employees were followed for four years [22]. Participants were divided into four physical activity groups based on the results obtained at the outset, from the International Physical Activity Questionnaire (IPAQ). Those who exceeded 3 000 MET minute per week were categorized as highly active; those who were active for < 3000 but > 1500 MET minutes per week were moderately active; while those who achieved <1500 but >600 MET minutes and <600 MET minute per week were categorized as some activity and sedentary, respectively [22]. Japanese employees with more than 4 diagnostic criteria for Metabolic syndrome were more likely to have lower levels of physical activity, however this was not significant in the univariate analysis [22]. In addition, when stratified according to Body Mass Index, levels of physical activity were not significantly associated with number of diagnostic criteria for metabolic syndrome among the Japanese workers. However, physical activity, as quantified by the IPAQ, was significantly associated with number of metabolic syndrome criteria in the

Poisson regression analysis which included gender, age, smoking habits and daily alcohol consumption [22].

These findings warrant further investigation to determine whether physical activity clusters with risk factors related to both lifestyle behaviors and clinical measures in the worksite setting. Furthermore, the relationship between physical activity and total number of risk factors for NCD has not been extensively investigated in larger samples of South African employees.

### **3.4 Effectiveness of Worksite health promotion programs on employee health**

Addressing NCD's in the workplace was reported as one of the most important and urgent concerns among the world's business leaders [1]. An overview of the effectiveness of various worksite health promotion programs that encourages behavior change is presented in Table 2.

A recent systematic review of worksite health promotion programs and their effect on health and economic outcomes was conducted by Osilla et al., 2012 [23]. The thirty-three studies were included in the Osilla review if they were United States based and had a control group for the comprehensive worksite health promotion program [23]. Most of the interventions aimed to improve physical activity and dietary behaviors [23]. Eight of the 13 studies that evaluated physical activity reported increased levels of physical activity among employees. However only 3 of the seven randomized control trials found improvements in physical activity. None-the-less, improvements included an increase in 103minutes of walking per week among the intervention group [23]. Similarly, half of the studies that measured dietary outcomes reported increased fruit and vegetable intake, and lower dietary fat intake [23]. This review underscored the importance of evidence-based

interventions, with a strong research design and sufficient statistical power to detect meaningful effects of the intervention [23].

Other reviews have reported that interventions in which the primary focus is physical activity have been effective in increasing employees' habitual levels of physical activity, in addition to improving body composition, fitness levels and a decreasing muscular skeletal disorders [10]. These findings are supported by a meta-analysis which included published and un-published physical activity-based intervention studies from 1969 until 2007 [24]. The effect size calculated for physical activity in the meta-analysis was 0.21 which equated to the intervention group walking approximately 612 extra steps per day than the control group at the post-test measurement [24]. In addition, fitness, quantified by maximal oxygen consumption was higher for the employees in the intervention group compared to the control group [24]. This meta-analysis also found that the risk for diabetes was reduced and that employees' lipid profile had improved following the intervention [24].

Those intervention which focus on dietary behavior have been effective in increasing fruit and vegetable intake, and reducing Body Mass Index [10]. A systematic review evaluating the effectiveness of worksite nutrition and physical activity intervention programs which targeted employees with varying Body Mass Index measures was performed by Anderson and co-authors in 2009 [25]. Forty-seven studies were included in the review, half of which were conducted in the USA and the other half conducted in Europe, Australia, New Zealand, Japan, Canada, India and Iceland [25]. The worksite interventions resulted in small, but significant changes in weight loss of approximately 3 pounds (1.36kg) after 6-12 months [25]. There were also modest improvements in Body Mass Index (-0.5) body fat percentage after 12 months [25].

Moreover, comprehensive worksite health promotion programs which include tailoring the program according to the company's and employees' needs have been found to be most effective [12]. In addition, worksite intervention programs that have had the greatest impact on improving employee health were those targeting the employees at highest risk for NCD's [16]. These interventions included a health risk assessment with feedback based on the employees screening results, were shown to play a role in employees improving their health behaviors and clinical measures, in addition to economic benefits achieved for employers [16].

The Health Risk Assessment (HRA) is often considered the first step of an intervention program as it provides an overview of employees current health status [26] [27]. Therefore, the following section of the literature review will discuss the role of the HRA, its components and effectiveness in improving employee health status.

### **3.5. Health Risk Appraisal**

The HRA has been advocated as a screening tool that should be used together with individual feedback to promote healthy lifestyles for employees [28]. Advances in technology include the introduction of web-based HRA's and therefore have the potential to increase its potential reach and uptake [13]. Indeed, the HRA is one of the most frequently implemented worksite health promotion programs and has been implemented in more than 50% of large companies (> 750 employees) in the USA by 2004 [13]. An updated survey found that this had increased to 72% of a sample of USA companies offered HRA's at their worksites [28].

The components of HRA's vary, but usually include an assessment of lifestyle behaviors, typically self-reported [13]. Clinical measures that are either self-reported or verified / measured also form part of the HRA [13]. Self-report behaviors that could form part of the HRA include physical activity, body mass index, tobacco use, habitual alcohol intake and healthcare services utilization [13] [29]. These results are then used to calculate the risk or standardized risk scores for various diseases, including NCD [13]. Ideally, the final component of the HRA might include feedback on the results and guidance to improve lifestyle behaviors and clinical interventions to reduce the risk of adverse health events such as NCDs [13]. The HRA is therefore beneficial to identify employees who might be at increased risk for NCD, and could be considered as the first step towards improved health. Consequently, the HRA is regarded as the 'gateway intervention' to more comprehensive health promotion intervention programs [13].

### **Participation in HRA's**

HRA participation is largely based on employees volunteering to complete the questionnaires and clinical assessments. Thus it is plausible that a bias exists when reporting HRA data, as this might reflect the proportion of employees who are interested in their health status [27]. In one study of employed persons (n= 45 398) from USA companies employer-sponsored health insurance, women, and persons with fewer chronic health conditions are more likely to complete an HRA than their counterparts [27]. The participants were more likely to be members of a consumer-directed health plan than being members of a health maintenance organizations (HMO) or point-of-service plans (POS) [27]. Furthermore, participants generally had lower healthcare-expenditures in the previous year than the non-participants (US\$242 versus US\$ 318) [27].

The determinants of participation in HRA's among employees (n= 5125) at four Dutch companies was recently investigated by Colkesen colleagues [30].

All employees were invited to participate in a web-based HRA program. Participants completed the HRA questionnaire, followed by a clinical assessment for anthropometrical measures and blood pressure and a laboratory assessment of serum cholesterol concentration. Each of the participants received tailored feedback based on their results [30]. The non-participants were sent a reminder and questionnaire via email whereby they could report on their self-rated health status and lifestyle behaviors anonymously [30]. The non-participants also reported on their reason for declining to participate in the HRA intervention program [30]. The main reasons the non-participants reported for failing to complete the HRA was lack of time and lack of awareness of the HRA screening intervention [30]. One of the main findings of this research study was that the participants were significantly older than the non-participants, 44 years and 41 years, respectively, with similar number of men in both groups [30]. Significantly more of the participants (85%) rated their health as either good or very good compared to 78% in the non-participants [30]. In addition, a significantly smaller proportion of the non-participants fewer than 10 days sick leave days in the previous year than the participants (86% versus 88%,  $p < 0.05$ ) [30]. These findings, therefore, support the hypothesis that HRA responders represent the 'worried well' employees.

In a similar study, Burton et al 2003 reported that the pharmaceutical expenses were similar for HRA participant and non-participants [31]. Employees completing the HRA in their research study were more likely to be women, and older than the non-participants [31]. However, the participants reported significantly fewer risk factors than the general US population [31], further supporting the hypothesis that employees who complete the HRA are the 'worried well'.

## **Effectiveness of HRA on employee health status**

A recent review of the effectiveness of HRA with feedback was conducted by Soler and colleagues who aimed to establish whether the HRA without feedback and advice leads to behavior change among employees [13]. Research studies included in this review were those that evaluated the effect of HRA's in the worksite setting and subsequent changes in health status or lifestyle behaviors [13]. Feedback sessions that only took place once and lasting less than one hour were regarded as part of the standard HRA process [13]. 'Feedback plus' was defined as those studies in which health education sessions lasting more than an hour, multiple sessions, policy and environmental change, or incentives to promote physical activity and nutrition [13].

These authors concluded that there insufficient evidence of the effect of this type on intervention on fruit and vegetable intake, body composition and fitness levels of participants [13]. Conversely, there was strong or sufficient evidence for HRA with 'feedback plus' to have a positive effect on tobacco use, alcohol intake, dietary fat intake, serum glucose and cholesterol concentration and improved composite risk status [13].

Repeating a HRA multiple times allows for comparison between assessments and to monitor change in health status and behaviors. Pai et al. 2009 researched the association between the frequency of HRA participation and subsequent health status [32]. Their study was based on longitudinal data (1997 – 2004) from a multistate USA-based manufacturing company [32]. All employees received individualized feedback upon completion of the HRA, which served as an entry point into other worksite health promotion programs [32]. The baseline health status was similar for the employees completing only one HRA and those completing two or more during this time period [32]. However, those employees who the HRA more than once had significantly fewer risk factors at follow up than at baseline [32]. In addition, significantly

fewer multiple HRA completers experienced a decline in their health status than those who completed the HRA once [32]. This improved health status could be a consequence of the feedback highlighting areas for improvement and suggested intervention or treatment.

One of the unintended consequences of completing an HRA may be short-term increased health-care expenditure among participants. Indeed completing a HRA has previously been associated with increased doctors visits (0.02 visit increase from baseline) and number of prescriptions filled (0.02 increase from baseline) [27]. This was coupled with associated increase in monthly healthcare spending for doctors visits and medication [27]. The economic consequences of completing the HRA will now be addressed in the final section of this literature review.

### **3.6. Economic Burden of Non-Communicable Disease**

The World Economic Forum states that NCD's have a substantial and negative impact on the economy due to decreased labor supply, capital accumulation and both country and global gross domestic product (GDP) [1]. This is largely due to the reduced number of employees, resulting in a decrement in the quantity and quality of the labor force [1]. Organizations and companies should therefore be aware of the impact that NCD might have on their employees' productivity, potential loss of skill, and increased healthcare-related expenditure [1]. Consequently, worksite health promotion programs, including HRA programs are becoming an increasing concern and vital component of employee care [1]. Indeed, implementing worksite intervention programs that targeted healthy eating and obesity resulted in an improvement in labor productivity of 1-2% in a range countries [12].

As documented earlier in this literature review, the HRA can identify the employees' health risks and the feedback would direct them to interventions to improve their health status and reduce their risk for NCD. It is plausible that an improvement in health status could result in reduced healthcare expenditure. Kowlessar and colleagues investigated the relationship between eleven health risks and medical expenditure [33]. Health risk data were obtained from HRA's administered by the Mayo clinic while healthcare expenditure was obtained from the Thomson Reuters MarketScan<sup>®</sup> Commercial Claims and Encounters database [33]. Both the HRA and claims data were for January 2005 to December 2008 [33]. Most of the employees in the sample were men (68-72%) and were salaried (84-85%) [33]. Lifestyle behaviors including physical activity, healthy nutrition and alcohol and tobacco use were associated with reduced healthcare expenditure, absenteeism and presenteeism [33]. Similarly, employees categorized at low risk for serum cholesterol, triglycerides and glucose concentrations had lower healthcare expenditure and increased productivity [33]. Results from a multivariate analyses showed that the main contributors to increased healthcare costs was a Body Mass Index more than 24.9kg/m<sup>2</sup>, high blood pressure, high blood glucose, high triglycerides and insufficient physical activity [33]. For example, employees who were meeting physical activity guidelines had 23% reduced healthcare costs than those who were inactive [33].

These findings are supported by similar research studies [31, 34, 35]. One of these studies by Pronk et al 2011 investigated the association between health assessment scores and health claims in the subsequent 12 months [35]. These authors calculated a number of scores which included "Total health potential score" (THPS), "modifiable health potential score" (MHPS), a "non-modifiable health potential score" (NMHPS) and a "quality of life score" (QOLS) [35]. The MPHS comprised of physical activity behavior, tobacco use, diet quality, breakfast consumption, fruit and vegetable consumption, calcium, sugar intake, sleep, alcohol use and self reported stress [35]. Each of these health scores resulted in significantly higher healthcare expenditure for the next 12 months [35]. Importantly, a higher MPHS was significantly associated

with future annual healthcare costs,  $F(46)=26.43$ ;  $p<0.001$  [35]. Thus those individuals with healthier lifestyle behaviors had lower subsequent medical expenses. Thus HRA's and related intervention programs have might play a role in attenuating the economic impact of NCD's on the economy.

#### **4. GAP IN KNOWLEDGE**

The burden of NCD's is increasing globally, however more so in low-middle-income countries such as South Africa. Despite the evidence for worksite health promotion programs, and the potential benefits of administering Health Risk Assessment, there is a paucity of data from the South African setting. In addition, there is limited data on the relationship between healthcare expenditure and NCD risk from this country. Should physical inactivity cluster with other NCD risk factors; it might be possible for worksite intervention programs, which aims to reduce inactivity, to also play a role in reducing additional NCD risk factors.

The World Economic forum has identified the need for additional research, particularly for countries other than the United States of America [12]. This research will contribute to comparing employee health metrics from different countries and sectors, in addition to providing return on investment (ROI) data that is context specific [12].

Therefore, further research is required from low and middle-income countries to determine the economic impact of being classified as having increased risk for NCD's. Moreover, there is even less research from low-middle-income countries which compares the health status or healthcare expenditure of HRA participants to that of non-participants. For these reasons, this thesis aims to determine the extent to which insufficient physical activity clustered with other

risk factors for NCD, and whether these risk factors were associated with higher healthcare costs.

**Table 1: The relative risk and odds ratio's for cardio-metabolic disease from various selected studies.**

<b>Risk Factor</b>	<b>Risk Factor Category</b>	<b>Prevalence (%)</b>	<b>Odds Ratio / Relative Risk<sup>#</sup></b>	<b>95% Confidence Interval</b>	<b>Data Source</b>	<b>Reference</b>
<b>Physical Activity:</b>	Active	50.7	1.00 (Referent)		US NHANES	[9]
	Somewhat Active	21.3	1.15	0.84 – 1.57		
	Inactive	28.0	1.52	1.16 – 1.98		
	No LTPA		1.00 (Referent)		Meta-analysis (males)	[36]
	Met PA guideline		0.91	0.79 – 1.04		
	Exceeded PA Guideline		0.82	0.74 – 0.91		
	No LTPA		1.00 (Referent)		Meta-analysis (females)	[36]
	Met PA guideline		0.80 <sup>#</sup>	0.69 – 0.92		
	Exceeded PA Guideline		0.72 <sup>#</sup>	0.63 – 0.83		
	Inactive (<150min/wk)		1.17	1.01 – 1.36	BRFSS	[37]
<b>Smoking Status</b>	Non-Smoker	52.3	1.00 (Referent)		US NHANES	[9]
	Ex-Smoker	24.4	1.90 <sup>#</sup>	1.45 – 2.50		
	Current Smoker	23.3	2.31 <sup>#</sup>	1.67 – 3.20		
	Current Smoker		1.37	1.10 – 1.70	BRFSS	[37]
	Never Smoker		1.00 (Referent)		Lipid Research Clinic's PFS	[38]
	Current smoker		1.42	1.01 – 201 <sup>§</sup>		
<b>Blood Pressure</b>	Normal	43.3	1.00 (Referent)		US NHANES	[9]
	Pre-hypertensive	29.3	0.71	0.49 – 1.01		
	Hypertensive	27.4	1.21	0.88 – 1.67		

<b>Glucose</b>	Normal	67.2	1.00 (Referent)		US NHANES	[9]
	Impaired	24.7	0.99	0.76 – 1.30		
	Diabetes	8.1	1.50	1.08 – 2.07		
<b>Triglycerides</b>	Normal	43.3	1.00 (Referent)		US NHANES	[9]
	Borderline High	29.3	0.89	0.64 – 1.21		
	High	27.4	1.21	0.90 – 1.64		
<b>LDL Cholesterol</b>	Optimal	26	1.00 (Referent)		US NHANES	[9]
	Near optimal	30.8	0.86	0.54 – 1.127		
	Borderline	21.6	0.82	0.55 – 1.24		
	High	21.6	1.99	1.42 – 2.83		
<b>HDL Cholesterol</b>	High	26.8	1.00 (Referent)		US NHANES	[9]
	Normal	53.4	1.37	1.01 – 1.89		
	Low	19.8	1.89	1.28 – 2.80		
<b>Body Mass Index</b>	BMI >24.9		1.30	1.11 – 1.52	BRFSS	[37]
<b>Waist Circumference</b>	Low	31.4	1.00 (Referent)		US NHANES	[9]
	Moderately high	21.8	1.45	0.99 – 2.12		
	High	46.9	1.46	1.04 – 2.08		

**Legend:**

US NHANES = United States National Health & Nutrition Examination Survey

BRFSS: Behavioral Risk Factor Surveillance System

PFS: Princeton Follow Up Study

§ = adjusted for confounders and other risk factors

LTPA = Leisure time physical activity

**Table 2: Summary of selected Worksite health promotion programs encouraging lifestyle behavior change:**

Reference	Intervention	Participants	Outcome Measures
Barham et al [39]	Twelve weekly sessions aiming to promote improved lifestyle behaviors. Monthly and 12 month follow up.	Employees at risk for diabetes (n=45) or with diabetes (n=10)	Significant reductions in weight, BMI, waist circumference, and Physical activity after 3 months in the intervention group. No significant improvements in blood pressure, lipid and glucose.
Engbers et al., 2007[40]	Food-based: Information sheets in food canteen, identification of healthy foods Brochures on healthy lifestyle Physical Activity: Point-of-decision prompts to use the stairs Slimming mirrors placed in stairwell 3 and 12 month follow up	Government companies (n=2) Office workers (n = 641)	Significant improvements in total cholesterol for women (-0.35mmol/l) and increased HDL in men (0.05mmol/l) at 3 months. Significant decrease in systole blood pressure (4mm Hg). BMI decreased (but not significantly) whereas there were significant decreases in skinfold measurements.
Groeneveld et al., 2011 [41]	Individual counseling using Motivational Interviewing techniques. Each participant had 3 face-to face and four telephonic counseling sessions. 6 and 12 month follow up	Construction workers (n=816) with increased risk for NCD	Fruit intake increased at 6 months. Reduction in unhealthy snacks at 6 and 12 months. No significant effects on leisure time physical activity. Significant reduction in smoking at 6 months, but not at 12 months.
MacKinnon et al., 2010 [42]	Self-help educational materials, Motivational interviewing-based counseling sessions, group based counseling sessions, internet-based activities.	Firefighters (n = 599)	Employees in the group based sessions increased fruit and vegetable intake. Those with individual based counseling increased habitual levels of physical activity and fitness.

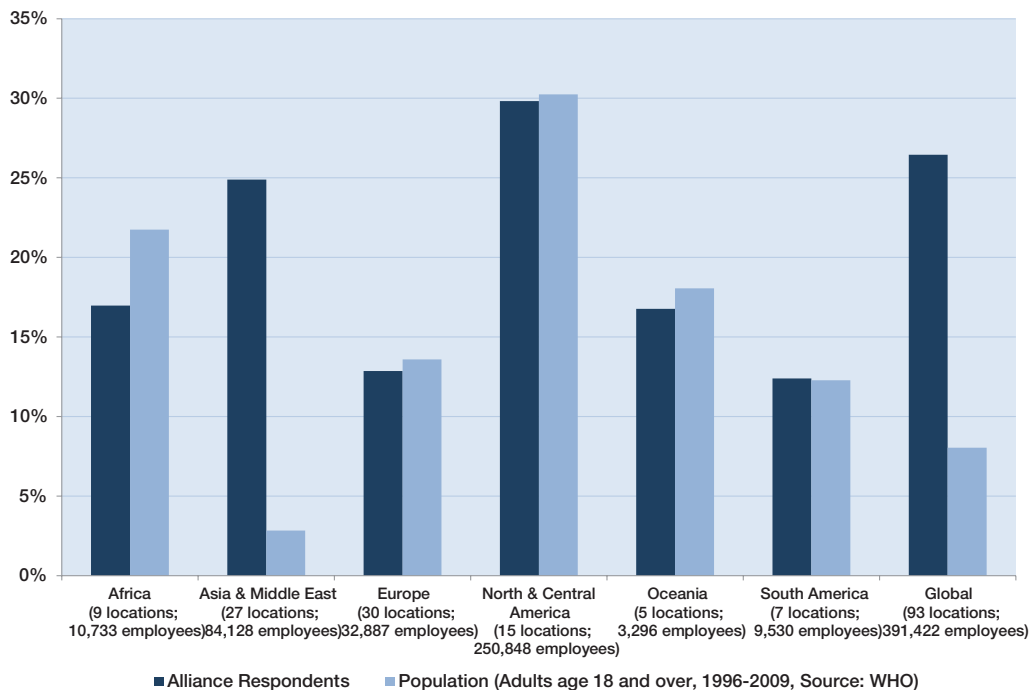
Pressler et al., 2010 [43]	Follow up every 6 months for 4 years 12 week internet-based intervention comprising of initial education session, followed by structured exercise sessions and concluded with another education session. Baseline and 12 week follow up.	Overweight employees (n=140);	Employees in the intervention group had significant improvements in fitness, waist circumference and reduced weight. The control group had significant improvements in waist circumference.
Prior et al., 2005 [44]	15 minute screening and counseling session. Educational booklets on cholesterol, blood pressure and smoking	Female employees (n=113) and male employees ( n = 4198); participants stratified according to NCD risk	Employees at high risk for NCD showed improvements in Blood pressure, total cholesterol, BMI for both men and women. There were no significant changes on physical activity score.
Terry et al., 2011 [45]	Tailored, telephone-based counseling program aiming to promote weight loss.	Private sector companies (n=10) with total of 1298 obese or overweight employees	Nearly half the program completers (48%) and non-completers (47%) lost weight. However the completers averaged 2.6 times higher weight loss than those who did not complete the intervention.

**Legend:**

HDL= High density lipoprotein

BMI = Body Mass Index

**Figure 1: Prevalence of obesity (BMI > 30kg/m<sup>2</sup>) among employees from the WEF Alliance survey and WHO population survey.**



**Legend:**

Figure is from the 'The Workplace Wellness Alliance: Making the right investment - Employee Health and Power of Metrics' report [12]

BMI" Body Mass Index

WEF: World Economic Forum

WHO: World health Organization

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## *Part C:*

### *Manuscript*

**Title:**

*Risk factors for non-communicable disease and healthcare expenditure in employees with private health insurance presenting for health risk appraisal*

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*Discovery Health contributed to the funding for this research study, however the University of Cape Town conducted the data analysis and interpretation, and there were no restriction in publishing the findings.*

**Running Header:**

Clustering of risk factors and healthcare expenditure

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*Author guidelines for this manuscript are in Appendix 3.*

**ABSTRACT:**

**Objective:** The study investigates the extent to which insufficient levels of physical activity (PA) cluster with other non-communicable disease (NCD) risk factors, and whether this is associated with increased healthcare expenditure. **METHODS:** Employees (n=3047) from 68 companies participated in wellness days in which health behaviors and clinical measures were assessed. Healthcare cost data were also obtained. **RESULTS:** The most prevalent risk factors were insufficient PA (68%) and overweight (67%). Those employees who were inactive, also had a greater number of NCD risk factors ( $\chi^2 = 43.55$ ;  $p < 0.0001$ ). PA employees had significantly fewer visits to the doctor (2.39 versus 2.85;  $p < 0.001$ ) than those who were insufficiently PA, with an associated average cost saving of ZAR100 per year ( $p < 0.01$ ). **CONCLUSIONS:** Physical inactivity was associated with clustering of risk factors, and increased health care expenditure. These results support the potential benefit for a comprehensive approach to risk factor modification in the workplace.

## INTRODUCTION:

It has been well established that the number of deaths attributable to non-communicable diseases (NCD's) such as coronary artery disease, diabetes and hypertension are increasing globally [1]. This trend is evident in South Africa, where more than a third (37%) of all deaths are due to NCD's [2]. The increase in the prevalence of NCD's, with specifically cardiovascular and metabolic disease, is accompanied by an increase in risk factors for these diseases such as inactivity, smoking and poor nutritional habits [3] [4]. The worksite has been shown to be a favorable setting to implement intervention programs aiming to reduce the risk for and prevalence of NCD's, as many individuals can be reached at the same time [5]. These programs have been shown to play a role in improving health status and lifestyle behaviors, such as increased physical activity and reduced dietary fat intake among employees [6].

The Health Risk Assessment (HRA) often represents the first step in preventive screening and an entry point for employee wellness programs [7]. The components of the HRA may vary, but often includes a medical history, self-reported health status, and lifestyle behaviors, as well as readiness to change for specific lifestyle behaviours [8]. In addition to providing employees with individual health-related feedback, the HRA can also be used to establish future human capital expenditure that might be incurred by companies, as a consequence of health risk behaviors [8]. Thus, the HRA can provide the underlying rationale for, and the focus of targeted worksite health promotion programs in corporate settings [8].

The implementation of an HRA at a worksite is largely dependent on individuals volunteering their participation and the aggregated results may therefore not be generalizable to the worksite, as a whole, or more broadly, to the population of employed persons. However, describing the clustering of risk behavior amongst

participants may provide further insight into the characteristics of individuals choose to participate in these types of health promotion activities, and also facilitate effective strategies to recruit new participants.

HRA results have also been associated with prospective medical expenses [6]. For example, Pronk and colleagues found that healthcare costs in the year following a HRA were lower for employees with healthier lifestyle behaviors and better health status [6]. These authors calculated a number of scores which included the “modifiable potential health score” (MPHS), comprised of physical activity behavior, tobacco use, diet quality, breakfast consumption, fruit and vegetable consumption, calcium, sugar intake, sleep, alcohol use and self reported stress [6]. A higher MPHS was significantly associated with future annual healthcare costs,  $F(46)=26.43$ ;  $p<0.001$  [6].

There are limited data from South Africa exploring the association between physical activity behavior and additional risk factors for non-communicable disease (NCD) and healthcare expenditure among employees who have private health insurance. Therefore, the main aims of this study were to determine the extent to which insufficient physical activity clustered with other risk factors for NCD, **with specifically cardiovascular and metabolic disease**, in employed persons presenting for health risk assessment as part of worksite wellness day. A second aim was to determine whether there was an association between increased number of risk factors for NCD and healthcare expenditure. Thirdly, we aimed to compare healthcare expenditure for employees participating in the worksite wellness day with those who did not participate.

## **METHODS:**

### *Setting*

South Africa's largest private health insurer offers their corporate clients an opportunity to host one wellness day for their employees annually, during which health screening and self-reported behaviors are assessed. This analysis comprises an evaluation of data that were collected over a 12-month period, from 68 companies. All employees from these companies were invited to participate in a one-day health and wellness event. They participated on a voluntary basis, and all information gathered remained confidential and was not made available to management or human resource departments.

In all instances, the wellness days were conducted during normal work hours. There were no exclusion criteria, with the only prerequisite for participation being that the individual was an employee of the respective company. Employees' data were recorded using unique identity codes, allocated by the health insurance administrators, ensuring anonymity to researchers for secondary analysis.

The health insurance company forwarded the unlinked data (no personal identifiers; all data coded) results of the health risk assessment and clinical measures to the researchers for data analysis. Ethical approval for this research study was obtained from the Research and Ethics Committee of the Faculty of Health Sciences, from the University of Cape Town.

*Participants:*

Employees (n= 6532) from companies (n=68) conducting wellness days participated on a voluntary basis. However, the data analysis only included those employees who were clients of the health insurer (n= 3047), as the healthcare expenditure data was available for this group only.

In addition to employees who participated in the wellness screening, the health insurer provided health-care expenditure for employees who did not attend the screening (non attenders, n = 46 789). Thus, the non-attendees were selected on the basis of incidence sampling, and represent the employees who did not participate in the annual wellness days. These data were sent without any personal identifiers, and allowed the researchers to compare the healthcare expenditure of employees who attended the health screening to those who did not participate.

*Measurements:*

## Health Risk Appraisal (HRA) Questionnaire:

The HRA included questions on participant demographics, medical and family history, self-reported modifiable lifestyle behaviors and intention to change or improve these behaviors. Participants reported the number physical activity sessions in a usual week, the duration and intensity of each session, from which the average minutes of at least moderate physical activity per week was calculated. The average number of daily servings of fruit and vegetables were recorded. In addition, employees reported on whether they were never smokers, ex-smokers or current smokers.

#### Clinical Measures:

Trained staff performed all clinical measurements on the wellness days. These measurements included screening tests for cholesterol concentrations, using finger-prick capillary blood samples (Accutrend<sup>®</sup> GC analysers, Roche Diagnostics). Blood pressure was measured twice per person using an automated sphygmomanometer and the average of the two readings was recorded. Employees sat quietly for approximately five minutes before being measured.

Standing *height* (cm) was measured to the nearest 0.1 cm, using a stadiometer and *body weight* was measured using a portable calibrated scale and recorded to the nearest 0.1 kg. Body Mass Index (BMI) was calculated as body mass (kg) divided by height (m) squared ( $\text{kg}/\text{m}^2$ ).

#### Total Risk Score:

A total risk score was calculated for each participant based on seven risk factors. A score of one was allocated if an employee was above the threshold for a specific risk factor. If the employee was below the threshold for the risk factor, they were given a score of zero. The risk factors and threshold included in the calculation for total risk included having a Body Mass Index (BMI) more than  $24.9 \text{ kg}/\text{m}^2$  [9], blood pressure greater than 140/90 mmHg [10], and a total cholesterol reading greater than 5.2 mmol/l [11]. Lifestyle behaviors for risk classification included consuming less than five servings of fruit and vegetables [12] per day and being a smoker [13]. Those employees who participated in less than 150 minutes of at least moderate physical activity per week were also categorized as being at risk for NCD [14]. Thus the maximum total risk score was seven and the theoretical minimum score was zero.

Employees were further subdivided according to the total number of risk factors for CVD based on the American College of Sports Medicine (ACSM) criteria. ASCM classifies individuals with two or more risk factors as being at moderate risk for CVD and those with one or less risk factors being low risk for CVD.

Healthcare expenditure:

Healthcare cost data, quantified in South African Rands, ZAR (1 US \$  $\approx$  8.8 ZAR), were obtained for employees from the health insurer, and included the number of visits and associated costs to the hospital and the family doctor (General Practitioner / GP).

Expenditure related to chronic disease medication and total healthcare expenditure was also obtained. These data were only available for employees who were clients of the national health insurer.

*Statistical Analysis:*

STATISTICA software package was used for all the analyses (Stasoft, Inc. 184-199, Tulsa OK, USA). Descriptive statistics were performed for the total sample and included calculating the mean, standard deviation and standard error for all continuous variables. Because physical activity data were not normally distributed, the median and quartile values were presented for minimum and maximum weekly physical activity. Frequency tables were used to determine the percentage of individuals at risk, and also for the stages of change data. We conducted a one-way ANOVA to determine whether there were any significant differences in healthcare expenditure among employees who participated in the wellness days and those who did not participate.

The Chi<sup>2</sup> analysis was performed to determine whether those employees who met physical activity guidelines had fewer additional cardiovascular disease risk factors than those who were insufficiently physically active. In addition, an analysis of variance (ANOVA) was used to compare healthcare expenditure between persons meeting physical activity guidelines against those who do not. Participants were further grouped into those with more than 2 risk factors for CVD and those with less than two risk factors, and a one-way ANOVA was performed to determine whether there were significant differences in healthcare expenditure between these two groups. Finally, a multiple linear regression analysis was conducted to examine the factors associated with meeting physical activity guidelines.

## RESULTS:

### *Wellness Day participants versus non-participants:*

Table 1 provides a comparison of healthcare costs for wellness day participants (n=3 047) and non-participants (n = 46 789) who had health insurance with Discovery, and for whom cost data was available. The total number of non-participants in the analysis included only those employees who were clients of the health insurance company. Thus the participation rate, based on Discovery Health members only, was 6.5%. However, the non-participants were comprised of those who chose not to attend the wellness days, or those who were unable to attend due to logistical constraints, such as being off-site or on another shift. We were unable to separate the non-participants into these two sub-groups.

Significantly fewer wellness day participants were registered for chronic medications and subsequently had lower chronic medication-related costs than the non-participants (Table 1). Similarly, the participants had significantly fewer hospital admissions and related costs. Despite no difference in the number of visits to the primary healthcare doctor, the General Practitioner (GP), the non-participants had significantly higher GP

related expenditure than the participants, as represented in Table 1. Furthermore, the total healthcare expenditure was significantly higher amongst the non-participants (mean ZAR 12 341, 95% CI 33 305-33 735) than the wellness day participants (mean ZAR 7 277, 95% CI 16 357-17 129) (Table 1).

*Participant Characteristics:*

The men and women were of similar age and the mean age of the employees was 36 years (Table 2). The mean Body Mass Index (BMI) was more than 25 for both men and women, placing them in the overweight category. The men reported consuming significantly fewer servings of fruit and vegetables per day and were significantly more physically active than the women. The women had significantly lower systolic blood pressure and fewer risk factors for coronary artery disease than the men (Table 2).

Figure 1 illustrates the prevalence of employees at risk and not at risk for the various clinical measures and health behaviors. More than two thirds of employees (67%) did not meet the recommended 150 minutes of at least moderate physical activity per week. Sixty-two percent of employees were either overweight or obese and 71% consumed less than five servings of fruit and vegetables per day. In addition, 62% were either non-smokers or ex-smokers. Finally, one third of the employees had blood pressure more than 140/90mmHg, and 41% had cholesterol values more than 5.2mmol/l for the finger prick test.

The total number of risk factors was calculated for each participant. Only 17% of employees had fewer than 2 risk factors and the most prevalent number of risk factors was 3, which was found in 32% of the employees (Figure 2).

### *Clustering of risk factors with physical activity*

Table 3 compares the additional number of risk factors for those who were classified as being insufficiently physically active compared to those who are meeting physical activity recommendations. Those employees who were meeting the physical activity guidelines had significantly lower than expected occurrence of other modifiable risk factors for NCD than those who were categorized as being insufficiently active ( $\text{Chi}^2 = 43.55$  and  $p < 0.0001$ ). These results were confirmed with the Kolmogorov-Smirnov test which showed that those who were sufficiently active had significantly fewer risk factors for coronary artery disease than those who were insufficiently physically active,  $1.67 \pm 1.1$  versus  $1.96 \pm 1.1$ ,  $p < 0.05$ .

Furthermore, those employees who were classified as being insufficiently active were 27% more likely to be overweight or obese (OR = 1.27; 95% CI = 1.15; 1.39) (Figure 3). Similarly the odds of having elevated total cholesterol concentration and increased blood pressure increased by 17% and 23%, respectively for those who were inactive (OR = 1.17; 95% CI = 1.00; 1.37 and OR = 1.23; 95% CI = 1.05; 1.45). Physical activity risk was not significantly associated with increased odds of being a smoker.

### *Healthcare expenditure*

Employees not meeting the physical activity recommendations were classified as being 'at risk' while those meeting guidelines were 'not at risk'. The multiple regression model which included age and use of chronic medication, showed that physical activity risk category had a marginal but significant association with the number of visits to the doctor ( $r^2 = 0.04$ ;  $p < 0.001$ ). Those who were insufficiently active had significantly higher number of visits than those who were meeting physical activity guidelines, 2.91 (95% CI: 2.8; 3.0) and 2.67 (95% CI: 2.44; 2.88), respectively,  $p = 0.04$ .

There were no significant differences in healthcare expenditure related to chronic medication, hospital admissions and total healthcare expenditure for those who were and those who were not meeting physical activity recommendations (data not shown).

Employees with two or more risk factors had significantly higher numbers of visits to the doctor in a 12-month period, and this was coupled with significantly higher health-care expenditure (related to doctors' visits), after adjusting for age in the multiple regression model (Figure 4). Furthermore, the odds of hospital admissions increased by 4% for each year that the Vitality Age was higher than chronological age (OR = 1.04; 95% CI = 1.02 – 1.06).

## **DISCUSSION:**

The first finding in the present study was that the employees attending the wellness day screening event, which included completing a HRA, had significantly lower healthcare expenditure than those who did not attend. This finding is supported by other studies that have reported that employees attending wellness days or completing HRA's have lower healthcare expenditure [13], are usually older, report fewer days of sick leave and have better self-reported health status, than those who do not [8]. For example, a recent study among Dutch employees found that those who completed the HRA had fewer sick leave days in the previous year than the non-participants [15]. Furthermore, significantly more Dutch employees who completed a HRA reported that their current health status was excellent than the non-participants [15]. Therefore, these results suggest that the employees who participated in the current study represent the 'attentive well' [15]. Consequently, the health profile of all employees may actually be worse than that reported in our results.

One of our main findings was that those employees who were insufficiently physically active had a higher number of additional modifiable risk factors for NCD's than those who were meeting physical activity recommendations. This suggests a clustering of risk factors with insufficient physical activity. These results are supported by those of a recent a cross-sectional study among Swedish men and women [16]. The odds of the physically active Swedish participants having three or more risk factors for cardiovascular disease were 50% lower than those who were inactive, even after adjusting for confounders [16]. Furthermore, the odds of having additional risk factors were further reduced among the participants with higher levels of cardiovascular fitness [16]. These researchers also supported our findings that meeting physical activity guidelines decreased the likelihood of being categorized as being at risk for other risk factors such as increased blood pressure or being overweight.

Conversely, Shi et al., 2011 did not report an association between physical activity and additional risk factors for cardio-metabolic disease [17]. The effect of a combination of lifestyle behaviors, including dietary habits, smoking status, alcohol intake and physical activity, on cardio-metabolic risk was investigated in participants in the Lipid Research Clinic's Princeton Follow-up study [17]. Cardio-metabolic risk was defined as having three or more clinical measures above recommended cut-points [17]. The participants that accumulated more than 4 hours of physical activity per week were less likely to have three or more additional risk factors for cardio-metabolic disease, but this association was not statistically significant [17]. Similarly, those who watched less than two hours of television per day were less likely to have additional risk factors for cardio metabolic disease (not statistically significant) [17]. The difference in results between this study and the current study are likely due to a more rigid threshold used for the physical activity threshold for risk, and defining 'at risk' as the presence of 3 or more risk factors. The 'Lipid Research Clinic's Princeton Follow-up study', investigated the relationship between more than 4 hours of physical activity per week, whereas our research study used the cut point of 2.5 hours per week. It is worth noting that the current recommendation for physical activity is 2.5 hours per week, thus the cut point of

4 hours per week in the Lipid Research Clinic's study may have reduced the sensitivity for finding an association.

The ability of physical activity to predict additional risks for NCD was also investigated in men (>18 years old; n=5 822) from the NHANES cohort [18]. The results from this study showed that participants accumulating less than 30 minutes of physical activity per week were 52% more likely to have cardiovascular disease than those who participated in 150 minutes per week [18]. Furthermore, physical activity and total number of risk factors were independent predictors of cardiovascular disease in their cohort [18]. Therefore, interventions that aim to increase habitual levels of physical activity could result in reducing concomitant risk factors and improve overall health status.

Another important finding from the current study was that those participants with 2 or more risk factors had significantly more visits to the doctor, and subsequently, higher associated healthcare expenditure. [From a practical and application point of view, these differences in costs are relatively small, despite being clinically significant. However, the potential total cost savings that can be accrued if a number of employees are able to have lower healthcare claims, is large and might therefore be of both statistical and practical significance.](#) This is in agreement with previous research that reported habitual levels of physical activity were negatively associated with health care expenditure [19]. Our findings are further supported by Hill et al, who found that members of a health plan that were inactive, obese and overweight had significantly higher healthcare costs than those without these risk factors [20]. The average total healthcare expenditure was nearly double among the employees in the high-risk group than those who were low risk [20]. This difference in healthcare expenditure was higher than that reported in our study, and might be due to Hill and colleagues including adults over the age of 65 years in their study. In addition, healthcare expenditure in our research study was for a 12-month period, while Hill examined expenditure over a 17-month period. Therefore, difference in the number of doctors' visits and healthcare costs might be greater

between those with more than, versus those with less than 2 risk factors, if we had followed them for a longer period of time.

### Strengths and Limitations

This research study has two key strengths. Firstly, the researchers were able to obtain healthcare expenditure data for those employees who did not attend the wellness days. We were, therefore, able to compare the healthcare expenditure of participants and non-participants. However, we were unable to determine their reasons for not participating. It is possible that some employees were unable to participate in the screening activities, as they were off-site or traveling when the wellness day took place. [A limitation of the research study is the possible selection bias that can occur whereby the healthier and more motivated employees attend the wellness days. These employees might therefore have better health seeking behaviour and lifestyles than those who do not attend.](#)

Secondly, most of the clinical measures were not self-reported, but measured by trained personnel, thereby verifying the health status of participants. Because the wellness days are predominantly a screening activity for large numbers of people, fasting blood glucose and serum triglyceride concentration were not measured. Despite this limitation, we were able to compare the clinical measures obtained in our study to findings from other similar research studies.

Healthcare expenditure data was available for all employees who were beneficiaries of the Discovery Health insurance program. These data were limited to those expenses, which were claimed from the health insurer, and do not include out-of-pocket expenses. Since only approximately 16% of South Africans have private health insurance [21], these findings are unlikely to be generalizable to the non-insured individuals. Lastly, the employees attending the wellness day are likely to represent the “worried well”, and as such introduce some selection bias. Despite these limitations, this research study

provides some insight into the relationship between physical activity and increased risk for NCD. In addition, it is among the first research studies investigating the relationship between NCD risk and healthcare expenditure in South African employees.

## **CONCLUSIONS**

There are research studies that have examined the effect of a combination of lifestyle factors on cardio-metabolic risk in employed persons presenting for health risk appraisal [17] [18]. However, there are fewer studies that have investigated whether individuals who meet physical activity guidelines also have other healthy lifestyle behaviors and reduced number of risk factors for NCD.

This research study has shown that insufficient physical activity is associated with increased odds of having additional risk factors for NCD's. Moreover, those employees with two or more risk factors had significantly higher healthcare expenditure related to doctor's visits than those with fewer risk factors. These results suggest that employees are at increased risk for non-communicable diseases and would benefit from worksite health promotion programs. The interventions should include the promotion of habitual physical activity, as most employees were not meeting the guidelines. We anticipate that participation in the intervention programs has the potential to change physical activity behavior, improve the employees' health status and play a role in reducing future healthcare expenditure. Additional research studies are required to determine the potential health and economic benefits of participation in physical activity-based worksite health promotion programs.

**Table 1: Comparison of healthcare costs for employees with health insurance, comparing those that attended the wellness day and those who did not participate. (mean; 95% CI)**

	Participants (n = 3047)	Non-Participants (n = 46789)	P-value
<b>GP Visits</b> (number in past 12 months)	2.86; 2.92-3.07	2.96; 3.07-3.11	>0.05
<b>Hospital Admissions</b> (number in past 12 months)	0.2; 0.53-0.56	0.31; 0.79-0.80	<0.0001
<b>Chronic Medication</b> (cost in ZAR)	466 ± 4 132 - 4 345	1 313 ± 4 579 - 4 819	<0.0001
<b>GP Visits</b> (cost in ZAR)	571; 736 - 774	644; 909 - 921	<0.0001
<b>Hospital Admissions</b> (cost in ZAR)	2 773 ;12 633 - 13 284	6 104 ;27 476 - 27 830	<0.0001
<b>Total healthcare expenditure</b> (cost in ZAR)	7 277;16 357 – 17 200	12 341 ± 33 305-33 735	<0.0001

**Table 2: Health and Lifestyle Characteristics of participating employees (mean ± SD)**

	Total (3047)	Men (n=635)	Women (n=729)	P-value
<b>Age</b> (years)	35.9 ± 10.1	35.6 ± 10.2	35.5 ± 9.7	NS
<b>BMI</b> (kg/h <sup>2</sup> )	26.6 ± 5.4	26.6 ± 4.4	26.4 ± 6.1	NS
<b>Cholesterol</b> (mmol/l)	4.8 ± 1.0	4.8 ± 1.1	4.8 ± 1.0	NS
<b>Systolic BP</b> (mm Hg)	123.8 ± 15.9	129.7 ± 18.8	120.0 ± 13.7	<0.0001
<b>Diastolic BP</b> (mm Hg)	79.7 ± 11.5	83.0 ± 11.1	77.4 ± 10.9	NS
<b>Fruit and Vege</b> (servings/day)	2.8 ± 1.6	2.6 ± 1.6	2.8 ± 1.7	0.042
<b>Physical activity</b> (min/wk)	#126.5 (75.0)	#144.6 (112.5)	#109.9 (56.25)	<0.0001
<b>Total risk factors</b> (number)		2.8 ± 1.2	2.6 ± 1.14	<0.0001

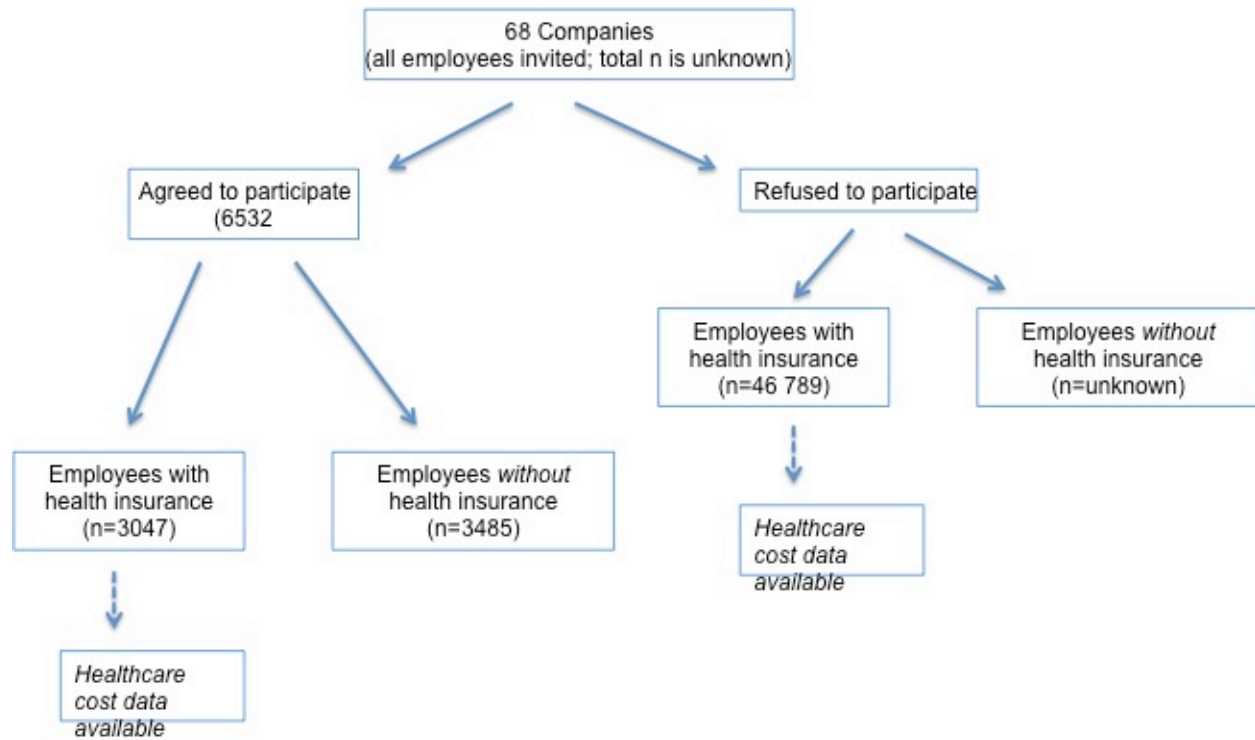
BMI: Body Mass Index; BP: blood pressure; vege: vegetables; Physical Activity: average minutes physical activity per week (self reported); # indicates median values reported for average weekly physical activity; Total Risk factors = total number of risk factors for non-communicable diseases; NS = no significant differences between men and women, p>0.05

**Table 3: Physical activity and additional risk factors for non-communicable disease (n=2878)**

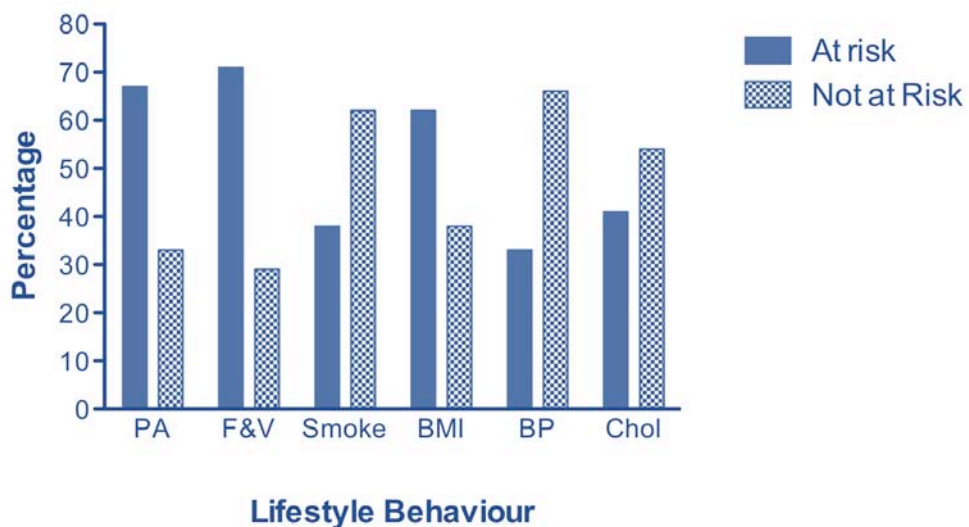
	<b>0 Additional Risk</b>	<b>1 Additional Risk</b>	<b>2 Additional Risk</b>	<b>3 Additional Risk</b>	<b>4 Additional Risk</b>
<b>Physical Activity Risk</b>					
<b>No</b>	88	223	211	114	30
<b>Yes</b>	168	591	815	481	157

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**Figure 1: Description of participants and non participants for the health insure's health and wellness day**

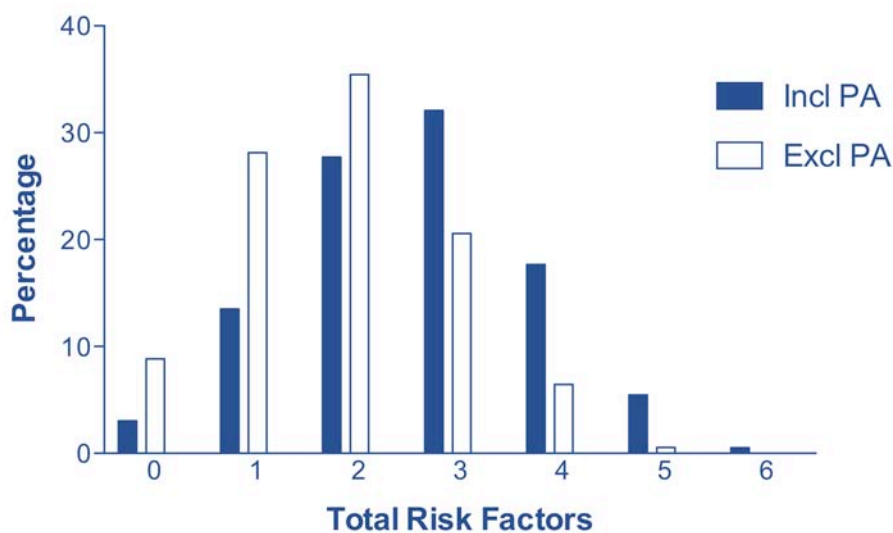


**Figure 2: Risk profile of employees (n = 3047)**



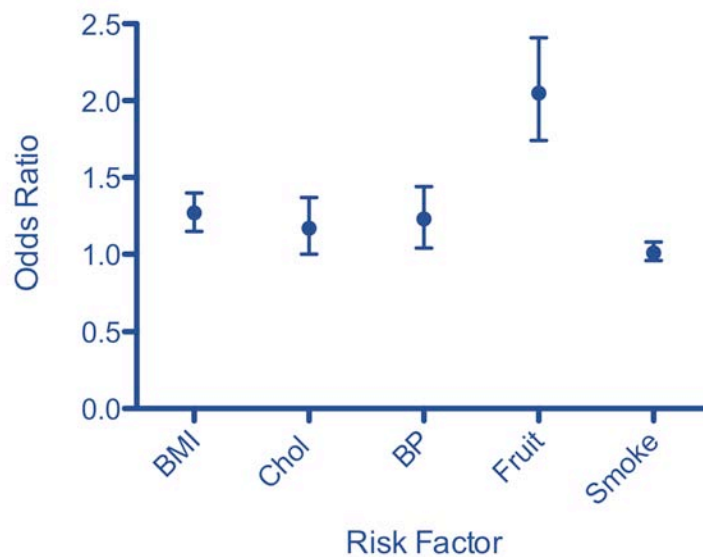
Legend: PA = physical activity; F&V fruit and vegetable intake; Smoke = smoking status; BMI = Body Mass Index; BP = blood pressure; Chol = cholesterol  
 At risk = above threshold value; Not at risk = below threshold value

**Figure 3: Prevalence of total number of risk factors including and excluding physical activity.**



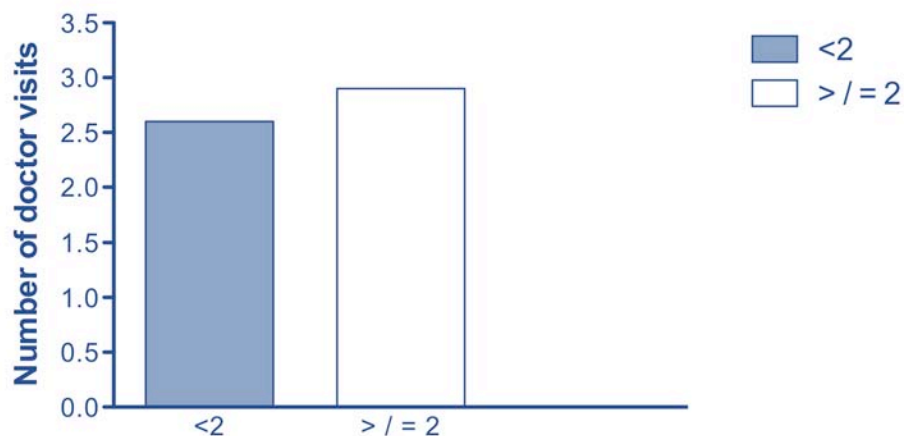
Legend: PA =  
 Legend: Incl PA= total number of risk factors including physical activity; Excl PA = total number of risk factors excluding physical activity

**Figure 4: The increased odds of having additional risk factors for NCD among those employees who are insufficiently physically active (OR: 95% Confidence Interval)**



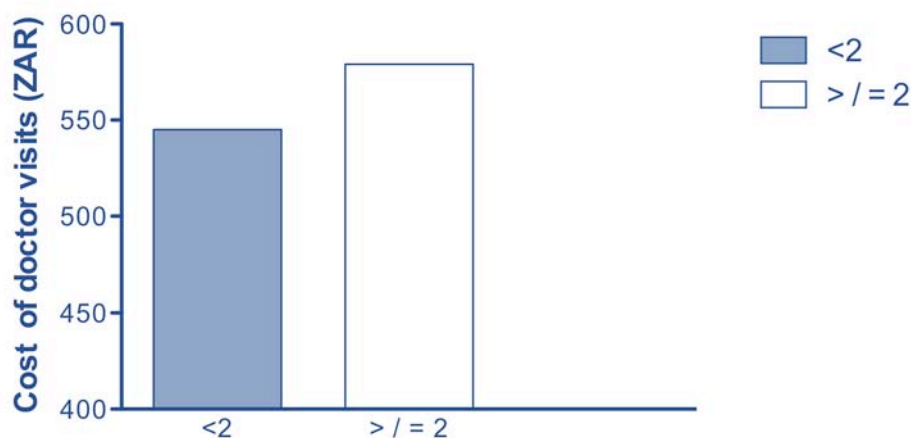
Legend: BMI = Body Mass Index > 24.9 kg/m<sup>2</sup>; Chol = cholesterol >5.2mmol/l; BP = blood pressure > 140/90 mmHg; Fruit = fruit and vegetable serving < 5 per day; Smoke = current smoker.

**Figure 5a: Number of doctors visits among employees with 2 risk factors and < 2 risk factors (n=3047)**



Legend: <2 represents those with less than two risk factors for non-communicable disease;  
> / = 2 represents having two or more risk factors for non-communicable disease

**Figure 5b: Healthcare expenditure (ZAR) related to doctors' visits among employees with 2 risk factors and < 2 risk factors**



Legend: <2 represents those with less than two risk factors for non-communicable disease;  
> / = 2 represents having two or more risk factors for non-communicable disease

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*Appendices*

University of Cape Town

## Appendix 1: UCT Research Ethics Approval



UNIVERSITY OF CAPE TOWN

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Health Sciences Faculty  
 Research Ethics Committee  
 Room E52-24 Groote Schuur Hospital Old Main Building  
 Observatory 7925  
 Telephone [021] 406 6338 • Facsimile [021] 406 6411  
 e-mail: lamees.emjedi@uct.ac.za

04 August 2008

REC REF: 348/2008

**Prof EV Lambert & Dr T Kolbe-Alexander**

Human Biology  
 Sports Science Institute

Dear Prof Lambert & Dr Kolbe-Alexander

**PROJECT TITLE: "STEPS PER DAY" CHRONIC DISEASE RISK FACTORS AND HEALTH CLAIMS IN SOUTH AFRICAN EMPLOYEES PRESENTING FOR HEALTH RISK APPRAISAL (HRA)**

Thank you for submitting your study to the Research Ethics Committee for review.

It is a pleasure to inform you that the Ethics Committee has **formally approved** the above-mentioned study.

**Approval is granted for one year till the 15 August 2009.**

Please submit an annual progress report if the research continues beyond the expiry date. Please submit a brief summary of findings if you complete the study within the approval period so that we can close our file.

Please note two minor typos: informed consent: 3<sup>rd</sup> paragraph:....identified only by (not be) a coded number.  
 Information sheet: page 2: to carry ON as per usual.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

**Please quote the REC. REF in all your correspondence.**

**PROFESSOR M BLOCKMAN**  
**CHAIRPERSON, HSF HUMAN ETHICS**

Federal Wide Assurance Number: FWA00001637.  
Institutional Review Board (IRB) number: IRB00001938

This serves to confirm that the University of Cape Town Research Ethics Committee complies to the Ethics Standards for Clinical Research with a new drug in patients, based on the Medical Research Council (MRC-SA), Food and Drug Administration (FDA-USA), International Convention on Harmonisation Good Clinical Practice (ICH GCP) and Declaration of Helsinki guidelines.

The Research Ethics Committee granting this approval is in compliance with the ICH Harmonised Tripartite Guidelines E6: Note for Guidance on Good Clinical Practice (CPMP/ICH/135/95) and FDA Code Federal Regulation Part 50, 56 and 312.

**Annual Progress Report**

REC REF Number	348/2008
Title	'Steps per day" Chronic disease risk factors and health claims in South African employees presenting for health risk appraisal (HRA)
Principal Investigator	Dr Tracy Kolbe-Alexander; Prof Estelle V. Lambert

**List of documentation**
**Research Proposal and Research synopsis (change in recruitment strategy)  
 Global Physical Activity Questionnaire (GPAQ)  
 Sedentary Behaviour Questionnaire**

Due to the challenges of recruiting sufficient participants in the research study, we are proposing additional strategies to achieve the required sample size. Thus the main amendment we are requesting is to include individuals presenting for their fitness assessment at Biokinetics Private Practices in the recruitment of participants. These participants will be recruited by the Biokineticist and not the research team, in order to ensure that patient records are not accessed by the research team at any stage, and thus remain confidential.

In addition, we will recruit individuals / employees presenting for their companies health and wellness days, who are not member of the health insurance company. They will be recruited by the health and wellness providers and not the research team. These changes have been highlighted in the protocol which is attached.

Furthermore, we wish to conduct additional analysis comparing self-reported physical activity to the objective measure of physical activity in a sub-sample (n = 80). Currently, a pedometer is being used to objectively measure of physical activity. In order to further quantify self-reported physical activity, we would like to add the Global Physical Activity Questionnaire (GPAQ) and a sedentary behaviour questionnaire for this sub-sample. These two questionnaires have been used extensively in research studies and are attached as appendix 1 and two.

**HREC office use only (FWA00001637; IRB00001938)**

<input checked="" type="checkbox"/> Approved	This serves as notification of annual approval, including all documentation described above.	
<input type="checkbox"/> Not approved	See attached comments.	
Type of review	<input checked="" type="checkbox"/> Expedited	<input type="checkbox"/> Full committee
Expiry date	15/8/2009	
Signature	Date	21/5/2010
Chairperson of the HREC		

**Appendix 2: Discovery Health Risk Appraisal ©®****Vitality HealthStyle Questionnaire****Gender**

Male

Female

**1. How old are you?**

\_\_\_\_\_ Years

**2. Do you know your height?**

Don't Know

Meters

Feet, inches

**3. A: Do you know your current weight?**

Don't Know

Kilograms

Pounds

**3 B: Do you think you are currently at your ideal weight?**

I would probably need to put on weight to get to the right weight for my height





**7. A: Do you currently smoke any tobacco products such as cigarettes, cigars or pipes?**

No, I have never smoked

No, but I used to smoke before

Yes, I am a current smoker

If yes, how long have you been smoking?

**7. B: Do you want to stop smoking? Choose the option that best reflects your circumstances.**

- I don't currently smoke
- I am an occasional or social smoker but I will try to give up in the next 12 months
- I am an occasional or social smoker and to be honest I won't try to give up in the next 12 months
- I am a heavy smoker but I will try to give up in the next 12 months
- I am a heavy smoker and to be honest I won't try to give up in the next 12 months
- Don't know

**8. A: In the past 12 months, how often have you had at least one alcoholic drink?**

5 or more days per week

1-4 days per week

1-3 days per month

< 1 per month

**8. B: When you drink alcohol, how many drinks do you have on average, per occasion?**

Number of drinks

8. **C: What do you think of your drinking habits? Choose the option that best reflects your own circumstances.**

- I don't drink alcohol at all or if I do, it's only occasionally and in moderation
- I drink in moderation at weekends
- I drink fairly regularly but almost always in moderation
- I drink fairly regularly and sometimes or often to excess
- I drink fairly or very regularly and I will try to go easier on alcohol over the next 12 months
- I drink fairly or very regularly and to be honest I won't try to reduce my alcohol intake in the next 12 months
- Don't know

9. A: Do you eat fruit and vegetables on most days (at least 4) of the week?

Yes

No

9. B: If yes, how many servings of fruit and vegetables do you eat on a usual day?

**Serving size:**

**Fruit:** 1 small to medium fresh fruit ( $\pm$  the size of a tennis ball or two golf balls);  $\frac{1}{2}$  cup canned fruit;  $\frac{1}{2}$  cup (150ml) fruit juice;  $\frac{1}{4}$  cup dried fruit

**Vegetables:** 1 cup raw vegetables;  $\frac{1}{2}$  cup cooked vegetables

<2

2

3

4

5

6

7

8

>8



9. C: Do you eat a healthy diet? Choose the option that best reflects your own circumstances

I eat fresh fruit and vegetables daily, and only eat unhealthy foods very occasionally or not at all

- I maintain a good balance in my diet by eating foods like fresh fruit and vegetables but I also eat unhealthy foods a fair amount
- I don't eat enough healthy foods like fresh fruit and vegetables but I intend to get a better balance in my diet over the next 12 months
- I don't eat enough healthy foods like fresh fruit and vegetables and I can't see that changing over the next 12 months
- Don't know

**10. A: How many days per week are you physically active at home, work, or leisure, on average in the past month?**

- 0 times per week
- Once per week
- Twice per week
- 3 times per week
- 4 or more times per week



**10. B: What is the total amount of time you spend being physically active on each of these days?**

- < 15 minutes
- 15-30 minutes
- 30 -45 minutes
- 45-60 minutes



60-75 minutes

75-90 minute

> 90 minutes

**10. C: On average, how hard do you exercise during these sessions?**

My exercise / physical activity sessions cause me to;

No change in breathing or heart rate

I breathe a little faster and my heart rate increases a little.

I breathe faster, my heart rate increases and I have a light sweat.

I am breathless, my heart beats very fast and I sweat

Vigorous intensity: I exercise as hard as I can

**10. D: Are you happy with your current activity habits? Choose the option that best reflects your own circumstances**

- I try to exercise several times each week
- Generally I exercise once or twice a month but I intend to start doing more from now on
- Generally I exercise once or twice a month and to be honest I can't think that will change in the next 12 months
- I exercise only occasionally or not at all but I intend to start doing more from now on
- I exercise only occasionally or not at all and to be honest I can't think that will change in the next 12 months

Don't know

11. **A. Are you losing sleep? Choose the option that best reflects your circumstances over the last 12 months**

I hardly ever lie awake at night worrying about things and I seldom dwell on problems at work or in my home life

I sometimes lie awake at night worrying about things and occasionally I find myself fretting about problems at work or in my home life but it's not a regular occurrence

I often lie awake at night worrying about things and I regularly find myself fretting about problems at work or in my home life

Don't Know

11. **B: Would you say that in general your health is**

Excellent      Very good      Good      Fair       Poor

11. **C: Thinking about your physical health, which includes physical illness and injury, for how many days during the past 30 days was your physical health not good?**

Number of days

11. **D: Now thinking about your mental health, which includes stress, depression, and problems with emotions for how many days during the past 30 days was your mental health not good?**

Number of days

11. **E: During the past 30 days, for about how many days did poor physical or mental health keep you from doing your usual activities, such as self-care, work, or recreation?**

Number of days





## Appendix 3: Journal of Occupational and Environmental Medicine Author Guidelines

# Journal of Occupational and Environmental Medicine

## Online Submission and Review System

**Manuscript Submission** All manuscripts must be submitted on-line through the new Web site at <http://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.

**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.

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**Supplemental Digital Content (SDC):** 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>.

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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>.

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University of Cape Town