# PHYSICAL ACTIVITY AND HEALTH STATUS AMONG UNDERGRADUATE STUDENTS OF THE SCHOOL OF THERAPEUTIC SCIENCES AT UNIVERSITY OF THE WITWATERSRAND

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## DECLARATION

I, **Temitope Ojelade,** hereby declare that the work contained in this dissertation is my own work, except to the extent indicated in the acknowledgement sections.

This dissertation is being submitted in fulfilment for the degree of Master of Science in Physiotherapy, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa

This work has not been submitted for any other degree or examination in this or any other university.

**27th August, 2018**

**Temitope Ojelade** **Date**

## DEDICATION

To my mother,

No book has the spine to carry the stories your back tell

## ABSTRACT

**Introduction:** Physical inactivity is a known risk factor for many non-communicable diseases. The increasing prevalence of low physical activity level among young adults, particularly university students, is an important public health concern. University students have been found to have poor physical activity habits, and its effect on their health status has been a focus of many studies. However, relatively few studies have objectively assessed the physical activity levels of university students and its relationship with their health status and anthropometric indices. The aim of this study was to evaluate the physical activity level and health status among university students.

**Methodology:** This study was a cross-sectional descriptive study. Physical activity levels were measured using the International Physical Activity Questionnaire (IPAQ) and a pedometer to measure the number of steps for a period of 7 days. Blood pressure and anthropometric indices (height, weight, waist circumference, hip circumference and BMI) were measured. Health status was identified using the Medical Outcome Study Short Form - 12 Health Survey. Descriptive statistics of averages were used to summarize the data and multivariate linear regression was used to determine the predictors of physical activity. Data was analyzed using Stata IBM SPSS Statistics 22.0

**Results:** A total of 242 undergraduate students from the School of Therapeutic Sciences participated in this study. Physical activity level was low in 22.5% and 48.5% of the population using the IPAQ and the pedometer respectively. The average score of the IPAQ and the number of steps was 3855 and 6057 respectively. Predictors of physical activity using the pedometer in this population were age, department of study, health status and waist to hip ratio for number of steps. These predictors had low Beta coefficient values, thereby suggesting that physical activity is weakly dependent on demographics, blood pressure, health status and anthropometric indices Using the multivariate linear regression (stepwise method), physical component summary and social functioning dimensions of health status were predictors of IPAQ scores ($p<0.05$).

**Conclusion:** Participants walked less than the recommended average number of steps per day (10,000 steps) which showed that the students are less active than standard recommendations. Health status was a significant predictor of physical activity using both the IPAQ and the number of steps. This implies that the work schedule of the students, age as well as the health status of the students is a significant predictor of the number of steps taken per day.

**Keywords:** Physical activity, health status, undergraduates

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# LIST OF ABBREVIATIONS

BAI: Body Adiposity Index

BMI: Body Mass Index

BP: Bodily Pain

CDC: Centre for Diseases and Control Prevention

DALY: Disability Adjusted Life Years

GH: General Health

HC: Health Circumference

HOD: Head of Department

HOS: Head of School

HRQoL: Health-Related Quality of Life

IPAQ: International Physical Activity Questionnaire

MCS: Mental Component Summary

MET: Metabolic Equivalent values

MH: Mental Health

MOS: Medical Outcomes Study

OT: Occupational Therapy

PAF: Population Attributable Fraction

PAL: Physical Activity Level

PCS: Physical Component Summary

PF: Physical Functioning

Pharm: Pharmacy

PT: Physiotherapy

QOLI: Quality of Life Index

RE: Role Emotional

RP: Role Physical

SF: Social Functioning

SF-12v2: Short Form 12 version 2 Health Survey

SPSS: Statistical Package for the Social Sciences

VT: Vitality

WC: Waist Circumference

WHO: World Health Organization

WHR: Waist Hip Ratio

WHtR: Waist to Height Ratio

## DEFINITION OF TERMS

Disability-Adjusted Life Years (DALY): is a measure of overall disease burden, expressed as the number of years lost due to ill-health, disability or early death

Health Related Quality of Life (HRQoL): is a multi-dimensional concept that focuses on the impact health status has on quality of life

Population Attributable Fraction (PAF): is a measure used by epidemiologists to estimate the effect of a risk factor on disease incidence in a population

# CHAPTER 1: INTRODUCTION

## 1.1 Introduction

Physical activity is key to health. It is described as "any bodily movements produced by skeletal muscles that result in energy expenditure, while exercise has been described as a subset of physical activity that is planned, structured, repetitive, and has a final or an intermediate objective of improving or maintaining physical fitness" (Westerterp, 2013). In addition, physical activity level (PAL) of an individual is described as a ratio of the total energy expended to his or her metabolic rate over a period of 24 hours (Hills, Mokhtar and Byrne, 2014).

Results from several studies indicate that lack of physical activity or a sedentary lifestyle, associated with smoking, drinking and an inadequate diet, increases the likelihood of developing many diseases, such as hypertension, coronary heart disease, cancer, obesity, and diabetes mellitus (Foulds, Bredin and Warburton, 2012; Knight, 2012; Ding *et al.*, 2016). These conditions, which were previously rare among children and adolescents, are today more prevalent among young people (May, Kuklina and Yoon, 2012). This chapter introduces the concept of physical activity and discusses the prevalence of physical activity among university students, globally and locally. It also includes the problem statement, poses the research question, and outlines the aims, objectives, and significance of the study.

Globally, physical activity is declining. The overall prevalence of physical activity worldwide was reported to be at 68.9%, (Hallal *et al.*, 2012). Whilst the national statistics in many countries show that at least one-quarter of all young people are deemed physically inactive (Rajappan, Selvaganapathy and Liew, 2015). Globally, there has been a decrease in physical activity levels among university students (Arias-Palencia *et al.*, 2015; Clemente *et al.*, 2016), with a gradual decline being observed with an increase in age, especially in the case of females (Molanorouzi, Khoo and Morris, 2015).

The steepest decline in physical activity tends to occur at the period of entry into the university and students end up even graduating as less active persons (Kwan *et al.*, 2012; Fagaras, Radu and Vanvu, 2015). The decline in physical activity levels among university students is a serious public health concern needing attention (Arias-Palencia *et al.*, 2015; Puello, Beltrán and Molina, 2015; Teleman *et al.*, 2015).

There are reported differences in the physical activity levels among university students (Pengpid *et al.*, 2015). Bergier, Bergier and Tsos (2016) conducted a study to compare the physical activity levels of students from different countries (the United States of America, Taiwan, Croatia, South Africa, Poland, India, the Czech Republic and Mainland China ). The study reported American students as having the highest level of physical activity (at 92.7 %) compared to 79.2% of students from Poland, 74.9% in Croatia and 67% in South Africa. Similar results were reported in India and Mainland China , where about 85% of the university students were physically active (Zhao *et al.*, 2007; Padmapriya, Krishna and Rasu, 2013).

El-Gilany *et al.* (2011) profiled a total of 1 708 university students in Egypt for physical activity, and reported that 88.7% of the participants were physically active, which is remarkably higher than the 54.2% reported in higher institutions of learning in Saudi Arabia (Awadalla *et al.*, 2014) and the 48% reported in men in Lebanon (Chamieh *et al.*, 2015). This observed difference in physical activity levels may possibly be related to variations in demography, the socio-economic status of the participants and the study design.

In Africa, there are relatively fewer studies investigating trends in the participation of university students in physical activity (Pengpid and Peltzer, 2013). However, available literature suggests that physical activity levels vary greatly across African Countries, from 46.8% recorded in Mali to 96% in Mozambique (Guthold *et al.*, 2011). Physical activity levels of South Africans (47.6%) was stated to be lower than the global prevalence of 68.9% (Hallal *et al.*, 2012a). A South-African- based survey reported that 41 to 60% of the children and youth in South Africa were found to be physically active in 2016 as opposed to the reports in 2014 where 21 to 40% of the children and youth were reported to be physically active (Draper *et al.*, 2014; Uys *et al.*, 2016). Although there are reports of improvement in the prevalence of physical activity among the youth in South Africa, the need to improve the health of young people has become a global concern. Therefore, there is a need to determine the physical activity levels of university students in South Africa in order to develop targeted health-promoting programmes.

The assessment of the prevalence of physical activity is a complex procedure (Warren *et al.*, 2010; Hills, Mokhtar and Byrne, 2014; Ainsworth *et al.*, 2015). Hence, many measuring tools have been developed with varying degrees of validity. The most commonly employed measuring tools were initially either self- or interviewer - administered questionnaires (Dale, Welk and Matthews, 2002; Silsbury, Goldsmith and Rushton, 2015). For example, the International Physical Activity Questionnaire (IPAQ), and subsequently, the Global Physical

Activity Questionnaire (GPAQ) were developed for national monitoring, descriptive studies and international comparisons of physical inactivity levels (Bull, Maslin and Armstrong, 2009).

Although these aforementioned tools are easy to use, less expensive and can easily be administered to cover large sample sizes, they are, however, subjective. With the aid of technology, more objective devices are being invented and employed to investigate physical activity levels. Such objective and modern physical activity measuring devices include accelerometers, pedometers, heart-rate monitors and armbands (Sylvia *et al.*, 2014). In recent times, researchers and practitioners have been using the pedometer, which is an affordable and basic motion sensor, worn on the body, to assess and motivate physical activity behaviour (McNamara, Hudson and Taylor, 2010; Gardner and Campagna, 2011).

There is a strong link between physical inactivity/activity and health. Physical inactivity has been identified as the fourth leading risk factor for global mortality (WHO, 2010b; May, Kuklina and Yoon, 2012). Lee *et al.*, (2012) assessed the impact of physical inactivity on the burden of disease in South Africa using the population attributable fraction (PAF) and reported that the prevalence of relative risk (RR) associated with physical inactivity for coronary heart disease, Type 2 diabetes, breast and colon cancer were 8.7%, 10.7%, 14.7% and 15.5% respectively. With physical activity being a vital component of wellbeing, and physical inactivity as a risk factor for non-communicable diseases and contributor to the burden of disease in South Africa (Durstine *et al.*, 2013), it is important to determine the physical activity level and health status among South Africa's young population.

In monitoring population health, certain indicators such as life expectancy, health-related quality of life (HRQoL) and disability-adjusted life-year (DALY) are used to measure different aspects of health for a community or defined population group (Parrish, 2010a). Wee, Davis and Hamel (2008) proposed that the 'Short-Form 36' should be used as the generic health status tool for measuring health-related quality of life (HRQoL). In order to prevent non-response on account of questionnaire length and also to reduce the respondent burden, (Ware, Kosinski and Keller (1996b) developed a substantially shorter questionnaire, the SF-12, which has high validity and reliability levels and has subsequently been used in health-status research. (Jenkinson *et al.*, 1997; Wee, Davis and Hamel, 2008; Shou *et al.*, 2016). Such measures are important in investigating and evaluating measures of health status, thus providing information that is necessary for the formulation of health policies and guidelines (Stoto, 2015).

## 1.2 Problem statement

In spite of the numerous advantages of an active lifestyle, university students still exhibit insufficient levels of physical activity (Kilpatrick, Hebert and Bartholomew, 2005; Katzmarzyk *et al.*, 2016). There is considerable evidence to show that physical activity levels decline from high school to university (Kwan *et al.*, 2012; Belton *et al.*, 2014). In addition, university students pursuing a health-related degree, supposedly have more knowledge on the benefits of physical activity to health which could influence their physical activity and health choices (Belton *et al.*, 2014; Ward, 2014; Brehm *et al.*, 2016). However, there is limited research indicating the physical activity levels of university students in the health-related degrees.

University students are usually encumbered with studies and are easily prone to higher stress levels, obesity, smoking and substance abuse, high blood pressure and poor health status, which all contribute to the risk of cardiovascular diseases when not properly monitored (Delgado *et al.*, 2015). There is insufficient literature on the physical activity levels and health status among university students, especially among those pursuing health-related degrees. Therefore, the purpose of this study is to determine the physical activity levels and health status amongst undergraduate students of the School of Therapeutic Sciences at University of the Witwatersrand.

## 1.3 Research question

What are the physical activity levels and health status levels of undergraduate students of the School of Therapeutic Sciences at University of the Witwatersrand?

## 1.4 Aim of the study

To determine the physical activity levels and health status of undergraduate students of the School of Therapeutic Sciences at University of the Witwatersrand.

## 1.5 Specific objectives of the study

1. To determine the physical activity levels of undergraduate students of the School of Therapeutic Sciences at University of the Witwatersrand.

2. To determine the health status and anthropometric indices of undergraduate students of the School of Therapeutic Sciences at University of the Witwatersrand.

3. To determine the relationship between physical activity levels and health status of undergraduate students of the School of Therapeutic Sciences at University of the Witwatersrand.

4. To determine the relationship between physical activity levels and anthropometric indices of undergraduate students of the School of Therapeutic Sciences at University of the Witwatersrand

## 1.6 Significance of the study

There is overarching evidence on the benefits of physical activity to health. In addition, assessing physical activity, health status and anthropometric indices such as blood pressure (BP) and the body mass index (BMI) is important for maintaining and improving student health (Joseph-Shehu, Irinoye and Ajani, 2016). The results from this study can be useful in future intervention studies, health promotion guidelines and present a basis for physical activity recommendations for university students. In addition, key insights from this study would contribute to the body of knowledge on the physical activity levels and health status of students at a university level. Lastly, the result of the study can also highlight areas for intervention among university students and, in general, the population.

## 1.7 Organisation of the dissertation

This dissertation is structured around six chapters (figure 1.1). The figure below briefly describes the contents of each chapter.

**Chapter 1- INTRODUCTION**

- An introduction to the topics of Physical activity and health was given, the problem statement was presented, and the research question, aims, objectives and significance of the study were highlighted.

**Chapter 2 - LITERATURE REVIEW**

- A literature review covering the main themes of the study, namely physical activity and health status is presented.
- A critical review of previous studies conducted in the field was documented

**Chapter 3 - METHODOLOGY**

- The study design, materials used and methods employed in achieveing the objectives of the study are presented.
- The tools used in collection and analysis of data are discussed in detail.

**Chapter 4 - RESULTS**

- The results are presented under each study objective

**Chapter 5 - DISCUSSION**

- Results are discussed; Similarities and differences with results from other studies are highlighted in this chapter.

**Chapter 6 - CONCLUSION, STRENGTHS, LIMITATIONS AND CONCLUSIONS**

- The conclusion from the main findings were highlighted; Strengths and limitations of the study are discussed and future recommedationsare stated.

**Figure 0.1** Organization of the dissertation

# CHAPTER 2: LITERATURE REVIEW

## 2.1 Introduction

This chapter reviews the relevant literature under two main themes, namely, physical activity and health status. The subtopics that will be covered in this chapter include definitions of important terminologies such as physical activity, exercise, physical fitness and health. The prevalence of physical activity and health status, barriers to physical activity, health benefits emanating from physical activity, and the measurement of physical activity and health status will be reviewed. The scope of this review includes published literature in English from the following databases, namely PubMed, Google Scholar, CINHAL, Science Direct and Scopus to identify the relevant literature using the following keywords, namely physical activity, health, anthropometry, and university students.

## 2.2 Definition of physical activity

Physical activity is a broad term used to describe "bodily movements produced by skeletal muscles that result in energy expenditure, including sport, active transport, playing, doing chores, engaging in recreational activities, and other activities that require some form of physical exertion" (Caspersen, Powell and Christenson, 1985). Although commonly interchanged with exercise and physical fitness, these terms are not synonymous. Caspersen, Powell and Christenson, (1985) emphasise that exercise is "a subset of physical activity that is planned, structured, repetitive and purposive, with the objective of improving or maintaining physical fitness" while physical fitness refers to "a set of attributes such as cardiovascular endurance, flexibility, muscular strength, body composition and muscular endurance which are achieved through physical activity".

Section 2.3 below shall explore previous studies on physical activity among the general population, and specifically university students globally, in sub-Saharan Africa and in South Africa.

## 2.3 Prevalence of physical activity

### 2.3.1 Global physical activity

Physical activity globally is low, especially in young adults. Despite the existence of irrefutable proof on the health benefits of physical activity (Warburton, Nicol and Bredin, 2006), 31.1% of the world's population still do not engage in levels of physical activity to produce considerable benefits (Hallal *et al.*, 2012). In the 2012 and 2016 publication of the Lancet series on physical activity, an emphasis was placed on the need for countries to achieve the WHO target of reducing physical inactivity by 10% by the year 2025 (Hallal *et al.*, 2012; Andersen, Mota and Pietro, 2016). According to the Healthy People 2010 Report, only about 25% of young people (ages 12-21) participate in light to moderate physical activity daily (National Center for Health Statistics, 2012).

National statistics in many countries reveal that at least one-quarter of all young people are deemed physically inactive (Rajappan, Selvaganapathy and Liew, 2015). Data from several studies suggest that there is a decline in physical activity levels among university students (Oyeyemi *et al.*, 2013; Fagaras, Radu and Vanvu, 2015; Rajappan, Selvaganapathy and Liew, 2015; Micalos *et al.*, 2017). Haase *et al.*, (2004) studied the leisure-time physical activity in university students from 23 countries and the results showed a prevalence of 56% in developing countries, 58% in Pacific Asia, 61% and 70% in the Mediterranean and Central and Eastern Europe respectively, with North-western Europe and the USA having the highest levels of physical activity at 77%.

Although this study revealed that young adults in economically-developed countries had comparatively higher physical activity levels than those in less-developed countries, Dumith *et al.*, (2011) reported that physical inactivity tends to be more prevalent among the developed countries (27.8%), while the less-developed countries have a physical inactivity prevalence of only 18.7%.

The disparity in prevalence of physical activity from the aforementioned studies by Dumith *et al.*, (2011) and Haase *et al.*, (2004) may be attributed to differences in the data collection tools. In contrast to Haase *et al.*, (2004), who used data from the International Health and Behaviour Survey (IHBS), Dumith *et al.*, (2011) obtained the physical activity levels of participants using the International Physical Activity Questionnaire (IPAQ). Using the IPAQ, Pengpid *et al.*, (2015) conducted research into physical activity among 17 928 university students from 23 countries and reported that four out of ten students are physically inactive. The prevalence rates ranged from 21.9% in Kyrgyzstan to 80.6% in Pakistan. Overall, the physical inactivity reported by region was 50.5% in Southeast Asia, 37.2% in Caribbean and South America and 37.1% in sub-Saharan Africa. Very few studies have in fact assessed and compared the physical activity level of countries in the sub-Saharan region.

### 2.3.2 Prevalence of physical activity in sub-Saharan Africa

Owing to the region's current industrial and technology revolution, the transition to physical inactivity in sub-Saharan Africa can be attributed to the shift from work involving a high expenditure of energy to activities demanding less physical activity, (Katzmarzyk and Mason, 2009). Despite this, in a study involving 57, 038 adults from 22 African countries, physical activity at work and transport were shown to contribute more to overall physical activity than leisure-time physical activity (Guthold *et al.*, 2011). Using the Global Physical Activity Questionnaire (GPAQ), 72.8% of Africans were classified as active, with prevalence rates ranging from 46.8% in Mali to 96.0% in Mozambique. This indicates that variation exists in physical activity levels across the African continent.

Although the WHO STEPwise approach to chronic disease risk factor surveillance (STEPS) is aimed at assessing physical activity levels among adults aged 25-64 in Africa (WHO, 2008) and the African Physical Activity Network (AFPAN) is aimed at promoting physical activity levels amongst children and teenagers (Wachira *et al.*, 2014)There is insufficient research on physical activity among the university population.

When the International Physical Activity Questionnaire measuring physical activity was administered among 1600 Obafemi Awolowo University students in Nigeria, 89.4% of the participants were found to be physically active (Awotidebe *et al.*, 2014). However, Pengpid *et al.*, (2015) reported physical activity prevalence of 52.5% among 820 Nigerian university students. A likely reason for this disparity could be differences in sample size, and bias common with self-report techniques of measuring physical activity (Molenberghs, 2011; Sylvia *et al.*, 2014).

Using the same tool (IPAQ), Pengpid *et al.*, (2015) reported physical activity among other sub-Sahara African countries namely Cameroun (73.2%), Ivory Coast (47.9%), Madagascar (68%), Mauritius (63%), and South Africa (74.6%). Like other developing nations, South Africa has high numbers of people who conduct physical activity at low intensity (Craig, Bland and Reilly, 2013). The section below reviews physical activity studies done in South Africa

### 2.3.3 Prevalence of physical activity in South Africa

Compared to the global average of 68.9% (Hallal, *et al.*, 2012), the prevalence of physical activity in South Africa is estimated to be at 55.3% (Guthold *et al.*, 2008). Based on the 2016 Report Card on Physical Activity for Children and Youth in South Africa, in which grades are assigned to physical activity indicators, ranging from A (81% to 100%) to F (0% to 20%), there has been an improvement in overall physical activity levels, as observed from the D grade (21% to 40%) assigned in 2014 to the C grade (41% to 60%) assigned in 2016 (Uys *et al.*, 2016).

In contrast, (Pienaar *et al.*, 2012) observed changes in the physical activity levels among 309 adolescents in South Africa over a three-year period and reported a decline in physical activity. These results support the notion that there is an increase in sedentary time and a corresponding decrease in physical activity levels among young South Africans (Moselakgomo, Monyeki and Toriola, 2014; De Vos, Du Toit and Coetzee, 2016).

Bloemhoff (2010) found a high prevalence of low physical activity (33%) among students of the University of the Free State. Likewise, the same level of physical inactivity (33%) was reported among undergraduate students at Limpopo University (Pengpid and Peltzer, 2013). These results are comparable because both studies utilized the same measuring tool for physical activity (IPAQ) and involved a population sample of approximate age group. Among the 19 students assessed at the University of Cape Town, less than one quarter (15.8%) of the participants was physically inactive (Noorbhai *et al.*, 2014). However, this study can be critiqued for its small sample size, as it is not representative enough of the student population at the University of Cape Town, and South Africa at large.

Comparatively, Dhurup & Garnett, (2011) investigated the level of participation in physical activity among 251 students at the Vaal University of Technology in Southern Gauteng, and reported that only 14% of the participants admitted that they often participated in physical activity, while a larger percentage (45.2%) was classified as sedentary, reporting no physical activity. Data from several studies (Miller *et al.*, 2005; Oyeyemi *et al.*, 2013; Fagaras, Radu and Vanvu, 2015; Rajappan, Selvaganapathy and Liew, 2015; Micalos *et al.*, 2017) suggests that there is a decrease in physical activity levels among university students (Irwin, 2004), especially in females (Butt *et al.*, 2011).

Although the reason for this is unknown, it has been shown that gender differences exist in levels of physical activity (Trost *et al.*, 2002; Azevedo *et al.*, 2007; Hallal *et al.*, 2012; Telford *et al.*, 2016). Similarly, Humbert *et al.*, (2006); Oyeyemi *et al.*, (2016); and Sallis *et al.*, (2016) argue that factors such as environmental and socio-economic factors largely determine physical activity participation.

### 2.4 Factors influencing physical activity participation

In an effort to understand why some people are more active than others, Bauman *et al.*, (2012) identified individual, interpersonal and environmental factors as key determinants of physical activity levels. Furthermore, a multiplicity of factors such as gender, culture, socioeconomic status, and access to recreational centres may contribute to the disparity in the prevalence of physical activity among young people (Talaei *et al.*, 2013). The investigation into barriers of physical activity participation is controversial and multidimensional (Lovell, Ansari and Parker, 2010).

These barriers can be broadly categorized into internal and external barriers; where internal barriers refer to those factors determined by an individual's personal decisions, and external barriers refer to factors beyond an individual's control (Schoeny *et al.*, 2017). Several studies report that both internal and external barriers are important determinants of students' participation in physical activity (Gómez-López, Gallegos and Extremera, 2010; Saadan *et al.*, 2015; Alsahli, 2016). Daskapan, Tuzun and Eker (2006) postulated from the results of their study that perceived external barriers seem more important than internal barriers. Therefore, this section reviews the internal and external barriers to participation in physical activity.

**Internal Barriers:** Internal barriers largely relate to the thoughts and emotions of individuals, especially their perceptions of physical activity (Justine *et al.*, 2013). Among the undergraduate population, the most recurrent perceived internal barriers to participation in physical activity are a lack of motivation and fatigue (Saadan *et al.*, 2015)

**External barriers:** Among the general population, lack of time is considered the most pertinent barrier to participation in physical activity (Justine *et al.*, 2013). Other identified barriers include lack of resources and social support (CDC, 2017). Hence, availability and accessibility of physical activity resources largely determine physical activity participation and choice of measurement tool (Sallis, 2010).

Existing empirical evidence on barriers to physical activity among university students highlights how the student's curriculum structure and time devoted to study can hinder participation in physical activity (Iván Martínez-Lemos, Puig-Ribera and García-García, 2014; Alsahli, 2016). Besides the existence of internal barriers such as the fact that some students just do not like physical activity nor find it useful (van Niekerk and Barnard, 2011), there are also external barriers such as lack of social support, unavailable facilities and limitation of time (Gómez-López, Gallegos and Extremera, 2010).

### 2.5 Guidelines and recommendations on physical activity

It has been recommended that adults should engage in 30 minutes of moderate to vigorous physical activity daily (WHO, 2010; Piercy *et al.*, 2015), and this can be achieved in a variety of ways, such as brisk walking or jogging for two miles (Pate *et al.*, 1995), or, more intermittently, at an equivalent intensity, by engaging in short bouts of activities such as dancing, frequent stair climbing, housework, etc.. Low-intensity activities have also been shown to be beneficial when engaged in for a longer duration of time (Carson *et al.*, 2013).

The table below highlights the World Health Organization's (WHO) recommendations for levels of physical activity for good health (WHO, 2010)

**Table 0.1** Global recommendations on physical activity for health

| **AGE (YEARS)** | **RECOMMENDATION** |
|---|---|
| **5-17** | 1. At least 60 minutes of moderate- to vigorous-intensity physical activity daily.<br>2. Levels of physical activity greater than 60 minutes provide additional health benefits.<br>3. Most of the daily physical activity should be aerobic. Vigorous-intensity activities should be incorporated in a programme to include those that strengthen muscle and bone, at least three times per week. |
| **18-64** | 1. At least 150 minutes of moderate-intensity aerobic physical activity throughout the week, or at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week, or an equivalent combination of moderate- and vigorous-intensity activity.<br>2. Aerobic activity should be performed in bouts of at least 10 minutes' duration.<br>3. For additional health benefits, adults should increase their moderate-intensity aerobic physical activity to 300 minutes per week or engage in 150 minutes of vigorous-intensity aerobic physical activity per week, or an equivalent combination of moderate- and vigorous-intensity activity.<br>4. Muscle-strengthening activities should be done involving major muscle groups on two or more days a week. |

| | |
|---|---|
| **65 and above** | 1. At least 150 minutes of moderate-intensity aerobic physical activity throughout the week, or at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week, or an equivalent combination of moderate- and vigorous intensity activity.<br>2. Aerobic activity should be performed in bouts of at least 10 minutes' duration.<br>3. For additional health benefits, adults aged 65 years and above should increase their moderate-intensity aerobic physical activity to 300 minutes per week or engage in 150 minutes of vigorous-intensity aerobic physical activity per week, or an equivalent combination of moderate and vigorous-intensity activity.<br>4. Adults with poor mobility in this age group, should perform physical activity to enhance balance and prevent falls on three or more days per week.<br>5. Muscle-strengthening activities should be done involving major muscle groups, on two or more days a week.<br>6. When adults of this age group cannot do the recommended amounts of physical activity on account of their condition of health, they should be as physically active as their abilities and conditions allow. |

## 2.6 Benefits of physical activity

Several epidemiological studies have shown positive correlations between physical activity and health status (Walter, Du Randt and Venter, 2011; Reiner *et al.*, 2013b; Dinger, Brittain and Hutchinson, 2014; Granger *et al.*, 2017). Participating in physical activity produces physiological responses such as increased cardiorespiratory function, improved immune function, an improved cholesterol balance and insulin sensitivity, all of which are beneficial to health (Rapporteur, 2015). Low levels of physical activity are associated with high health risks such as being overweight and suffering from obesity-related diseases (Jakicic and Davis, 2011; Poitras *et al.*, 2016). This is because physical inactivity increases the likelihood of developing high cholesterol and hypertension (Go *et al.*, 2013).

Using various measuring tools, Anokye *et al.* (2012) conducted research involving a nationwide sample of 5 537 adults in England. Physical activity was measured using a validated questionnaire and an actigraph model GT1M accelerometer (worn at the waist for seven days), while health related quality of life (HRQoL) was assessed using the EuroQol-5 Dimensions (EQ-5D). results revealed that participation in a higher level of physical activity correlates positively with an improved health related quality of life. Although participants in this study were within the ages of 40 and 60, other studies have reported similar findings among the younger population (Akber, Portale and Johansen, 2014; Mannocci *et al.*, 2015; Zhang *et al.*, 2016; Bermejo-Cantarero *et al.*, 2017).

Maintaining high levels of physical activity from childhood to adulthood is necessary to enjoy both short-term and long-term benefits (Reiner *et al.*, 2013a; Poitras *et al.*, 2016). Earlier studies by Paffenbarger, Hyde and Wing (1986) among 16 936 Harvard alumni revealed that for a dose of 2000 kcal [8400 kJ], regular physical activity produces a response of an increased life expectancy of one to two years by the age of 80. Subsequent studies have shown that expending low to moderate levels of energy expenditure, such as 1000 kcal (4200 kJ) per week produces substantial health benefits - enough to accrue a 20% to 30% reduction in all causes of mortality (Skerrett and Lee, 2001).

Several studies (Janssen and LeBlanc, 2010; Reiner *et al.*, 2013a) have provided compelling evidence on the health benefits of physical activity across all age groups, both as a preventative strategy and as a lifestyle modification to reduce risk factors to chronic diseases. Since the definition of health encompasses physical, mental and social domains (WHO, 2017), health benefits of physical activity will be reviewed as they pertain to the physical, mental and social domains of health and support the objectives of this research.

**Physical benefits of physical activity**

Physical activity has been shown to be both a preventative approach (Booth, Roberts and Laye, 2012) and a treatment of several chronic diseases (Pedersen and Saltin, 2015). Owing to current lifestyle behaviours, chronic diseases which were previously prevalent among the older population are today more prominent among young adults (Kushner and Sorensen, 2013). According to the WHO, obesity, cardiovascular diseases, and Type 2 diabetes are identified as the most severe non-communicable diseases (WHO, 2017). In a systematic review on the long-term benefits of physical activity on non-communicable diseases, Reiner *et al.*, (2013b) concluded that there is a negative relationship between physical activity and obesity, as evident from various studies (De Ridder, Strydom and Greeff, 2012; Mukherjee and Dhara, 2014; Afrifa-Anane *et al.*, 2015)

Physical activity reduces the risk of cardiovascular diseases by improving cholesterol levels, lowering blood pressure and improving the health of the blood vessels (Hagberg, 2011). Myers et al. (2004), reported a negative correlation between physical fitness and cardiovascular deaths in men. There was a reduction of 50% in cardiovascular mortality in physically fit of active men. On the other hand, 59% of the deaths from cardiovascular disease among women were as a result of excess weight and physical inactivity (Hu *et al.*, 2004).

Despite the fact that events of cardiovascular diseases such as stroke occur later in life (Ruiz and Ortega, 2009), research has shown that the risk factors do in fact prevail in childhood and progress through to adulthood (Berenson *et al.*, 1998). Hence, Biddle, Sallis and Cavill (2001) have emphasized the importance of regular physical activity among young people for both current and future health benefits.

Being the third-leading cause of death in the United States of America (US) (Stokes and Preston, 2017), diabetes has in fact been identified as a global health problem. (Wild *et al (*2004) estimated that the global prevalence of diabetes in the year 2000 was 2.8% and is projected to rise to 4.4% by 2030. Increased sedentary habits have been shown to increase the risk of diabetes (Biswas *et al.*, 2015). Among diabetic individuals, physical activity has been shown to have positive benefits on carbohydrate metabolism and insulin sensitivity (American Diabetes Association, 2004). Cuenca-García *et al.* (2012) reported that young people with diabetes who engage in moderate to vigorous physical activity have better glycaemic control. Therefore, regular participation in physical activity is recommended for the management and prevention of diabetes.

**Mental benefits of physical activity**

While it is understood that multiple and diverse factors determine well-being and mental health, it is important to identify the role of physical activity in buffering the negative effects of psychological stress, thereby promoting mental wellbeing (Taylor, 2014). Depression and anxiety have been identified as leading causes of disability in the world today (WHO, 2017).

Using the General Health Questionnaire (GHQ-12), (Griffiths *et al.* (2014 examined the relationship between physical activity (expressed in MET/week) and mental health among 26 913 Finnish women of various age groups. The results revealed that participants who engage in intense physical activity have a lower likelihood of future mental ill-health when compared to their counterparts who are less physically active. The findings in their study are similar to those of previous studies conducted to explore the relationship between physical activity and mental health. For example, in a systematic review by Biddle and Asare (2011), on physical activity and mental health in children and adolescents, it was shown that while there is a positive association between physical activity and mental health, likewise there is also a negative association between sedentary behaviour and mental health.

Existing evidence shows that the period spent at college or university increases the risk for poor mental health and depression as a result of academic and social stressors such as examinations and interpersonal relationships (Weitzman, 2004). Several studies have shown that physical activity not only reduces stress, anxiety, and depression (Anderson and Shivakumar, 2013; Rebar *et al.*, 2015), but also improves mental health outcomes such as self-esteem, self-efficacy and mood (Joseph *et al.*, 2014). In the student population, engaging in physical activity was shown to aid the emergence of improved on-task behaviour (Whitt-Glover, Ham and Yancey, 2011), increased concentration (Singh *et al.*, 2012) and improved academic performance (Whitehead *et al.*, 2011).

In a national cross-sectional sample of 14 804 undergraduate students in the United States, self-reporting in terms of vigorous activity was shown to have a strong positive relationship with mental health (measured using the SF-36) and a negative relationship with perceived stress levels (measured using the Cohen Perceived Stress scale) (VanKim and Nelson, 2013).

**Social benefits of physical activity**

Social health can be described as a person's ability to interact with individuals (Umberson and Montez, 2010). While several studies have been published on the physical and mental health benefits of physical activity, relatively few studies have been conducted to explore the role of physical activity in social health (Eime *et al.*, 2013).

In a systematic review on the psychological and social benefits of sports participation among children and adolescents by Eime *et al.* (2013), based on 11 publications, it was reported that physical activity has positive effects on social health, the most common benefits reported being improved wellbeing, self-esteem, social functioning, social interaction and reduced stress and depression. Furthermore, in the book, "The psychology of exercise", Lox, Ginis and Petruzzello (2017) argue that the primary role of physical activity is in social, psychological and emotional well-being, as in social relationships, body image, and mood.

According to Hurst, Baranik and Daniel, (2013), the most important stressor faced by undergraduates is that of general academics, followed by family, romantic and peer relationships. This indicates that the social health of university students is of vital importance. Studies (Huesman *et al.*, 2009; Henchy, 2011) that examined the correlation between recreational sports and social integration show that students who engage in campus recreation programmes exhibit better social skills, as these spaces provide them with opportunities to make new friends and develop informal support groups. Physical activity has many broader health benefits and thus should be encouraged among university students (Skaal, Monyeki and Toriola, 2015).

## 2.7 Definition of health

Despite calls and reviews for a refined definition for health (Fantuzzi, 2014; Hafen, 2016; Charlier *et al.*, 2017; Witt *et al.*, 2017) the definition by the WHO since 1948 is still the most commonly used and cited definition in literature to date: “Health is defined as a state of complete physical, mental and social wellbeing, not merely the absence of disease or infirmity.” (WHO, 2014). The American Physical Therapy Association (APTA) defines health as “a state of being associated with freedom from disease, injury, and illness that also includes a positive component (wellness) that is associated with a quality of life and positive well-being”, and health status as “the state of the conditions that comprise good health” (APTA, 2009).

Conceptually, the health status of an individual or population can be described as the relative level of wellness (Zabriskie, 2011). Before the 21st century, communicable diseases such as influenza, tuberculosis, and pneumonia were the most common causes of death. However, with the inventions of vaccines, medical technologies and better public health protocols, the spread of communicable diseases has widely abated (Center for Disease Prevention and Epidemiology, 2000; Statistics, 2012). Today, non-communicable diseases such as diabetes, cardiovascular diseases, cancer and chronic respiratory diseases are the most common causes of death in developing (Nugent, 2008) and developed countries (Unwin, Alberti and Sanders, 2006).

## 2.8 Health status

### 2.8.1 Global health status

Every year, the WHO compiles health-related data for its 194-member states that are based on globally-accepted objective indicators such as life expectancy, which reflects the overall mortality level of a population. In 2015, the global life expectancy at birth was 71.4 years (73.8 years for females and 69.1 years for males). Between the years 2000 and 2015, global average life expectancy increased by five percent (5%) and Disability-adjusted Life Years (DALY) declined (WHO, 2015). Of the 56 million deaths recorded worldwide in 2015, non-communicable diseases, mainly cardiovascular diseases, diabetes, cancers and chronic lung diseases, were collectively responsible for 70% of global deaths. Communicable, maternal, neonatal and nutritional conditions caused 21% of the global deaths, while injuries caused the remaining nine percent (WHO, 2015).

Karakaş and Bozkir, (2012) assessed the anthropometric indices in relation to cardiovascular risks and metabolic diseases among 1 163 second-year medical students in Turkey. It was observed that 31.42% of the participants smoked cigarettes and 14.79% used alcohol. In addition, the mean values of waist circumference, waist-to-hip ratio, and waist-to-height ratio were 73.15 ±5.1 cm, 0.76 and 0.44 respectively in women, whereas the same indices were 77.73 ±5.81 cm, 0.81 and 0.43 respectively in men.

Although obesity levels by body mass index (BMI) were not reported in this study, Peltzer *et al.*, (2014) obtained data from 15 686 university students in 22 countries and reported that 22% of the participants were overweight and obese. Similarly, wide variations in the prevalence of overweight/obesity have been reported in other studies, such as 26.6% in Lebanon, (El-Kassas, Itani and Ali, 2015), 47.9% in Northern Greece (Chourdakis *et al.*, 2010) and 69.8% in China, when assessed by the combination of BMI, Waist Circumference and Waist Height Ratio (Xu *et al.*, 2016).

Such high prevalence of overweight/obesity levels, coupled with physical inactivity, cigarette and alcohol consumption levels, contribute to the development of non-communicable diseases, which has become a public health problem to developing and developed countries globally.

### 2.8.2 Health status in sub-Saharan Africa

There is insufficient information on the health status of people in sub-Saharan Africa. Data from the Gallup World Poll in 2012 showed that, compared to other regions, sub-Saharan Africa had the lowest wellbeing rating when assessed using the Cantril Ladder (Deaton and Tortora, 2015). Despite recording the highest decline in the relative burden of disease, Africa remains the only region where deaths due to communicable, maternal, neonatal and nutritional conditions are as high as 62% (WHO, 2015).

It is projected that by 2030, non-communicable diseases would be the leading cause of deaths in Sub-Saharan Africa (Naik and Kaneda, 2015), and that the identified risk factors are physical inactivity, tobacco use, harmful alcohol consumption and unhealthy diet. The increasing prevalence of overweight/obesity in Africa is particularly worrisome, as obese youth have been reported to have lower physical HRQoL (Paulis *et al.*, 2017) and are at higher risk of presenting with other chronic conditions and diseases (Fedacko *et al.*, 2011).

### 2.8.3 Health status in South Africa

Relatively few studies have explored health and lifestyle behaviours of university students in South Africa (Janse van Rensburg and Surujlal, 2013). van Niekerk and Barnard (2011) conducted a three-year study among female students at Stellenbosch University which involved 941 students and used a questionnaire designed specifically to provide information on the levels, motivators, and barriers to exercise, and the health status and smoking habits of the participants.

Their results revealed a mean BMI of 21.7, which suggests a normal distribution across board, and 13% of the participants reported that they smoked. Despite being lower than the 14.2% and 23% prevalence observed in Rhodes University (Young and De Klerk, 2009) and the University of KwaZulu-Natal (Tesfai, 2016) respectively, habitual smoking significantly impacts the health of an individual and is one of the four main risk factors in the development of non-communicable diseases. In South Africa, alcohol use, high blood pressure, and high BMI contribute majorly to the proportion of DALY (Mayosi and Benatar, 2014). Therefore, measures should be put in place to mitigate these risk factors, as they subsequently contribute to the burden of disease nationally and globally.

## 2.9 Factors influencing health status

The health of an individual is influenced by a variety of factors. These factors are better illustrated by the Dahlgren and Whitehead (1991) Rainbow Model (Figure 2.1). The framework shows that at the core of the determinants of health are inherited attributes namely, age, sex and inherited factors.

The first layer comprises of the individual’s lifestyle factors, such as the level of physical activity engaged in, diet, smoking and alcoholic consumption, which can “promote or damage health”. These lifestyle factors lead to vital metabolical/physiological changes and are risk factors in the development of non-communicable diseases such as cardiovascular diseases, diabetes and cancer (Chakma and Gupta, 2017).

The next layer proposes that health is affected by personal interconnections. Umberson and Montez (2010) highlight the fact that social networks influence health behaviourally, psychologically and physiologically.

The outermost layer takes into consideration general socio-economic, cultural and environmental conditions. This shows that health is influenced by living and working conditions such as level of education attained, access to health-care services, housing, national and global policies etc (Bambra *et al.*, 2010).

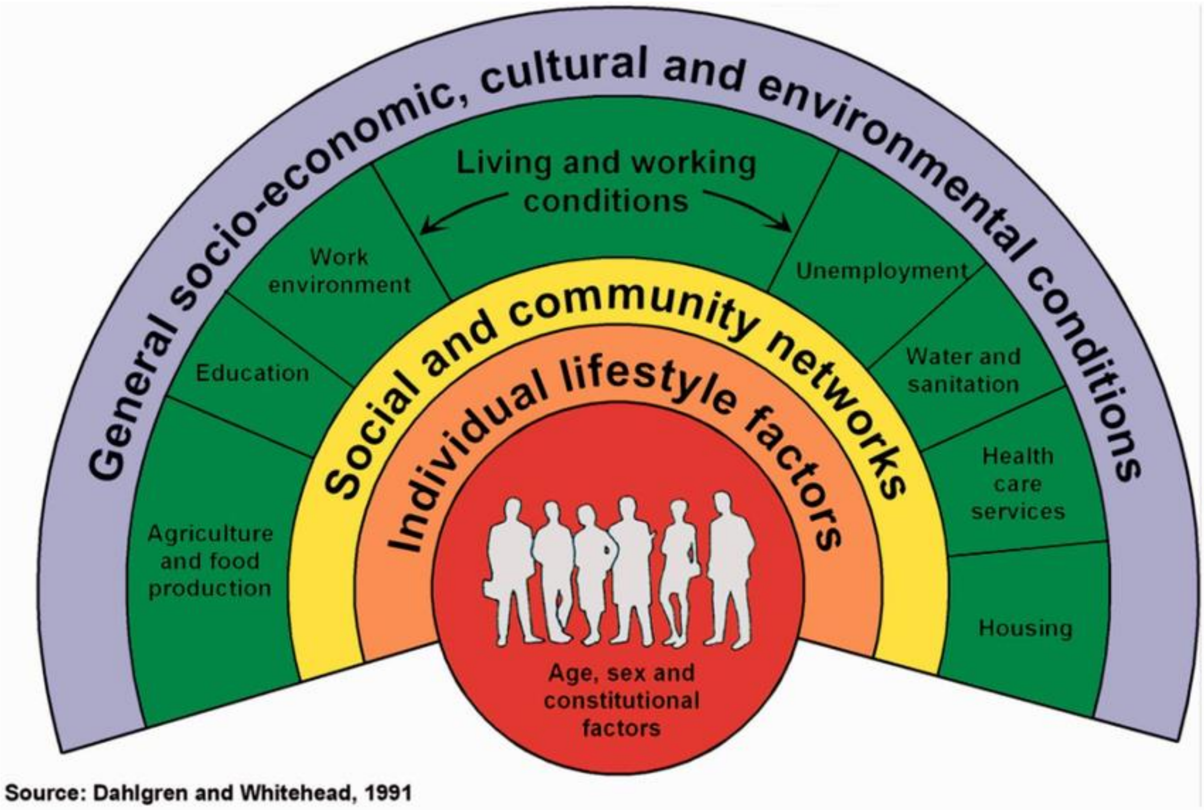


**Figure 2.1** Determinants of health

Both PA and health status are linked and should be measured together. The measures of PA and health status are reviewed in Section 2.10 and 2.11

## 2.10 Measurement of physical activity

In research, and particularly in the clinical setting, many techniques are employed to measure physical activity (Kahn *et al.*, 2010). With the many dimensions (such as frequency, time, duration, intensity) and domains (such as occupational, leisure-time, and transportational) associated with physical activity, there is no gold standard tool for assessing physical activity (Sallis, 2010).

Surveillance systems use self-reporting measures and questionnaires to assess physical activity levels (Matthews, 2002; Bassett and Fitzhugh, 2009), but on being compared with objective measures such as heart-rate monitors, pedometers and accelerometers, participants have been shown to overestimate or underestimate their physical activity levels (Sylvia *et al.*, 2014). Measuring physical activity among the youth, therefore, requires the selection of appropriate tools that would help determine the best objectives of the investigator (Taylor, 2014).

For the purpose of this study, both subjective and objective means of measuring physical activity levels were employed. Generally, the techniques of assessing physical activity were classified under self-report, objective monitors and direct observation (Warren, Ekelund, Besson, Mezzani, Geladas, Vanhees, *et al.*, 2010; Taylor, 2014). Each of these techniques has undergone various reliability and validity studies and can be used concurrently or independently (Kelly, Fitzsimons and Baker, 2016).

### 2.10.1 Self-reporting techniques

The self-reporting approach to measuring physical activity is one that is commonly used because of its affordability, low respondent burden and ability to capture a large population in a shorter time frame (Esliger, Kingsnorth and Sherar, 2018). It relies on the ability of participants to recall their physical activity in retrospect, and can be documented with the aid of a questionnaire, either self-administered or interview-administered (Matthews, 2002) or by daily logs and diaries (Sylvia *et al.*, 2014). Self-reporting physical activity instruments can be further classified into physical activity records and diaries, global self-reporting, recall questionnaires and quantitative history questionnaires. Each of these forms are described below, together with an analysis of their reliability and validity.

**Physical Activity records and diaries:** While logs involve the participants documenting the amount of time spent in broad categories of activity (sitting, standing, walking), records/a diary require the participant to record the individual sessions of activity as they occur prospectively (Strath *et al.*, 2013). Both forms require the documentation of activities, classified according to the type, pattern, intensity and metabolic equivalents over a 24-hour period in 15-minute intervals (Matthews, 2002). However, it should be noted that this depends largely on the cooperation of the participant, and could also be subject to memory bias (Sylvia, 2015). Examples include the physical activity log book (Ainsworth *et al.*, 2000) and Bouchard's activity diary (Wickel, Welk and Eisenmann, 2006).)

Steene-Johannessen *et al.* (2016) proposed that the physical activity diary could be used to monitor changes in energy expenditure. However, in testing the concurrent validity of the physical activity diary amongst stroke patients, Vanroy *et al.*, (2014) reported a low correlation between the physical activity diary and the objective activity monitor (r = 0.29) for the total physical activity  and the energy expenditure levels. Verstraeten *et al.*, (2013) analysed the validity and reliability of physical activity records among 302 adolescents, for physical activity of a moderate intensity.  According to these authors, the Kappa statistics showed fair to moderate agreement between the physical activity record and the accelerometer (validity = 0.34-0.48, 95% CI).  Likewise, a reliability level of 0.35-0.63 (95% CI) was shown between the first and second physical activity records.

**Global self-reporting:** When the objective of the researcher or clinician is to stratify an individual's level of physical activity as either high or low on the basis of  generic terms, self-reporting assessments are usually used (Biddle *et al.*, 2011). This involves using an instrument that contains one to four items to identify the physical activity pattern of the individual, in a specific domain, and over a specific period of time (Steene-Johannessen *et al.*, 2016).

The Single Item Measure (SIM) and the Patient-centred Assessment and Counselling for Exercise (PACE+) were used to assess physical activity guidelines among university students (Murphy *et al.*, 2017). Agreement, sensitivity and specificity values for the SIM were 45.20%, 31.10% and 75.50% respectively, while they were 44.50%, 31.10% and 73.50% for the PACE+. In comparison with the IPAQ-SF (0.52), the SIM showed moderate reliability (0.67) while the Nine-day test-retest reliability showed a strong ICC (0.70) for the PACE+

**Recall questionnaires:** In surveillance studies, the physical activity patterns of participants are quantified using short and easy instruments that contain less than 15 items (Matthews, 2002). Data from these questions can further be described and individuals classified into broad categories.  On account of  its cheap methodology relative to objective monitors, this type of questionnaire  has widespread use despite the  disadvantage it presents in that  the amount of physical activity could be  underestimated or overestimated (Westerterp, 2009; Hills, Mokhtar and Byrne, 2014).

An example of a recall questionnaire is the Stanford Seven-Day Physical Activity Recall (PAR), which was used in a study by Garfield *et al.*, (2012) to compare its validity against a validated activity monitor, the Sense Wear Armband (SWA) in a cohort of patients with COPD. The results showed a significant correlation ($r=0.54$, $p<0.001$) with an ICC of 0.40.

**Quantitative history questionnaires:** When the objective of the researcher is to capture the physical activity patterns of participants over multiple domains, a more detailed approach of assessment such as the quantitative history questionnaire is used (Strath *et al.,* 2013). This usually entails more questions over multiple segments and is designed to provide comprehensive information on the physical activity patterns over a period of time, such as months or years (Ainsworth *et al.*, 2000; Strath *et al.*, 2013).

A common example is the Bone Loading History Questionnaire, which is used to determine hip and spine weight-bearing and bone-loading activities from childhood to the past year in the interviewee's life (Dolan *et al.*, 2005). The questionnaire demonstrated good test-retest reliability in postmenopausal women using interclass correlation coefficient (spine $r = 0.89$, $p < 0.001$; hip $r = 0.92$, $p < 0.001$)

### 2.10.2 Objective monitors

The use of monitoring devices such as accelerometers, pedometers and heart-rate monitors in measuring physical activity has been made possible through recent advances in technology (Taylor, 2014). When worn, the intensity of body acceleration is measured using an electronic component embedded within the device (Graham and Hipp, 2014), which usually has the capacity to store and record these data over a period of time.

**Pedometers:** A pedometer is a device used to count the number of steps taken by an individual over a period of time (Bassett *et al.*, 2011). The pedometer was invented by Leonardo Da Vinci 500 years ago, and was previously used for land survey purposes (Bassett *et al.*, 2017). It consists of a horizontal, spring-suspended lever arm which deflects every time there is a vertical hip motion beyond the pre-selected stride length (Sylvia *et al.*, 2014). Recent versions have an internal electric circuit that accumulates steps and shows these numbers on its digital display. This feature makes it a key instrument in intervention studies where the aim is to encourage physical activity among participants (Akber, Portale and Johansen, 2014).

Since walking has been shown to provide substantial health benefits (Celis-Morales *et al.*, 2017) and is a known form of physical activity commonly engaged in by people, the measurement of walking-based activity has become an important issue. It is made possible through the use of a pedometer, which is usually worn on the waist (or the wrist, ankle, shoe). Although pedometers are inexpensive, more advanced versions with added features may cost more.

Available types include the Kenz Lifecorder, New-Lifestyles NL-2000 (piezoelectric), and Yamax Digi-Walkers SW-200 and SW-70

**Accelerometers**: An accelerometer is a device that measures the acceleration of a body (velocity over time) across one (uniaxial) to three (triaxial) orthogonal planes of movement (Taylor 2014). Information on the amount, frequency, and duration of the physical activity can be obtained from the accelerometer, whose output is expressed in form of "counts" per unit time (Ndahimana and Kim, 2017). This generated output is then converted into energy expenditure and metabolic equivalents (METs) units of physical activity using predictive equations (Lee and Shiroma, 2014).

The accelerometer is a more advanced and slightly more expensive electronic device than the pedometer (O'Neill *et al.*, 2017). It has the added advantage of being portable, non-invasive and of providing quality information on human movement (Lee and Shiroma, 2014). The accelerometer is able to distinguish between walking and running by the wearer (Walker, Hickey and Freedson, 2016). . . Available types include the GT3x Actigraph and the Activpal monitor (Lee and Shiroma, 2014).

**Heart-rate monitor:** the heart-rate monitor is a device that generates real-time information on the frequency, duration and intensity of physical activity engaged in by an individual (Sylvia *et al.*, 2014). Physiologically, the heart responds to the body's physical activity by increasing the heart rate proportional to the level of intensity of the physical activity being carried out (Plowman and Smith, 2007). Heart-rate monitors, usually worn on the chest or wrist, have an electrocardiogram (ECG) transmitter that sends signals to the receiver, which calculates the average heart rate within five- to 15-second intervals and displays it as beats per minute (Welk, 2002).

Although more expensive than pedometers and accelerometers, heart-rate monitors are valuable in that that they can transfer the data that they gather to a computer. They are also useful in calculating energy expenditure and physical activity for observational and intervention studies (Janz, 2002). Available types include the Fitbit Surge fitness super watch, the Timex personal trainer, Polar FT7, and Garmin vivofit (Wright *et al.*, 2017).

### 2.10.3 Direct observation

Obtaining accurate information on the frequency, duration, intensity, and type of physical activity carried out by an individual is only possible through systematic observation (Taylor, 2014). In direct observation, the physical activity levels are assessed in specific settings (Dugdill and Stratton, 2007) such as the playground, classes, etc., and can be carried out by a trained observer or through videotaping (Welk, 2002). Several instruments such as System for Observing Fitness Instruction Time (SOFIT), Fargo Activity Time Sampling Survey (FATS) and Children's Activity Rating Scale (CARS) have been specifically designed to capture different dimensions of interest, depending on the behavioural category of interest (Mckenzie, 2002). The results obtained can be useful in assessing and designing intervention programmes for a target group (Bird *et al.*, 2015). Hence, the measurement tool of physical activity is dependent on the population group and dimension of physical activity being measured.

Diverse types of physical activity are undertaken in daily living. Hence, physical activity can be categorized according to domains, such as, occupational, transport and leisure (Wallmann-Sperlich and Froboese, 2014; Piggin, Mansfield and Weed, 2018). Furthermore, describing and measuring the dose of physical activity performed takes into consideration how often the activity is performed (frequency), how long the activity lasts (duration) and the magnitude of effort required to perform the activity (intensity) (Esliger, Kingsnorth, & Sherar, 2018). Guidelines concerning physical activity take into consideration these three dimensions. Therefore, the World Health Organization recommends that adults should do at least 150 minutes of physical activity weekly (World Health Organization, 2010). Individuals not meeting this recommended guideline are described as physically inactive.

## 2.11 Measurement of health

The aim of health measurement should not be influenced by biased self-reporting on health issues (Cook, 2010). On account of the abstruse innate characteristics of health, a gold-standard measurement tool for measuring health is currently unavailable. Unlike weight or height, health cannot be measured directly (Krabbe, 2016), but can be assessed using pathological or clinical methods (Cano and Hobart, 2011). Health status measurement, however, has some indicators, that have been accepted through consensus and that enable clinicians and researchers to categorize the health status of an individual or a population (Thacker *et al.*, 2006). These indicators can be measured subjectively or objectively, with both measures especially desirable for public policy purposes (Johnston, Propper and Shields, 2009). Subjective and objective health measurements will be discussed briefly below:

### 2.11.1 Subjective health measurement

Also known as self-reported measures of health, subjective health measurement involves an individual's perception of his/her own health (Johnston, Propper and Shields, 2009). The collection and processing of this information depend largely on human judgment (Krabbe, 2016). On account of its simplicity and cost-effectiveness, subjective health measurement is widely used for individual and group assessments, as in population studies where the goal of the survey is to measure health status (Parrish, 2010b).

There are many different instruments for and ways of measuring self-reported health, depending on whether one measures well-being as a clinical outcome, a population health outcome, for cost-effective studies, or for other purposes (Dolan *et al.*, 2005; Tinkler and Hicks, 2011). The generally accepted outcome measure of health care encompasses the physical, psychological and social domains of health and is known as the Health-Related Quality of Life (HRQoL), which is a multidimensional subjective concept (Krabbe, 2016).

Several health status surveys are currently available, and the table below highlights their usage, duration of application, methods for scaling, reliability and validity (McDowell, 2006)

**Table 0.2** Health status surveys

| **Survey** | **Number of items** | **Application** | **Average self-administration time** | **Scale** | **Reliability** | **Validity** |
|---|---|---|---|---|---|---|
| Nottingham Health Profile (Hunt *et al.*, 1981) | 45 | Clinical, survey | 10-15 min | Interval | ** | ** |
| Functional status questionnaire (Jette *et al.*, 1986) | 34 | Clinical, screening | 15min | Ordinal | ** | ** |
| Duke Health Profile (Parkerson, Broadhead and Chiu-Kit, 1990) | 17 | Clinical | 5 | Ordinal | * | ** |
| EORTC Quality of Life Questionnaire QLQ-C30 (Scott *et al.*, 2008) | 30 | Clinical, Research | 12min | Ordinal | *** | *** |
| Quality of Life Index (Spitzer, 1980) | 5 | Clinical | 2min | Ordinal | ** | ** |
| Single-item Health Indicators (Andrews and Withey, 1976) | 1 | Survey | <1min | Interval | ** | ** |
| WHO Quality of Life Scale (The WHOQOL Group, 1996) | 100 | Clinical, Survey | 10-20min | Ordinal | *** | *** |

| | | | | | | |
|---|---|---|---|---|---|---|
| MOS SF-36 Health Survey (Ware *et al.*, 1994) | 36 | Survey | 10min | Likert | *** | *** |

KEY

* = The evidence suggests weak reliability or validity

** = Adequate reliability or validity

*** = Excellent reliability or validity: higher coefficients than those normally seen in other instrument

For this study, the SF-12v2 Health Survey was used. This section discusses the content and intended population and review studies conducted using the SF-12v2 Health survey.

**THE SF-12v2 HEALTH SURVEY**

The SF-12 health survey is a subset of 12-items from the SF-36 Health Survey that measures general health concepts. It can be a self-administered or interviewer-administered questionnaire (Ware, Kosinski and Keller, 1996b; Jenkinson *et al.*, 1997; Lam *et al.*, 2013). The SF-12 measures eight concepts, namely, physical functioning, role limitations owing to physical health problems, bodily pain, general health, vitality (energy/fatigue), social functioning, role limitations owing to emotional problems and mental health (psychological distress and psychological well-being) (Ware, Kosinski and Keller, 1995).

While the SF-12 health survey was developed in order to reduce respondent burden and time spent on the administration of questionnaires, it has been shown to be a reliable and valid tool in clinical and research settings (Larson, 2002). Vilagut *et al.* (2013) evaluated the performance of the Mental Component of the SF-12 and concluded that the SF-12 can be used as a screening tool for the monitoring and targeting of treatment and the prevention of affective disorders. In measuring the health outcomes of homeless people, Larson (2002) reported a 0.62 to 0.88 convergent validity coefficient of the SF-12.

SF-12 has been identified as an acceptable outcome measure for HRQoL among healthy population groups and those with different diagnoses (Gandek *et al.*, 1998; Lam, Tse and Gandek, 2005; Montazeri *et al.*, 2009). The reliability and validity study of SF12v2 showed that the physical (ICC 0.73) and mental (ICC 0.64) component summaries of the SF-12 demonstrated high and moderate test-retest reliability respectively and high internal consistency

(Cronbach's alpha and Mosier's alpha >0.8). It is therefore considered a vital tool in clinical settings and has been translated into several languages to suit research purposes conducted in various countries (Obtel *et al.*, 2013; Younsi, 2015).

### 2.11.2 Objective health measurement

In a study conducted to assess the health status of India's elderly population, (Cramm *et al.* (2015) reported that there is a weak relationship between objective health outcomes and subjective measures. Although the best approach to measure health is still debatable (Kaplan, 1989; Baker, Stabil and Deri, 2004; Wu *et al.*, 2013; Krabbe, 2016). As opposed to subjective health measurement, which is based on human judgement, there is no such subjective element in the collecting and processing of information in objective health measurement However, be what it may, the human element might come in when interpreting the quantitative reports (Mcdowell, 1989). From this, one should not assume, however, that reporting errors do not occur in objective health measurement.

Health indicators and clinical parameters such as blood pressure, respiratory rate, etc. are used to monitor changes in the health of an individual or a population (Wu *et al.*, 2013). In a study by Johnston, Propper and Shields (2009), it was observed that a large income/health gradient exists with objectively measured hypertension but not with self-reported hypertension. Other body measurements (anthropometry) also provide information on the nutritional and health status of an individual (Tovee, 2012)

According to the World Health Organization, anthropometry provides "the single most portable, universally-applicable, inexpensive and non-invasive technique for assessing the size, proportions and composition of the human body" (WHO, 2017). Basic anthropometric measurements such as height, weight, waist circumference, and hip circumference are combined in diverse computations to make up anthropometric indices (Frison *et al.*, 2016). These anthropometric indices (such as BMI, Waist to Height Ratio) can then be constructed into indicators which can be used to describe the nutritional or health status of a population and predict morbidity or mortality (WHO, 1995).

For the purpose of this study, the following anthropometric indices were observed:

**Body mass index (BMI):** the BMI of an individual is the weight (kg) of an individual divided by the square of his/her height (m). This is the most widely-used screening index in research and clinical studies to evaluate obesity, nutritional status and relevant diseases among a population (Chung, 2015). Several epidemiological studies (Jun, 2011; Jingya *et al.*, 2013; Peltzer *et al.*, 2014; Majeed, 2015) among university students employ the BMI to assess overweight/obesity level.

In a study involving university students from 22 countries, with participants between the ages of 16 to 30 years, the overall overweight/obesity prevalence was 22%, with men being more overweight than women (Peltzer *et al.*, 2014). Although some studies (Brunt, Rhee and Zhong, 2008; Kanter and Caballero, 2012) corroborate this finding, some other results (Romero-Corral and Somers, 2010; Ogden *et al.*, 2012) contradict this with a potential explanation that women have greater leptin concentrations than men (Romero-Corral and Somers, 2010). Nevertheless, this indicates that there are gender differences in the BMI levels of university students and a large preponderance of overweight/obesity

**Body adiposity index (BAI):** the BAI of an individual is calculated as *[hip circumference (cm) ÷ height (m)* $^{1.5}$*] − 18* It was developed in 2011, as a measure to estimate body fat percentage (BF%) and has been validated in African-American adults (Bergman *et al.*, 2011).

Among Colombian college students, a poor correlation was observed between BAI and body fat percentage based on Bioelectric Impedance Analysis (BAI) (Ramírez-Vélez *et al.*, 2017). Similarly, other studies (Freedman *et al.*, 2012; Sung, Oh and Lee, 2014; Ezeukwu *et al.*, 2015) have indicated that the estimates reported by the BAI underestimates and overestimates body fat at higher and lower percentages respectively.

**Waist to hip ratio (WHR):** the WHR is also a recent outcome measure for body fat distribution (Myint *et al.*, 2014), and is calculated by dividing the waist (cm) of the individual by the height (cm) (Guasch-Ferré *et al.*, 2012). The validity of the WHR as a measure of abdominal obesity was evaluated by (Owens *et al.* (1999) and results showed that WHR is a good predictor of intra-abdominal fat among obese members of the youth.

Likewise, (Doustjalali *et al.* (2016) found a positive correlation between BMI and WHR among undergraduate medical students at SEGi University (r=0.623). Although, the WHO places the standard ratio for cardio-metabolic health as >9.0 in men and >8.5 in women, WHR is highly age-dependent (Cole *et al.*, 2000)

**Waist to height ratio (WHtR):** the WHtR is an anthropometric index obtained from the ratio of waist circumference to height (Yoo, 2016). The WHtR has been identified as a cheaper, easier to use, and sensitive tool in detecting central adiposity and cardio-metabolic risks in children (Kuba, Leone and Damiani, 2013) and adults (Ashwell and Hsieh, 2005).

In a systematic review and meta-analysis by Ashwell, Gunn and Gibson, (2012) involving 31 publications, results showed that compared to WC and BMI, the WHtR was better at predicting obesity-related cardio-metabolic risk.

### 2.12 Summary of the literature review

This chapter presented significant elements of the literature selected for this study, focusing on the prevalence of physical activity and the health status of university students. The health benefits and barriers to participation in physical activity were discussed. This was followed by an analysis of the various measuring tools available for assessing physical activity and health. Studies on the health and anthropometric status of university students, especially in relation to physical activity levels, were reviewed.

# CHAPTER 3: METHODOLOGY

## 3.1 Introduction

This chapter introduces the materials and methods applied in this study. It describes the study design and setting, study population and the recruitment of participants, ethical considerations, data collection procedures, data management, and analysis.

## 3.2 Study design

A cross-sectional descriptive study design was used in this study because it is an appropriate cost-effective measure for epidemiological studies that provide adequate information from a large pool of participants (Olsen and St. George, 2004).

## 3.3 Study setting

The study was carried out at the School of Therapeutic Sciences, Faculty of Health Sciences, at the University of the Witwatersrand (WITS). The Faculty of Health Sciences is one of the five (Commerce, Law and Management; Engineering and the Built Environment; Health Sciences; Humanities; Science) faculties at University of the Witwatersrand. The Faculty of Health sciences is comprised of seven schools namely, School of Anatomical Sciences, School of Medicine, School of Oral Health Sciences, School of Pathology, School of Physiology, School of Public Health and the School of Therapeutic Sciences.

The School of Therapeutic Sciences is located at the Faculty of Health Sciences building at the University of the Witwatersrand, Health Sciences Campus in Parktown. It is made up of five departments which are:

(i) Department of Physiotherapy; located at the Khanya Block, Wits University Education Campus

(ii) Department of Occupational Therapy; located at the Khanya Block, Wits University Education Campus

(iii) Department of Pharmacy and Pharmacology; located on the 8$^{th}$ floor, Wits University Faculty of Health Sciences

(iv) Department of Nursing; located at the Department of Nursing Education, Marie Curie Theatre, Wits University Faculty of Health Sciences

(v) Department of Exercise Science and Sports Medicine; located at Wits University Education Campus

## 3.4 Study population

The study population was undergraduate students (first year to fourth year) at the school of Therapeutic Sciences, comprised of the departments of Physiotherapy, Occupational Therapy, Nursing, Biokinetics, Pharmacy and Pharmacology. The undergraduate programme in the Biokinetics Department serves second and third-year students only and were also included in the study.

**Inclusion Criteria**

Full-time registered Physiotherapy, Occupational Therapy, Pharmacy, Pharmacology, Nursing, and Biokinetics students at the University of the Witwatersrand.

**Exclusion Criteria**

Students who did not consent to be participants in the study.

Postgraduate students

## 3.5 Sample size calculation

The sample size was calculated using the formula by (Daniel and Cross (2013)

$$n = \frac{\{NZ^2 P(1-P)\}}{\{d^2(N-1) + Z^2 P(1-P)\}}$$

**Population size (*N*) = 960**

The population parameter was obtained from the course coordinators (1st year to 4th year) of the Departments of Physiotherapy, Occupational Therapy, Pharmacy and Pharmacology, Nursing and Biokinetics.

The table below presents the overall number of students in each department and their year of study at the School of Therapeutic Sciences.

**Table 0.1** Population size of School of Therapeutic Sciences

| Year of study | Physiotherapy | Occupational Therapy | Pharmacy | Nursing | Biokinetics |
|---|---|---|---|---|---|
| First | 74 | 73 | 97 | 37 | - |
| Second | 56 | 55 | 79 | 42 | 11 |
| Third | 50 | 71 | 89 | 36 | 5 |
| Fourth | 54 | 44 | 61 | 26 | - |
| TOTAL | 234 | 243 | 326 | 141 | 16 |

**Expected prevalence (*P*) = 0.3**

From previous studies, the prevalence of physical inactivity varies widely across regions (Pengpid *et al.*, 2015). In South Africa, current literature (Bloemhoff, 2010; Pengpid and Peltzer, 2013) places physical inactivity at 33%.

**Precision (*d*) = 0.05**

The Precision level (*d*) was selected according to the Expected prevalence level (*P*) (Pourhoseingholi, Vahedi and Rahimzadeh, 2013)

**Confidence level = 95%**

The confidence level was selected based on the theoretical ability of the analysis to produce accurate intervals. It is based on the postulation that 95% of the values will lie within two standard deviations of the mean (Daniel, 2001).

**Z static for level of confidence (*Z*) = 1.96**

This is determined by the level of confidence and is defined as “the approximate value of the 97.5 percentile point of the normal distribution” (OpenStax College, 2015)

$$\text{Sample size (n)} = \frac{960 * 1.96^2 * 0.3\ (1-0.3)}{0.05^2\ (960-1) + 1.96^2 * 0.3\ (1-0.3)}$$

$$\frac{774.46656}{3.204236} = 242$$

Therefore, the required sample size = 242

In order to ensure adequate representation from each department and year of study, the percentage ratio was calculated per department from the sample size calculated and subsequently calculated per class. The results of this calculation are presented below:

**Table 0.2** Percentage representations of departments in the School of Therapeutic Sciences

| Department | Population | Percentage (%) |
|---|---|---|
| Physiotherapy | 234 | 24.375 |
| Occupational Therapy | 243 | 25.313 |
| Pharmacy and Pharmacology | 326 | 33.958 |
| Nursing | 141 | 14.688 |
| Biokinetics | 16 | 1.667 |
| TOTAL | 960 | 100 |

Physiotherapy → (24.375/100) * 242 = 59

Occupational Therapy → (25.313/100) * 242 = 61

Pharmacy → (33.958/100) * 242 = 82

Nursing → (14.688/100) * 242 = 36

Biokinetics → (1.667/100) * 242 = 4

Total = 59+61+82+36+4 = 242

Therefore, the minimum of participants required per class is as presented below

**Table 0.3** Sample size required for each department and year of study

| Year of study | Physiotherapy | Occupational Therapy | Pharmacy | Nursing | Biokinetics |
|---|---|---|---|---|---|
| First | 19 | 18 | 25 | 9 | - |
| Second | 14 | 14 | 20 | 11 | 3 |
| Third | 13 | 18 | 22 | 9 | 1 |
| Fourth | 14 | 11 | 15 | 7 | - |
| TOTAL | 60 | 61 | 82 | 36 | 4 |

Students were sequentially approached to participate in the project until the minimum required number from each department could be recruited.

The stratified sampling technique was used because it helps identify a sample population that is representative of the strata in the population, the information retrieved can be used to highlight the specific groups within the population, and the relationships between the groups can be observed (Thompson, 2012)

## 3.6 Data collection tools and measurements used

### 3.6.1 Outcome measures/Questionnaires

**The International Physical Activity Questionnaire (IPAQ-SF)** (Appendix C) is a self-reported measurement tool for physical activity suitable for assessing physical activity and inactivity in a population (Booth, 2000). IPAQ-SF measures the physical activity levels of people aged 15 to 69 years and was coined from the long form IPAQ, which assesses activity levels across five domains (job-related, transportation, housework, recreation and time spent sitting), while the IPAQ-SF contains four generic items, and can be self-administered or administered via the telephone (Booth, 2000). Both questionnaires require information on the time spent on physical activities over the past seven days.

Between 1998 and 1999, the pilot testing of the IPAQ was carried out (Booth, 2000), and in the year 2000, a reliability and validity testing of the IPAQ was conducted in 12 countries (Craig *et al.*, 2003). Results revealed that the IPAQ questionnaires produced repeatable data (Spearman's p-value clustered around 0.8). The observed concurrent validity had a pooled p-value of 0.67 (95% CI 0.64–0.70) for comparisons between long and short forms and 0.58 (0.51–0.64) for comparisons of different short instruments. Likewise, similar to other self-reporting validation studies, criterion validity had a median p=value of 0.30, reporting a fair to moderate agreement between the IPAQ and the Computer Science and Application's Inc. (Shalimar, FL) accelerometer (CSA model 7164).

Subsequently, the IPAQ has been reproduced and modified to suit different study populations such as adolescents (Regaieg *et al.*, 2016), young adults (Quick *et al.*, 2016), urban and rural South African adults (Oyeyemi *et al.*, 2016), elderly adults (Tomioka *et al.*, 2011) and Nigerian university students (Awotidebe *et al.*, 2014) The IPAQ is therefore considered a reliable and validated tool for measuring physical activity amongst young adults at university (Craig *et al.*, 2003).

**Short Form (12) Health Survey (SF-12)** (Appendix D) by Ware, Kosinski and Keller, (1996) is a 12-item questionnaire derived as a subset of the SF-36 Health Survey, developed for the Medical Outcomes Study (MOS). It comprises the eight domains of health outcomes (physical functioning (PF), role-physical (RP), bodily pain (BP), general health (GH), vitality (VT), social functioning (SF), role-emotional (RE), and mental health) and is used to assess generic health outcomes.

The SF-12v2 reproduces the two aggregate summary scores of the SF-36, the Physical Component Summary (PCS) and the Mental Component Summary (MCS) and contains a Likert scale type (three-point scale, five-point scale and six-point scale) and categorical (yes or no) questions. The standard form uses a four-week recall period, while the acute form uses a one-week recall period and is more appropriate for use in circumstances where changes are expected to occur rapidly (Busija *et al.*, 2011).

In scoring the SF12v2, after data based on the raw scores had been entered, the items were re-coded such that the scores for four items, namely the General Health (GH), Bodily Pain (BP), Vitality (VT), and Item 6a of Mental Health (MH) were reversed to ensure that a higher value item would indicate better health. Following this, the raw scores were transformed based on the formula (Ware, 2002)

$$\text{Transformed score} = \left[\frac{\text{Actual raw score} - \text{lowest possible score}}{\text{possible raw score range}}\right] \times 100$$

The table below gives a brief description of the scores for each of the eight subscales in the SF12v2 (Younsi, 2015)

**Table 2.3** Aggregated scale items and range of possible scores

| SF 12v2 scale | Sum of final item values | Lowest and highest possible raw scores | Possible raw score range |
|---|---|---|---|
| Physical Functioning (PF) | 2a + 2b | 2,6 | 4 |
| Role Physical (RP) | 3a + 3b | 2,10 | 8 |
| Bodily Pain (BP) | 5 | 1,5 | 4 |
| General Health (GH) | 1 | 1,5 | 4 |
| Vitality (VT) | 6b | 1,5 | 4 |
| Social Functioning (SF) | 7 | 1,5 | 4 |
| Role Emotional (RE) | 4a + 4b | 2,10 | 8 |
| Mental Health (MH) | 6a + 6b | 2,10 | 8 |

Scoring the SF12v2 requires the use of population-based standardized values (Andersen *et al.*, 2007). Currently, population norms for South Africa and other African countries do not exist. Hence, the recommended 1998 general US population mean of 50 and a Standard Deviation of 10 is used as the reference scale to obtain the standard form of the SF12v2 in order to make cross-cultural comparisons of results an easier task (Gandek *et al.*, 1998). The scoring and linear transformation of the SF-12v2 scores involves the following steps (Ware *et al.*, 2002):

Obtain the standardized z-score for each scale using the formula below:

PF_Z = (PF – 81.18122) / 29.10558

RP_Z = (RP – 80.52856) / 27.13526

BP_Z = (BP – 81.74015) / 24.53019

GH_Z = (GH – 72.19795) / 23.19041

VT_Z = (VT – 55.59090) / 24.84380

SF_Z = (SF – 83.73973) / 24.75775

RE_Z = (RE – 86.41051) / 22.35543

MH_Z = (MH – 70.18217) /20.50597

Multiply the z-score of each SF12v2 scale by its respective physical and mental factor score coefficient to obtain the aggregate physical (AGG_PHYS) and mental (AGG_MENT) scores summary using the formula below:

AGG_PHYS = (PF_Z * 0.42402) + (RP_Z * 0.35119) + (BP_Z * 0.31754) + (GH_Z * 0.24954) + (VT_Z * 0.02877) + (SF_Z * -0.00753) + (RE_Z * -0.19206) + (MH_Z * -0.22069)

AGG_MENT = (PF_Z * -0.22999) + (RP_Z * -0.12329) + (BP_Z * -0.09731) + (GH_Z * -0.01571) + (VT_Z * 0.23534) + (SF_Z * 0.26876) + (RE_Z * 0.43407) + (MH_Z * 0.48581)

Transform the aggregate physical and mental summary scores into standard forms using the formula below:

Transformed Physical (PCS) = 50 + (AGG_PHYS *10)

Transformed Mental (MCS) = 50 + (AGG_MENT * 10)

In interpreting the scores obtained from the SF12v2 health survey, based on the US population norms, physical component summary (PCS) and mental component summary (MCS), scores between 47 and 53 reflect normal scores, while poorer health status is indicated by lower numerical values (Maruish and Kosinki, 2009). However, the Utah Department of Health posits that such numerical scores have little intuitive meaning, and rather suggests that the age-specific mean difference score is a better indicator of health status (Utah Health Survey, 1996)

**Measuring Instruments**

The following measuring instruments were used in collecting data for this research project:

**Yamax Digiwalker SW200 (Pedometer):** This two-dimensional pedometer was used to objectively track the number of steps taken. Earlier studies by (Tudor-Locke *et al.*, (2002) assessed correlations in output between the dual-mode CSA and Yamax pedometer and revealed a strong relationship between them (r = 0.74-0.86). Subsequently, in a comparative study of 13 pedometer models, the Yamax Digiwalker SW200 was used as the criterion pedometer (Schneider, Crouter and Bassett, 2004). On account of its accuracy and its ability to detect steps at an acceleration of ≥0.35g, the Yamax Digiwalker SW200 has been used in a number of epidemiological studies involving the evaluation of free-living physical activity (Schneider, Crouter and Bassett, 2004; Coffman *et al.*, 2016) and in persons with neurological conditions (Elsworth *et al.*, 2009). Being an affordable and portable (usually worn on the hip) device, the pedometer is considered a reliable and validated tool for intervention and observational studies of physical activity levels among young people (McNamara, Hudson and Taylor, 2010).

**Measuring tape**: This was used to measure the waist and hip circumference of the participants in centimetres (cm), with the participant standing.  The measurement was taken around the navel, midpoint between the last palpable rib in the mid-axillary line and the top of the iliac crest (de Onis and Habicht, 1996).

**Weighing scale**: This is a device used to measure weight. The participant was required to stands on the Nova analog weighing scale.  His/her weight was measured and recorded in kilograms (kg)

**Stadiometer:** This is a height-measuring device made up of a ruler and a movable headpiece placed on the head for measurement accuracy and safety. The height of each participant was measured and recorded to the nearest metre.

**Calculator:** This is an electronic device used for mathematical calculations. The calculator was used to derive the BMI by dividing the weight (in kilograms) of the participant by the square of height (in metres) measured.

**Blood pressure monitor**: This is a device used to measure blood pressure. It is composed of an inflatable cuff that collapses and releases the artery under the cuff in a controlled manner. The mechanical manometer measures the pressure and is displayed on the screen.

### 3.6.2 Measurements of Anthropometric Indices

**Weight measurement:** The weight of the participant was measured in kilograms (kg) using the weighing scale. The participants were instructed to stand on the scale, with the body weight evenly distributed on both feet.

**Height measurement: P**articipants were requested to take off their shoes and to stand erect on the stadiometer for the height measurement. Additional accessories such as caps and high hairpieces were removed. The height of the participant was measured by placing the ruler across the top of the head, and the readings were recorded in centimetres (cm).

**Waist and Hip circumference:** The waist, and hip circumferences were measured with the participant being minimally clothed. An inelastic tape-measure, placed at the level of the umbilicus and the widest point over the greater trochanters respectively, was used. The measurements were taken to the nearest centimetre.

**BMI:** for each participant, the weight in Kg was divided by the square of the participant's height in metres.

**BAI:** unlike the BMI, the BAI is calculated using the hip circumference rather than the weight. It is obtained using the formula: hip circumference divided by height$^{1.5}$ minus 18.

**Waist to Hip Ratio:** This was calculated by dividing the waist circumference in centimetres by the hip circumference in centimetres.

**Waist to Height ratio:** the waist circumference in centimetres was divided by the height in centimetres of each participant.

### 3.6.3 Recording sheets

**Bio-data form**: This form contains the demographic data of the respective participants (age, gender, Department and year of study) and the measured data of height, weight, BMI and blood pressure (Appendix E).

**Daily Activity Sheet**: This form was used to keep daily records of the number of steps taken (Appendix E)

## 3.7 Procedure

### 3.7.1 Pilot study

The pilot study was carried out by administering the International Physical Activity Questionnaire long form (IPAQ-LF) and the Short Form 36 Health Survey (SF-36).

**Aim of the pilot study**

To determine the feasibility of the main study

To evaluate the efficacy of the research instrument

**Objectives of the pilot study**

The objective of the pilot study was to test the adequacy of the research instruments, researcher and participants in achieving the outlined objectives of the study and to identify potential challenges for improvement where necessary (Gardner *et al.*, 2003). Hence, the pilot study aimed to determine the ease of understanding and response time required to fill in the questionnaires by the participants.

**Sample population for pilot study**

The sample size of 10 percent of the calculated total sample size was used for the pilot study.

A total number of 30 students participated in the pilot study: eight second-year nursing students, eight second-year Pharmacy students, five fourth-year Pharmacy students, six fourth-year Physiotherapy students and three third-year Occupational Therapy students were approached during lunch breaks and participated in the pilot study.

**Procedure for the pilot study**

Undergraduate students were selected conveniently over their lunch hour from the Medical School at the University of the Witwatersrand.

Participants were approached by the researcher at the canteen on the fourth floor of the Medical School, at the lecture theatres on the fifth floor and at the Khanya block on the Wits Parktown Education campus to confirm that they were undergraduate students of the university and that they were willing to participate in the pilot study.

The location was selected by convenience as it is a common converging point for the students.

Participants were informed of the objectives of the study by the researcher and invited to sign the consent form and fill in the questionnaires. IPAQ and SF-12 forms were administered by the researcher.
Oral feedback was requested by the participants on their opinions on the questionnaires

**Findings from pilot study**

- Participants experienced no difficulty in reading and understanding the questions for both questionnaires.
- Participants complained about the length of time spent filling in each questionnaire, explaining that it took too much time to fill out both questionnaires, as the IPAQ contained 27 questions and the SF-36 contained 36 questions.
- It was proposed that the short form of both the IPAQ and SF-12 be used for the main study, as this would reduce the respondents' burden.
- It was also proposed that the researcher should get in touch with the course representatives and course coordinators to schedule details such as the time, date, and venue that would be appropriate for arranging to meet the students and to invite them to participate in the study

### 3.7.2 Main study

A fourth-year student from the Department of Physiotherapy was recruited as a research assistant to help with data collection twice a week for six weeks. The research assistant was skilled at taking blood pressure and anthropometric measurements, and therefore assisted with these measurements.

Permission was sought from the heads of the departments, and information on the teaching and clinical timetable was obtained. Contact was made with the class coordinators from each discipline to confirm the most suitable date and time to approach the students. An appropriate time and date were established for data collection.

Data collection commenced on the first week of the students' fourth teaching block (September, 2017) and was completed at the end of the first week of examinations (November, 2017).

Owing to the wide range of departments and the year/s of study of the participants, the timetable varied per class. The researcher kept a mini-calendar of the pre-scheduled dates, times and venues to contact the students.

During the visits to each class, the objectives and procedure of the study were explained to the class, and the students were invited to participate in the study

Participants who consented to the study were invited to fill in the biodata form and the SF-12 health status form. (Appendix D)

The blood pressure of the participants was measured on the left arm by the research assistant and recorded in the biodata form.

The participants were then asked to take off their shoes for their height and weight measurements to be taken.

Measurements were then taken of their waist/hip circumference with the participants being minimally clothed in accordance with the ACSM's Guideline for Anthropometric Measurements.

The researcher distributed the pedometers and administered the SF-12 questionnaires. The pedometers were coded to tally with the study number assigned to each questionnaire and biodata form. Participants were then assigned a pedometer to be worn on either hip, whenever they were awake, for a period of seven days, and the daily number of steps was to be recorded on a sheet of paper by the participants.

An appointed date and time was scheduled following on an agreement between the researcher and the participants when the pedometers would be returned and the IPAQ forms completed.

At the end of seven days, the pedometers were returned and the completed IPAQ forms were submitted by the participants.

### 3.8 Data analysis

The data was captured in an Excel format and analysed using the Statistical Package for the Social Sciences (SPSS), version 22, with significance p-value set at $< 0.05$. The data were cleaned and tested for normality using the Shapiro-Wilk W test. It was shown that the distribution of the data was not normal. Hence, non-parametric tests were used in the analysis. Based on these assessments, the appropriate statistical tests were conducted, as shown in the table below:

**Table 0.4** Outcome measures and statistical tests used in the study

| S/N | Objective | Outcome Measure | Type of Data | Statistical Test |
|---|---|---|---|---|
| 1 | To determine the physical activity level of undergraduate students of the School of Therapeutic Sciences at University of the Witwatersrand. | IPAQ<br>Number of steps by pedometer | Continuous<br>Categorical | Frequencies<br>Means and Standard Deviation<br>Median<br>Interquartile range<br>Mann-Whitney U<br>Kruskal Wallis |
| 2 | To determine the health status and anthropometric indices of undergraduate students of the School of Therapeutic Sciences at University of the Witwatersrand. | SF-12<br>Height<br>Weight<br>Waist circumference<br>Hip circumference<br>Waist to hip ratio<br>BMI<br>Blood pressure | Nominal<br>Interval<br>Continuous | Means and standard deviation<br>Frequencies |
| 3 | To determine the relationship between physical activity levels and the health status of undergraduate students of the School of Therapeutic Sciences at University of the Witwatersrand | IPAQ and SF-12 | Ranked<br>Ordinal<br>Continuous | Spearman Rho's correlation |

| | | | | |
|---|---|---|---|---|
| 4 | To determine the relationship between physical activity levels and anthropometric indices of undergraduate students of the School of Therapeutic Sciences at University of the Witwatersrand | IPAQ<br>Pedometer number of steps<br>BMI<br>Waist circumference<br>Hip circumference<br>Waist to hip ratio<br>Blood pressure | Continuous | Spearman Rho's correlation |

### 3.9 Ethical considerations

Ethical approval (Appendix F) was sought from the Ethics and Research Committee at the University of the Witwatersrand (No. M170424).

Permission was obtained from the Head of the School of Therapeutic Sciences, the Assistant Dean of Teaching and Learning, and the respective Therapeutic Science Departments (Physiotherapy, Occupational Therapy, Nursing, Biokinetics, Pharmacy, and Pharmacology) at the University of the Witwatersrand (Appendix G).

The informed consent of the participants was obtained by asking students for their signatures. The information included explicit information on the aims and objectives of the research. The right of withdrawal, anonymity, and confidentiality of information was explained to the participants.

### 3.10 Summary of the methodology

This is a cross-sectional study to determine the physical activity levels and health status among university students. It was achieved using both questionnaires and objective measurements

The physical activity levels were determined using pedometers that reported the number of steps taken over a period of seven days. Furthermore, a physical activity questionnaire, the IPAQ, was completed for participants to self-report as to how much time they had spent being physically active over the past seven days.

Their health status was determined using the SF-12 Health Status form, version 2 (SF12v2) and anthropometric measurements were taken.

# CHAPTER 4: RESULTS

## 4.1 Introduction

This study aimed to determine the physical activity level and health status of undergraduate students of the School of Therapeutic Sciences at University of the Witwatersrand. Physical activity levels were measured using a pedometer (SW-200) to measure the number of steps of each participant over a seven-day period. The daily number of steps was recorded, and the average was calculated. Subsequently, upon return of the pedometer, a self-report of their physical activity levels over the past seven days was obtained through responses from the short form of the International Physical Activity Questionnaire (IPAQ-SF). A once-off measurement of the blood pressure and anthropometric indices of the participants was obtained at the beginning of the study, and anthropometric variables were calculated thereafter. The SF-12 Health survey was used to obtain information on the health status of the participants.

The results are presented in three parts. Part A – sociodemographic data, Part B – data on physical activity level and health status, Part C – exploring the relationships between physical activity and health status, and between physical activity and anthropometric indices. This chapter also presents results of physical activity predictors. 263 participants were recruited into the study based on the sample size calculations illustrated in Figure 4.1

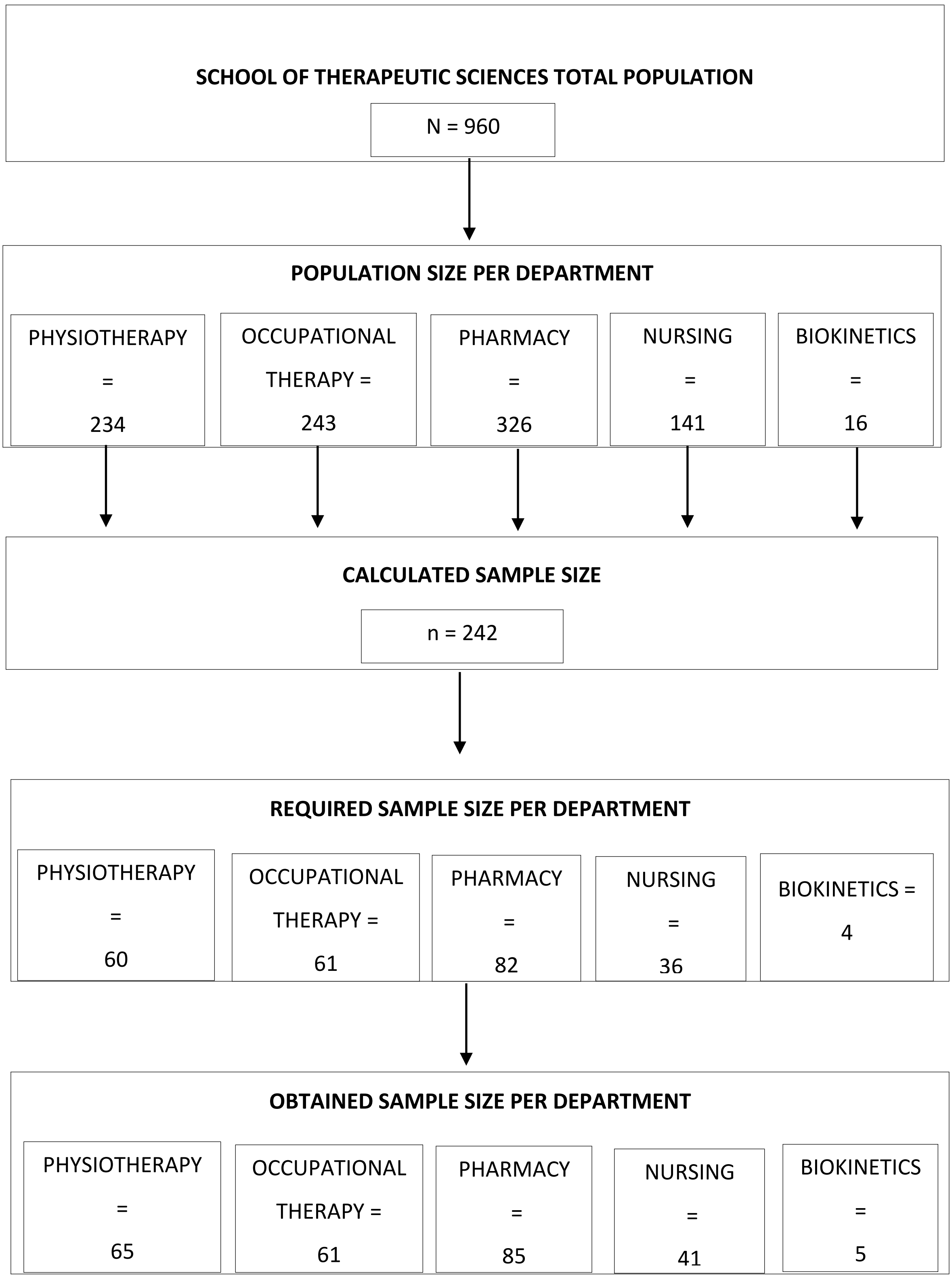


**Figure 0.1** Participants recruited into the study per department

## TEST FOR NORMALITY OF DATA

The Shapiro-Wilk test was used to test for normality of the data. The result obtained is illustrated in the table below:

**Table 0.1** Test for normality of data

| Physical activity | Statistic | Df | Sig. |
|---|---|---|---|
| Total IPAQ score | 0.924 | 260 | 0.000 |
| Average number of steps | 0.970 | 260 | 0.000 |

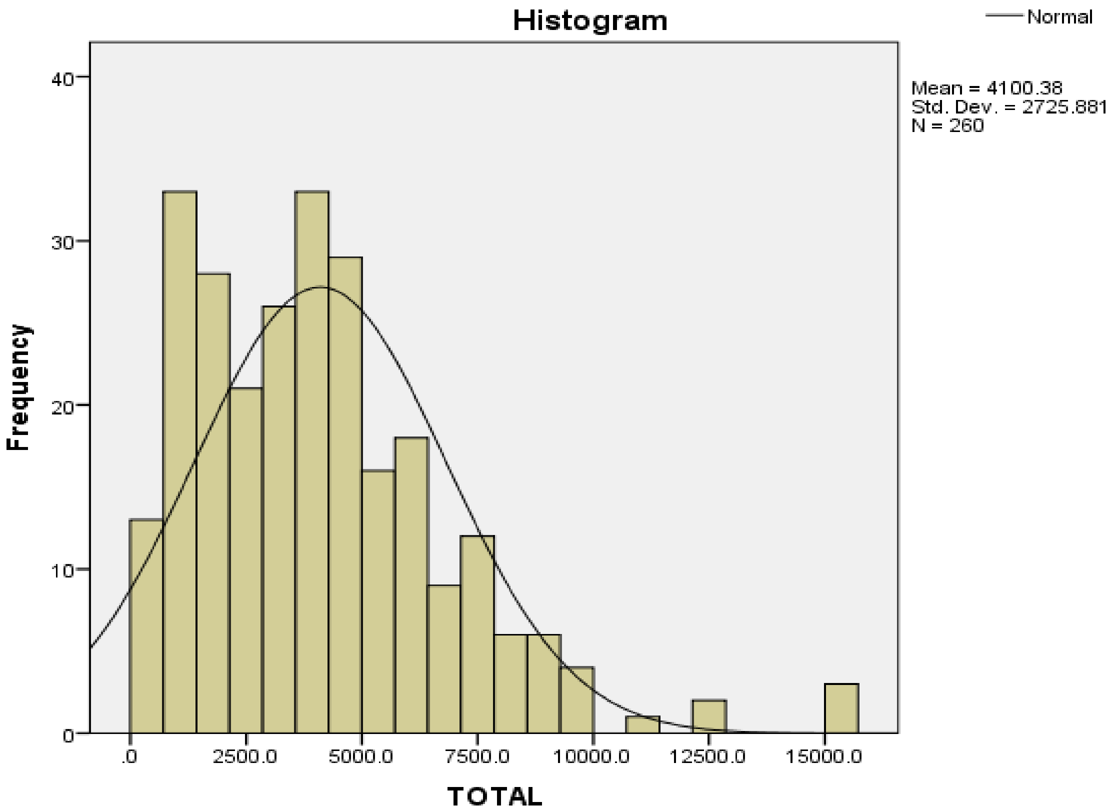


**Figure 0.2** Test for normality of data

The data from the outcome measures were not normally distributed ($p<0.05$). Based on this assessment, non-parametric statistical tests were used to analyse the data.

## PART A: SOCIO-DEMOGRAPHIC DATA

### 4.2 Socio-demographic profile of participants

Table 4.2 shows the socio-demographic characteristics of the sample. Participants in this study were male and female undergraduate students (first year to fourth year) in the school of Therapeutic Sciences, University of the Witwatersrand

**Table 0.2** Socio-demographic profile of participants (n = 263)

| **Age** | Median (IQR) | 20 (18-25) |
|---|---|---|
| **Variables** | **n** | **(%)** |
| **Gender** | | |
| Male | 48 | 18.25 |
| Female | 215 | 81.75 |
| **Department** | | |
| Physiotherapy | 65 | 24.75 |
| Occupational Therapy | 67 | 25.48 |
| Pharmacy | 85 | 32.32 |
| Nursing | 41 | 15.59 |
| Biokinetics | 5 | 1.90 |
| **Year of study** | | |
| First | 73 | 27.76 |
| Second | 65 | 24.71 |
| Third | 68 | 25.86 |
| Fourth | 57 | 21.67 |

Majority (81.75%) of the participants were females. Pharmacy and Occupational Therapy students account for 32.32% and 25.48% of the participants respectively. Similarly, most of the participants were first-year (27.76%) students while the least number of participants were from the fourth year of study (n = 57).

In Table 4.3, the socio-demographic profile of the participants is presented according to the departments that comprise the School of Therapeutic Sciences at University of the Witwatersrand.

**Table 0.3** Socio-demographic profile of participants by department (n = 263)

| Variables | Physiotherapy n (%) | Occupational therapy n (%) | Pharmacy n (%) | Nursing n (%) | Biokinetics n (%) |
|---|---|---|---|---|---|
| **Gender** | | | | | |
| Male | 18 (27.69) | 2 (2.99) | 21 (24.71) | 6 (14.63) | 1 (20.00) |
| Female | 47 (72.31) | 65 (97.01) | 64 (75.29) | 35 (85.37) | 4 (80.00) |
| **Year of study** | | | | | |
| First | 19 (29.23) | 18 (26.87) | 28 (32.94) | 8 (19.51) | * |
| Second | 16 (24.62) | 14 (20.90) | 20 (23.53) | 11 (26.83) | 4 (80.00) |
| Third | 15 (23.08) | 19 (28.36) | 22 (25.88) | 11 (26.83) | 1 (20.00) |
| Fourth | 15 (23.08) | 16 (23.88) | 15 (17.65) | 11 (26.83) | * |

*The Centre for Exercise Science and Sports Medicine (CESSM) only offer the undergraduate Biokinetics program to second and third-year students. Therefore, there were no participants recruited from first and fourth year in Biokinetics department.

As outlined in Table 4.3, there were more female participants (97.01%) in the occupational therapy department in comparison to other departments. Except for nursing and occupational therapy department, the majority of participants from each department were first-year students.

## PART B: PHYSICAL ACTIVITY AND HEALTH DATA

### 4.3 Prevalence of physical activity levels

The first objective of the study was to determine the physical activity levels of undergraduate therapeutics science students at University of the Witwatersrand. Table 4.4 shows the participants' median scores of physical activity based on the two outcome measures used in the study which were the IPAQ scores and number of steps measured by the pedometer.

**Table 0.4** Physical activity level of participants by socio-demographic variables (n = 263)

| **Variables** | **IPAQ (MET-min/week)** | **Pedometer (Number of steps)** |
|---|---|---|
| **Gender** | Median (IQR) | Median (IQR) |
| Male | 4460 (2271 - 6964) | 6094 (4778 - 7489) |
| Female | 3573 (1773 - 5256) | 6044 (4893 - 7475) |
| **Department** | | |
| Physiotherapy | 4515 (2085 - 6360) | 7261 (6007 - 8758) |
| Occupational Therapy | 3465 (1440 - 4959) | 6563 (5411 - 7840) |
| Pharmacy | 3531 (1596 - 5376) | 5534 (4620 - 6859) |
| Nursing | 4092 (2772 -- 4932) | 5371 (4259 - 6362) |
| Biokinetics | 2613 (2034 - 3732) | 5738 (5140 - 7926) |
| **Year of study** | | |
| 1 | 3810 (2034 - 5184) | 6637 (5131 - 7765) |
| 2 | 3354 (1440 - 4718) | 6042 (4615 - 7568) |
| 3 | 4185 (2489 - 5955) | 6017 (4763 - 7630) |
| 4 | 3960 (1933 - 6360) | 6019 (5190 - 6803) |
| **Total** | 3855 (1866 - 5493) | 6057 (4828 - 7482) |

Using both the IPAQ scores and number of steps measured by the pedometer, males (IPAQ score = 4460, number of steps = 6094) were more active than females (IPAQ score = 3573, number of steps = 6044). Overall, participants from physiotherapy department had the highest physical activity scores (IPAQ score = 4515, number of steps = 7261). While nursing students took the least number of steps (5371), students from Biokinetics department had the lowest IPAQ scores (2613). Third year students had the highest IPAQ score (4185) but took the least number of steps (6017).

Figure 4.3 shows the physical activity levels of the participants based on the number of steps and IPAQ category classification of sedentary, low, moderate and vigorous

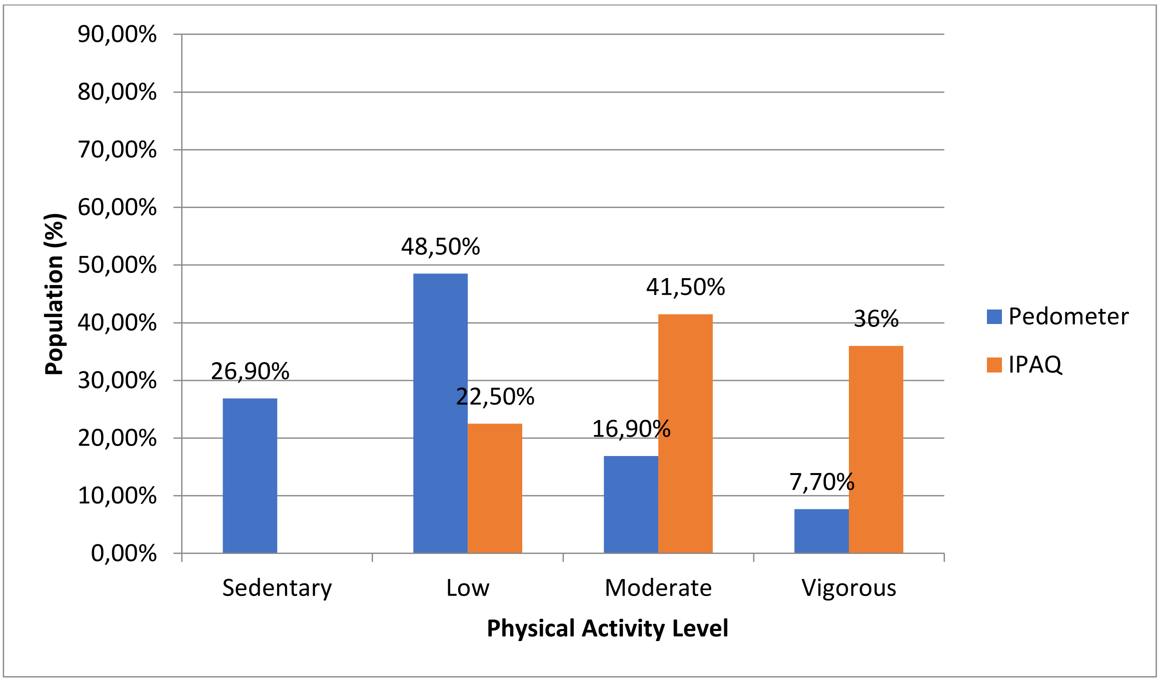


**Figure 0.3** Physical activity level of the participants

According to the number of steps measured using the pedometer, 26.9% of this population are sedentary (i.e. take less than 5000 steps a day). Based on categorization by number of steps, majority (48.5%) of the population were classified as engaging in low physical activity. However, the IPAQ classification showed that majority (41.5%) of the participants engaged in moderate physical activity.

Table 4.5 outlines the association between physical activity and sociodemographic variables. Mann-Whitney U was used to explore the association between physical activity and gender, while Kruskal Wallis test statistic was used to test the association between physical activity and department, and physical activity and year of study of the participants.

**Table 0.5** Association between sociodemographic groups and physical activity level (n = 263)

| Variables | IPAQ | | Number of steps | |
|---|---|---|---|---|
| | **Mann-Whitney U** | **p-value** | **Mann-Whitney U** | **p-value** |
| **Gender** | 4203.00 | 0.045* | 4944.500 | 0.896 |
| | **Kruskal Wallis** | **p-value** | **Kruskal Wallis** | **p-value** |
| **Department** | 4.675 | 0.322 | 32.682 | 0.000* |
| **Year of study** | 3.554 | 0.314 | 1.837 | 0.607 |

There is a significant association between the IPAQ scores and gender ($p<0.05$). There is also a significant association between the number of steps taken and the departments of the participants ($p<0.05$)

Table 4.6 explores the intraclass correlation coefficient of the two outcome measures (IPAQ and number of steps) of physical activity used in the study

**Table 0.6** Intraclass correlation between IPAQ scores and number of steps

| | | 95% Confidence Interval | |
|---|---|---|---|
| | **Intraclass correlation** | **Lower Bound** | **Upper Bound** |
| **Average measures of physical activity scores** | 0.489 | 0.347 | 0.600 |

There is a moderate agreement (ICC = 0.489) between the IPAQ scores and the number of steps measured by the pedometer

## 4.4 Health status

The second objective of the study was to determine the health status of undergraduate therapeutics science students at University of the Witwatersrand. The outcome measures used in the study was the SF-12 Health Survey. Figure 4.3 illustrates the overall mean score for each subscale, and the health summary measures of the SF-12

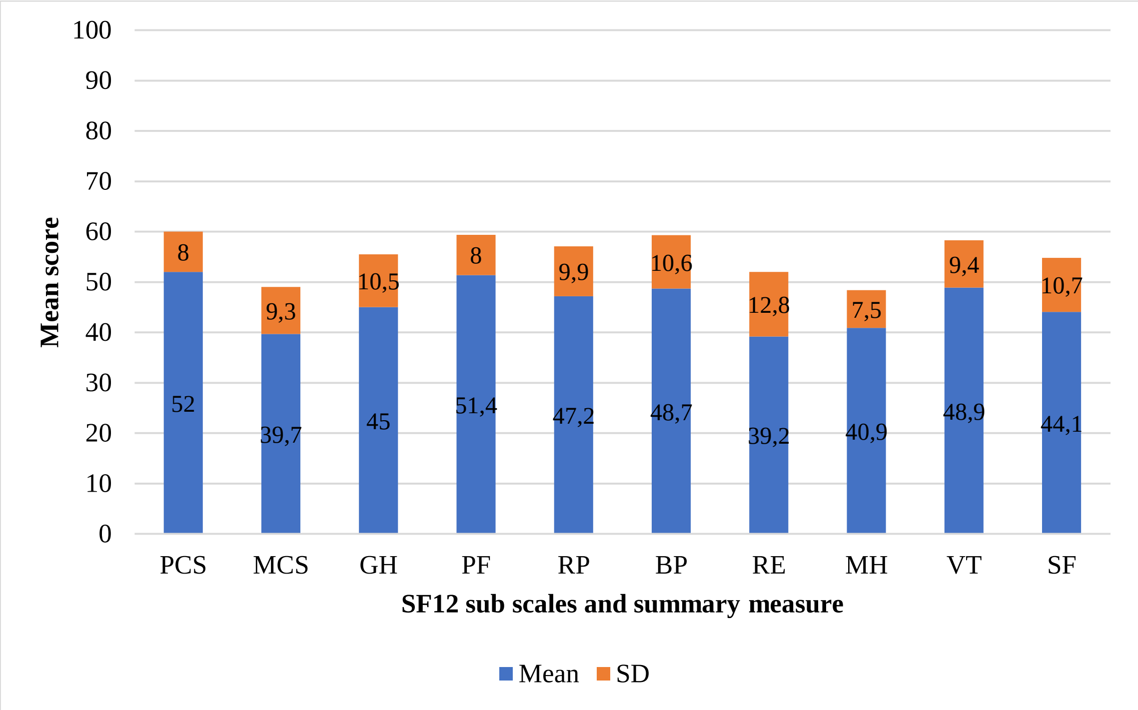


**Figure 0.4** SF-12 Health status of all the participants (n = 263)

KEY :

PCS – Physical Component Summary

MCS – Mental Component Summary

GH – General Health

PF – Physical Functioniing

RP – Role Physical

BP – Bodily Pain

RE – Role Emotional

MH – Mental Health

VT – Vitality

SF – Social Functioning

The mean Physical Component Summary (PCS) and Mental Component Summary (MCS) scores of participants in this study were 52.02 and 39.67 respectively. Participants in this study scored the least in Role Emotional (39.24), and the highest score (51.37) was in the Physical Functioning domain

Table 4.7 presents the health status of the participants based on gender. The SF-12v2 health survey scores of both the physical and mental health summary measures, as well as each of the eight-subscale profile are reported. Independent samples t-test was used to determine the significant difference in the mean health status scores between males and females.

**Table 0.7** Health status of participants by gender (n = 263)

| Health status | Male | Female | p-value |
|---|---|---|---|
| **Physical Component Summary** | 53.74±5.87 | 51.76±8.35 | 0.07 |
| **Mental Component Summary** | 42.94±6.93 | 38.89±9.63 | 0.00* |
| **General Health** | 49.15±10.21 | 44.13±10.46 | 0.01* |
| **Physical Functioning** | 53.85±6.24 | 50.91±8.07 | 0.01* |
| **Role Physical** | 48.86±8.77 | 46.90±10.12 | 0.37 |
| **Bodily Pain** | 49.02±11.63 | 48.69±10.45 | 0.86 |
| **Role Emotional** | 44.90±10.28 | 38.09±13.00 | 0.00* |
| **Mental Health** | 42.15±5.90 | 40.73±7.83 | 0.25 |
| **Vitality** | 51.25±9.30 | 48.60±9.31 | 0.11 |
| **Social Functioning** | 46.03±10.42 | 43.80±10.75 | 0.27 |

Mental component summary (MCS) scores show a statistically significant difference in scores between males and females (p=0.00). Similarly, a significant difference in scores between males and females was observed in the general health (GH), physical functioning (PF) and role emotional (RE) dimensions. Overall, both males and females scored the highest in the physical functioning (PF) dimension, while the lowest scores for males was observed in the mental health (MH) dimension (42.15±5.90), females scored lowest in the role emotional (RE) category (38.09±13.00).

The health status of participants in this study categorised per department is described in Table 4.8. The mean scores of the physical component summary (PCS), mental components summary (MCS) and each subscale are presented. Analysis of variance (ANOVA) was used to determine the existence of statistical differences across the departments.

**Table 0.8** Health status of participants by department (n = 263)

| Health status | Physiotherapy | Occupational Therapy | Pharmacy | Nursing | Biokinetics | p-value |
|---|---|---|---|---|---|---|
| **Physical Component Summary** | 54.55±6.82 | 51.43±7.31 | 51.08±8.27 | 50.12±9.19 | 58.52±6.62 | 0.78 |
| **Mental Component Summary** | 40.74±10.30 | 39.02±9.88 | 40.97±8.50 | 37.03±7.85 | 33.71±8.40 | 0.04* |
| **General Health** | 47±10.20 | 43.39±10.77 | 45.35±9.66 | 42.74±12.06 | 51.21±5.90 | 0.88 |
| **Physical Functioning** | 54.09±4.43 | 50.82±7.70 | 50±9.64 | 50.18±8.59 | 56.47±7.94 | 0.64 |
| **Role Physical** | 49.10±9.67 | 46.45±10 | 46.82±9.74 | 45.15±10.34 | 53.49±8.24 | 0.64 |
| **Bodily Pain** | 51.17±9.82 | 49.84±8.75 | 47.61±11.28 | 45.26±11.89 | 47.25±12.48 | 0.51 |
| **Role Emotional** | 41.28±13.71 | 38.97±12.42 | 39.96±12.63 | 35.21±12.44 | 37.07±7.50 | 0.27 |
| **Mental Health** | 41.94±8.80 | 41.25±7.72 | 40.80±7.23 | 39.86±5.61 | 37.72±3.34 | 0.29 |
| **Vitality** | 51.31±8.61 | 47.60±8.31 | 49.17±10.32 | 47.01±9.65 | 45.74±8.42 | 0.55 |
| **Social Functioning** | 46.78±9.61 | 43.30±11.15 | 44.09±10.64 | 41.30±10.86 | 42.43±15.31 | 0.05 |

The difference in scores among departments was statistically significant for the mental component summary (p=0.04). Overall, participants from Biokinetics department had the highest physical component summary score (58.52±6.62) and lowest mental component summary (33.71±8.40) scores. The lowest score among the subscales was observed in the role emotional (RE) category among participants from nursing department (35.21±12.44).

The health status of participants in this study categorised per year of study is described in Table 4.9. The mean scores of the physical component summary (PCS), mental components summary (MCS) and each subscale are presented. Analysis of variance (ANOVA) was used to determine the existence of statistical differences across the years of study

**Table 0.9** Health status of participants by year of study (n = 263)

| Health status | 1st year | 2nd year | 3rd year | 4th year | p-value |
|---|---|---|---|---|---|
| **Physical Component Summary** | 54.55±6.82 | 51.43±7.31 | 51.08±8.27 | 50.12±9.19 | 0.78 |
| **Mental Component Summary** | 40.74±10.30 | 39.02±9.88 | 40.97±8.50 | 37.03±7.85 | 0.04* |
| **General Health** | 47±10.20 | 43.39±10.77 | 45.35±9.66 | 42.74±12.06 | 0.88 |
| **Physical Functioning** | 54.09±4.43 | 50.82±7.70 | 50.00±9.64 | 50.18±8.59 | 0.64 |
| **Role Physical** | 49.10±9.67 | 46.45±10 | 46.82±9.74 | 45.15±10.34 | 0.64 |
| **Bodily Pain** | 51.17±9.82 | 49.84±8.75 | 47.61±11.28 | 45.26±11.89 | 0.51 |
| **Role Emotional** | 41.28±13.71 | 38.97±12.42 | 39.96±12.63 | 35.21±12.44 | 0.27 |
| **Mental Health** | 41.94±8.80 | 41.25±7.72 | 40.80±7.23 | 39.86±5.61 | 0.29 |
| **Vitality** | 51.31±8.61 | 47.60±8.31 | 49.17±10.32 | 47.01±9.65 | 0.55 |
| **Social Functioning** | 46.78±9.61 | 43.30±11.15 | 44.09±10.64 | 41.30±10.86 | 0.05 |

Mental component summary (MCS) scores show a statistically significant difference in scores across the year of study (p=0.04). Overall, first year students the highest scores in all domains of the SF-12. The lowest score among the subscales was observed in the role emotional (RE) category among fourth year students (35.21±12.44).

Table 4.10 outlines the association between health status and sociodemographic variables. Mann-Whitney U was used to explore the association between health status and gender, while Kruskal Wallis test statistic was used to test the association between health status and department, and health status and year of study of the participants.

**Table 0.10** Associations between sociodemographic groups and health status

| **Variables** | **PCS** | | **MCS** | |
|---|---|---|---|---|
| | **Mann-Whitney U** | **p-value** | **Mann-Whitney U** | **p-value** |
| **Gender** | 4596.500 | 0.237 | 3952.000 | 0.011* |
| | **Kruskal Wallis** | **p-value** | **Kruskal Wallis** | **p-value** |
| **Department** | 13.623 | 0.009* | 9.951 | 0.041* |
| **Year of study** | 3.971 | 0.265 | 6.492 | 0.090 |

There is a significant association between gender and the mental component summary (MCS) scores of the participants ($p<0.05$). There is also a significant association between participants' department and their health status scores (PCS and MCS).

### 4.5 Anthropometric description

Table 4.11 shows the blood pressure and anthropometric indices of participants in this study based on gender. Independent samples t-test was used to determine the significant difference in the mean scores between males and females.

**Table 0.11** Blood pressure and anthropometric variables by gender (n = 263)

| Health status | Male | Female | p-value |
|---|---|---|---|
| **Systolic Blood Pressure** | 120.69±15.44 | 112.59±11.55 | 0.001* |
| **Diastolic Blood Pressure** | 74.50±8.35 | 72.32±8.24 | 0.099 |
| **Height** | 1.68±0.07 | 1.61±0.07 | 0.000* |
| **Weight** | 68.22±11.08 | 62.16±11.72 | 0.001* |
| **Waist Circumference** | 79.04±8.47 | 76.84±9.40 | 0.136 |
| **Hip Circumference** | 95.99±8.16 | 96.02±10.13 | 0.986 |
| **Body Mass Index** | 24.11±3.53 | 23.94±4.00 | 0.791 |
| **Body Adiposity Index** | 26.26±4.24 | 29.04±4.87 | 0.000* |
| **Waist to Hip Ratio** | 0.82±0.04 | 0.80±0.05 | 0.007* |
| **Waist to Height Ratio** | 47.03±4.81 | 47.73±5.41 | 0.405 |

Males had a significantly higher systolic blood pressure than females ($p<0.05$). There exists a significant difference in height, weight, body adiposity index and waist to hip ratio between males and females.

Table 4.12 shows the blood pressure and anthropometric indices of participants in this study based on department. Analysis of variance (ANOVA) was used to determine the existence of statistical differences across the departments

**Table 0.12** Blood pressure and anthropometric variables by department (n = 263)

| Variables | Physiotherapy | Occupational Therapy | Pharmacy | Nursing | Biokinetics | p-value |
|---|---|---|---|---|---|---|
| **SBP** | 117.31±13.63 | 114.66±12.18 | 111.69±11.72 | 112.15±12.04 | 120.20±21.11 | 0.050 |
| **DBP** | 71.22±7.58 | 72.55±8.50 | 73.71±8.64 | 72.76±7.07 | 77.40±15.14 | 0.291 |
| **Height** | 1.64±0.09 | 1.63±0.07 | 1.60±0.06 | 1.63±0.08 | 1.65±0.07 | 0.017* |
| **Weight** | 63.83±12.54 | 64.42±11.82 | 61.95±10.44 | 64.01±13.35 | 56.76±11.51 | 0.475 |
| **Waist Circumference** | 77.31±8.54 | 78.28±9.72 | 76.29±8.76 | 78.17±10.54 | 71.00±8.47 | 0.352 |
| **Hip Circumference** | 95.11±9.39 | 97.73±10.31 | 94.93±8.90 | 97.38±11.11 | 91.70±8.96 | 0.246 |
| **BMI** | 23.68±3.40 | 24.19±4.14 | 24.20±3.92 | 23.96±4.24 | 20.90±4.03 | 0.416 |
| **BAI** | 27.52±4.60 | 28.93±4.95 | 28.99±4.70 | 28.80±5.36 | 26.20±5.40 | 0.256 |
| **WHR** | 0.81±0.05 | 0.80±0.05 | 0.80±0.05 | 0.80±0.06 | 0.77±0.06 | 0.371 |
| **WHeightRatio** | 47.25±4.49 | 47.99±5.57 | 47.71±5.42 | 47.88±5.82 | 43.08±4.36 | 0.353 |

There is a significant difference in heights across departments ($p<0.05$). Participants from Biokinetics department were the tallest (1.65±0.07) while Pharmacy students were the shortest (1.60±0.06). Participants from occupational therapy and pharmacy had the same mean waist to height ratio scores.

Table 4.13 shows the blood pressure and anthropometric indices of participants in this study based on their year of study. Analysis of variance (ANOVA) was used to determine the existence of statistical differences across the years of study

**Table 0.13** Blood pressure and anthropometric variables by year of study (n = 263)

| Variables | First year | Second year | Third year | Fourth year | p-value |
|---|---|---|---|---|---|
| **SBP** | 112.10±12.33 | 111.65±12.34 | 115.91±12.53 | 117.16±13.14 | 0.029* |
| **DBP** | 72.05±7.51 | 72.97±8.77 | 73.46±8.39 | 72.40±8.67 | 0.767 |
| **Height** | 1.63±0.07 | 1.63±0.08 | 1.62±0.06 | 1.61±0.08 | 0.551 |
| **Weight** | 64.05±10.67 | 62.72±12.33 | 62.72±12.33 | 62.04±13.03 | 0.726 |
| **Waist Circumference** | 78.08±8.84 | 76.53±9.03 | 77.27±8.68 | 76.95±10.77 | 0.793 |
| **Hip Circumference** | 96.92±9.02 | 96.05±10.21 | 95.70±9.79 | 95.17±10.38 | 0.773 |
| **BMI** | 24.14±3.72 | 23.49±3.71 | 24.41±3.94 | 23.78±4.36 | 0.553 |
| **BAI** | 28.74±4.60 | 28.28±4.97 | 28.52±4.89 | 28.56±5.18 | 0.960 |
| **WHR** | 0.80±0.05 | 0.80±0.05 | 0.80±0.06 | 0.80±0.06 | 0.555 |
| **WHeightRatio** | 47.98±5.24 | 46.95±4.93 | 47.75±4.92 | 47.70±6.22 | 0.705 |

There is a significant difference in systolic blood pressure across departments ($p<0.05$). Fourth year students had the highest systolic blood pressure (117.16±13.14), while second year students had the least systolic blood pressure (111.65±12.34)

The blood pressure of each participant was measured and classified according to the WHO hypertension categories. The percentage population for each gender is represented in the chart below

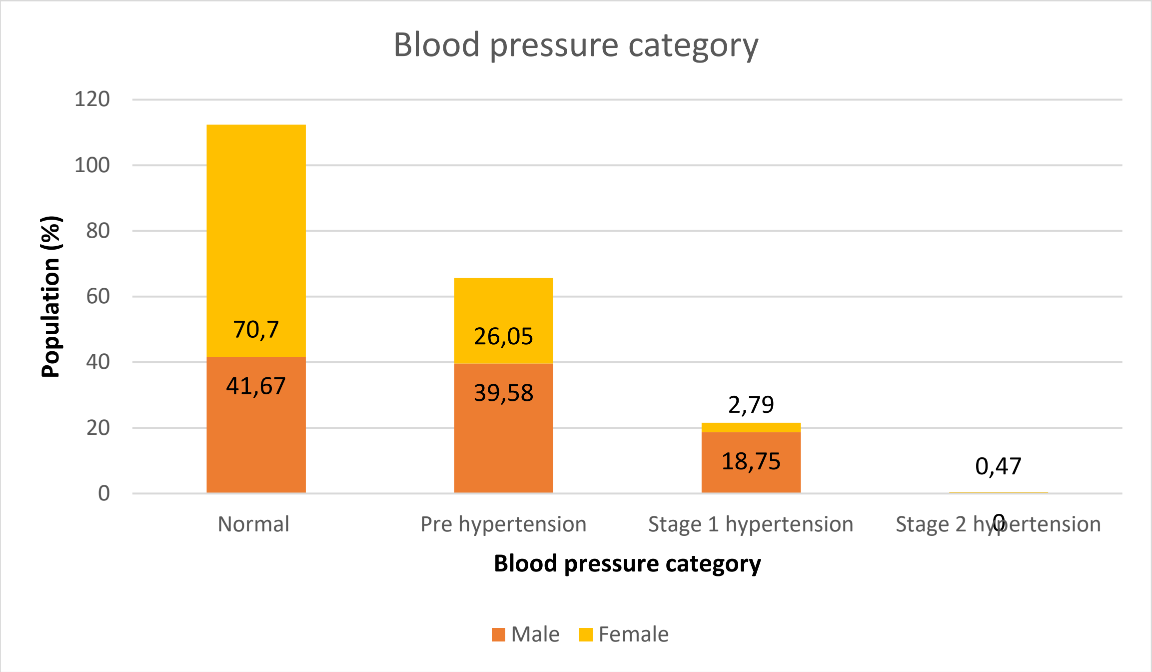


**Figure 0.5** Blood pressure of the participants (n = 263)

Majority of the participants fell into the category of normal blood pressure. 0.47% of the population had stage 2 hypertension.

Table 4.14 outlines the association between blood pressure and sociodemographic variables. Mann-Whitney U was used to explore the association between blood pressure and gender, while Kruskal Wallis test statistic was used to test the association between blood pressure and department, and health status and year of study of the participants.

**Table 0.14** Association between socio-demographic group and blood pressure (n = 263)

| **Variables** | **Systolic blood pressure** | | **Diastolic blood pressure** | |
|---|---|---|---|---|
| | **Mann-Whitney U** | **p-value** | **Mann-Whitney U** | **p-value** |
| **Gender** | 3623.000 | 0.001* | 4234.000 | 0.052 |
| | **Kruskal Wallis** | **p-value** | **Kruskal Wallis** | **p-value** |
| **Department** | 8.646 | 0.071 | 4.377 | 0.357 |
| **Year of study** | 9.226 | 0.026* | 0.433 | 0.933 |

There is a significant association between gender and systolic blood pressure, and between year of study and systolic blood pressure ($p<0.05$)

Figure 4.6 shows the anthropometric distribution of the participants in the study based on obesity levels categorization of body mass index (BMI), body adiposity index (BAI) and waist to height ratio (WtHeight)

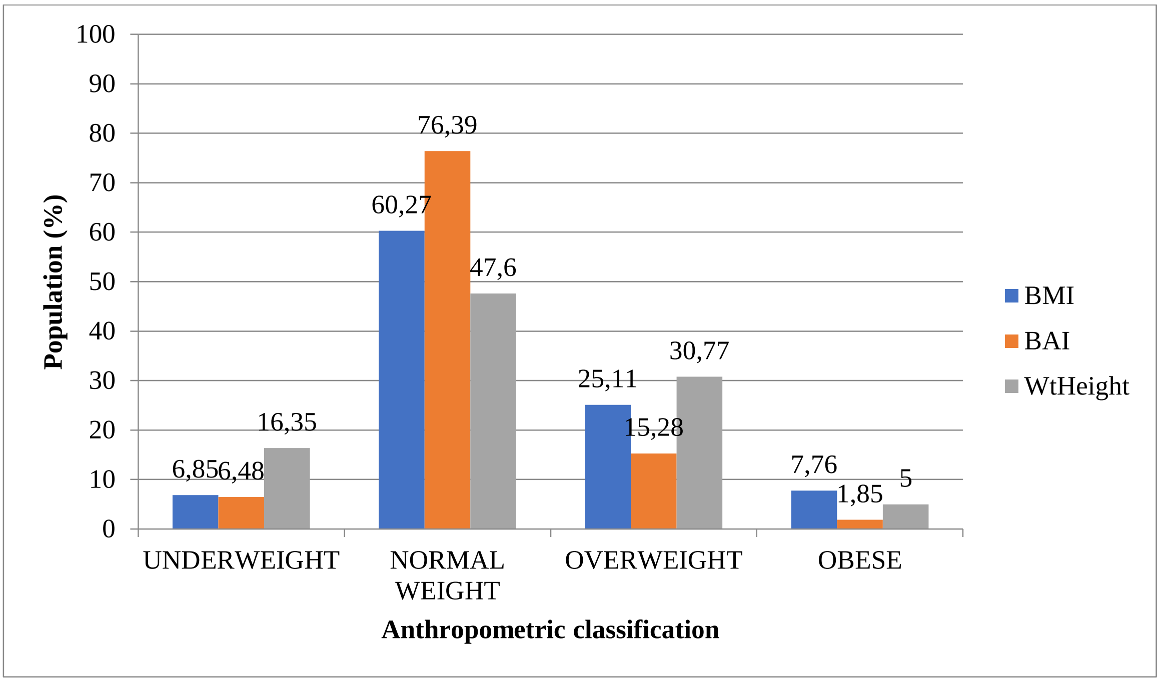


**Figure 0.6** Anthropometric description of the participants (n = 263)

Based on BMI, BAI and waist-to-height ratio, a majority of the participants had normal weight. Based on BMI, 6.85% of the participants were underweight. However, the prevalence of overweight and obesity were 25.11% and 7.76% respectively according to BMI criteria

Table 4.15 outlines the association between anthropometric indices and sociodemographic variables. Mann-Whitney U was used to explore the association between anthropometric indices and gender, while Kruskal Wallis test statistic was used to test the association between anthropometric indices and department, and health status and year of study of the participants.

**Table 0.15** Association between socio-demographic group and anthropometric indices (n = 263)

| Variables | Waist circumference | | Hip circumference | | BMI | |
|---|---|---|---|---|---|---|
| | **Mann-Whitney U** | **p-value** | **Mann-Whitney U** | **p-value** | **Mann-Whitney U** | **p-value** |
| **Gender** | 4248.500 | 0.056 | 4938.000 | 0.641 | 4955.000 | 0.667 |
| | **Kruskal Wallis** | **p-value** | **Kruskal Wallis** | **p-value** | **Kruskal Wallis** | **p-value** |
| **Department** | 3.088 | 0.543 | 3.125 | 0.537 | 2.991 | 0.559 |
| **Year of study** | 1.161 | 0.762 | 1.541 | 0.673 | 1.926 | 0.588 |

This study found no significant association between sociodemographic variables and anthropometric indices.

**PART C: CORRELATIONS**

The third objective of this study was to determine the relationship between physical activity and health status among undergraduate students of the School of Therapeutic Sciences. Spearman's rho was used to explore the relationship between the physical activity levels (measured by the total IPAQ scores and the average number of steps measured by the pedometer) and the health status (measured by the SF12v2 health survey). Table 4.16 below shows the result of the statistical test

**Table 0.16** Relationship between physical activity and health status

| | IPAQ scores (MET-min/week) | | Pedometer (steps/day) | |
|---|---|---|---|---|
| | **Spearman rho** | **p-value** | **Spearman rho** | **p-value** |
| **Physical Component Summary** | 0.123 | 0.048* | 0.067 | 0.284 |
| **Mental Component Summary** | -0.048 | 0.442 | -0.056 | 0.368 |
| **General Health** | 0.089 | 0.152 | 0.054 | 0.387 |
| **Physical Functioning** | 0.127 | 0.040* | 0.096 | 0.122 |
| **Role Physical** | 0.052 | 0.401 | 0.025 | 0.685 |
| **Bodily Pain** | 0.044 | 0.477 | -0.026 | 0.677 |
| **Role Emotional** | 0.039 | 0.530 | -0.058 | 0.352 |
| **Mental Health** | 0.004 | 0.951 | 0.065 | 0.296 |
| **Vitality** | 0.032 | 0.603 | 0.018 | 0.769 |
| **Social Functioning** | -0.099 | 0.108 | 0.004 | 0.950 |

There is a significant positive relationship between the MET of physical activity, based on IPAQ scores and the physical component summary (PCS) of health status ($r_s$=0.123, p=0.048). There is also a significant relationship between IPAQ scores and physical functioning ($r_s$=0.123, p=0.040). There is a weak correlation ($r_s$<0.40) between SF-12 health status and physical activity scores

## 4.6 Relationship between physical activity and anthropometric indices

The relationship between physical activity and anthropometric indices was tested using the Spearman's rho statistical test. The results are shown in Table 4.17

**Table 0.17** Relationship between physical activity and anthropometric indices

| | IPAQ scores (MET-min/week) | | Pedometer (steps/day) | |
|---|---|---|---|---|
| | **Spearman rho** | **p-value** | **Spearman rho** | **p-value** |
| **Systolic blood pressure** | -0.030 | 0.626 | 0.082 | 0.187 |
| **Diastolic blood pressure** | -0.057 | 0.361 | -0.044 | 0.478 |
| **Waist circumference** | 0.033 | 0.599 | -0.030 | 0.630 |
| **Hip circumference** | 0.004 | 0.955 | 0.041 | 0.515 |
| **BMI** | -0.027 | 0.667 | -0.022 | 0.728 |
| **BAI** | -0.070 | 0.259 | -0.018 | 0.771 |
| **Waist to height ratio** | -0.006 | 0.925 | -0.072 | 0.247 |
| **Waist to hip ratio** | 0.094 | 0.132 | -0.085 | 0.172 |

This study found no significant relationship between the physical activity levels and anthropometric indices of participants. There is a weak negative correlation between BMI and physical activity, and between blood pressure and physical activity ($r_s$<0.40)

## 4.7 Relationship between physical and mental health status and anthropometric indices

Correlation between health status and anthropometric indices was determined using Spearman rho's correlation test. The result is depicted in the Table 4.18

**Table 0.18** Relationship between health status and anthropometric indices

| | PCS | | MCS | |
|---|---|---|---|---|
| | **Spearman rho** | **p-value** | **Spearman rho** | **p-value** |
| **Systolic blood pressure** | -0.033 | 0.590 | 0.015 | 0.807 |
| **Diastolic blood pressure** | -0.030 | 0.623 | -0.110 | 0.075 |
| **Waist circumference** | 0.033 | 0.599 | -0.030 | 0.630 |
| **Hip circumference** | -0.070 | 0.255 | -0.033 | 0.592 |
| **BMI** | -0.108 | 0.080 | -0.015 | 0.811 |
| **BAI** | -0.076 | 0.219 | -0.121 | 0.050 |
| **Waist to height ratio** | -0.073 | 0.240 | 0.014 | 0.817 |
| **Waist to hip ratio** | 0.015 | 0.810 | 0.150 | 0.015* |

There is a significant relationship between mental component summary (MCS) of health status and the waist to hip ratio. No relationship was found between health status and other anthropometric indices ($p>0.05$). This study found weak correlations ($r_s<0.40$) between blood pressure, anthropometric indices and SF-12 Health Status

## PREDICTORS OF PHYSICAL ACTIVITY

Physical activity was measured using two outcome measures, IPAQ and the Number of steps Univariate linear regression was used to determine the factors that influence physical activity level among participants.

**Table 0.19** Univariate linear regression

| | IPAQ | | | | NUMBER OF STEPS | | | |
|---|---|---|---|---|---|---|---|---|
| | Beta | 95%CI | | Sig. | Beta | 95%CI | | Sig. |
| | | Lower Bound | Upper Bound | | | Lower Bound | Upper Bound | |
| **Demographics** | | | | | | | | |
| Age | -0.006 | -207.658 | 188.470 | 0.924 | -0.108 | -288.552 | 17.311 | 0.082 |
| Gender | 0.116 | -32.315 | 1685.034 | 0.059 | 0.023 | -548.001 | 803.066 | 0.710 |
| Department | -0.069 | -482.518 | 134.258 | 0.267 | -0.314 | -842.991 | -386.555 | 0.000* |
| Year of study | 0.103 | -45.495 | 553.227 | 0.096 | -0.070 | -367.184 | 99.493 | 0.260 |
| **Blood pressure** | | | | | | | | |
| Systolic | -0.031 | -32.916 | 19.711 | 0.622 | 0.090 | -5.378 | 35.423 | 0.148 |
| Diastolic | -0.061 | -60.368 | 20.264 | 0.328 | -0.039 | -41.319 | 21.320 | 0.530 |
| **Health status** | | | | | | | | |
| PCS | 0.130 | 3.156 | 86.334 | .035* | 0.051 | -19.068 | 45.915 | 0.417 |
| MCS | -0.058 | -52.888 | 18.801 | 0.350 | -0.078 | -45.492 | 10.065 | 0.210 |
| GH | 0.087 | -8.975 | 54.440 | 0.159 | 0.070 | -10.483 | 38.975 | 0.258 |
| PF | 0.107 | -4.725 | 78.403 | 0.082 | 0.060 | -16.621 | 48.121 | 0.339 |
| RP | 0.073 | -13.572 | 53.736 | 0.241 | 0.018 | -22.532 | 30.233 | 0.774 |
| BP | 0.057 | -16.873 | 46.336 | 0.360 | -0.053 | -35.261 | 13.865 | 0.392 |
| RE | 0.040 | -17.585 | 34.577 | 0.522 | -0.048 | -28.168 | 12.365 | 0.443 |
| MH | -0.021 | -52.174 | 36.978 | 0.737 | -0.023 | -41.057 | 28.191 | 0.715 |
| VT | -0.004 | -37.062 | 34.445 | -0.943 | -0.041 | -37.002 | 18.510 | 0.512 |
| SF | -0.113 | -60.036 | 1.974 | 0.066 | 0.027 | -18.976 | 29.628 | 0.666 |
| **Anthropometrics** | | | | | | | | |
| WC | 0.056 | 0.000 | 0.001 | 0.365 | -0.016 | -0.001 | 0.000 | 0.795 |
| HC | 0.023 | 0.000 | 0.001 | 0.708 | 0.050 | 0.000 | 0.001 | 0.421 |
| BMI | -0.034 | -109.170 | 61.778 | -0.586 | 0.000 | -66.564 | 66.221 | 0.996 |
| BAI | -0.036 | -89.178 | 48.078 | -0.556 | 0.005 | -51.060 | 55.788 | 0.931 |
| Waist to Height ratio | 0.026 | -49.538 | 76.647 | 0.285 | -0.045 | -67.216 | 30.859 | 0.466 |
| Waist to Hip ratio | 0.066 | -2881.340 | 9758.802 | 0.285 | -0.104 | -9101.028 | 710.929 | 0.093 |

There is a significant positive correlation between IPAQ scores and physical component summary (PCS) with Beta = 0.130, $p < 0.05$. there is a negative correlation between number of steps by pedometer and department of participants with Beta = -0.314, $p < 0.05$. The low value of the Beta coefficient suggests that physical activity is weakly dependent on demographics, blood pressure, health status and anthropometric indices. Therefore, other factors may influence physical activity level.

Multivariate linear regression was used to predict the value of IPAQ scores based on the value of the SF-12 scores and socio-demographic variables. The result of the variables that fit into the model is presented in Table 4.20

**Table 0.20** Multivariate linear regression for IPAQ

| | **Standardized Coefficients** | **95% Confidence Interval** | | **Sig.** |
|---|---|---|---|---|
| | **Beta** | **Lower Bound** | **Upper Bound** | |
| **PCS** | 0.146 | 8.352 | 91.753 | 0.018* |
| **Social Functioning** | -0.131 | -64.459 | -2.546 | 0.034* |

Using the multivariate linear regression (stepwise method), physical component summary and social functioning dimensions of health status were predictors of IPAQ scores ($p<0.05$). The beta coefficient of social functioning was negative, indicating that for every one unit increase in social functioning score, the IPAQ score will decrease by 0.13 units. Other factors were excluded due to their collinearity (Appendix N)

Multivariate linear regression was used to predict the value of number of steps based on the value of the SF-12 scores and socio-demographic variables. The result of the variables that fit into the model is presented in Table 4.21

**Table 0.21** Multivariate linear regression for number of steps

| | **Standardized Coefficients** | **95% Confidence Interval** | | **Sig.** |
|---|---|---|---|---|
| | **Beta** | **Lower Bound** | **Upper Bound** | |
| **Age** | -0.116 | -290.156 | -2.069 | 0.047* |
| **Department** | -0.352 | -918.951 | -460.703 | 0.000* |
| **Bodily Pain** | -0.129 | -49.340 | -2.475 | 0.030* |
| **Waist to Hip ratio** | -0.126 | -9708.759 | -468.133 | 0.031* |

The predictors of physical activity as measured by number of steps was department of the students, bodily pain, waist to hip ratio and age. Age, department, bodily pain and waist to hip ratio had negative beta coefficients, suggesting that for every one unit decrease in each of these variables, there is a corresponding increase in number of steps. A one unit decrease in age and waist to hip ratio increases the number of steps by 0.12 and 0.13 respectively ($p<0.05$). Other factors were excluded due to their collinearity (Appendix O)

### 4.8 Summary of the results

A total of 263 undergraduate students of the School of Therapeutic Sciences participated in this study. This study had more female participants (81.75%) than male participants (18.25%). Majority (32.32%) of participants were from the Pharmacy department. Participants in this study had a median IPAQ score of 3855 MET-min/week and took 6057 steps. Based on the IPAQ categorical score, 22.5% of the participants engaged in low physical activity. The SF-12 Health Survey mean Physical Component Summary (PCS) and Mental Component Summary (MCS) scores of the participants in this study were 52.02 and 39.67 respectively.

There was a significant relationship between the IPAQ scores of physical activity and the physical component summary (PCS) of the SF12- Health Survey. No relationship was found between physical activity and anthropometric indices.

When analysed independently (univariate linear regression), the department from which the students were students were studying was shown to be a predictor of number of steps, while physical component summary (PCS) was shown to predict IPAQ score. Multivariate linear regression revealed that physical component summary (PCS) and social functioning (SF) were predictors of IPAQ score, while age, department, bodily pain and waist to hip ratio had significant negative correlation with number of steps.

# CHAPTER 5: DISCUSSION

## 5.1 Introduction

This chapter discusses the results obtained in answer to the objectives. The objectives of the study were to determine the physical activity levels and health status among undergraduate students of the School of Therapeutic Sciences at University of the Witwatersrand. Furthermore, the relationships between physical activity, health status and anthropometric indices were explored.

## 5.2 Physical activity

Measurement of physical activity levels in this study using the IPAQ revealed that 22.5%, 41.5% and 36% of the students engaged in low, moderate and vigorous physical activity respectively. The average number of steps achieved by participants in this study over a seven-day period ranged from 1 703 to 14 575, and the overall mean number of steps taken was 6 630±2 090. This value is higher than the results of Althoff et al., (2017) in which the average number of steps taken by South Africans was reported to be 4 105, and the overall average applicable to 717 527 people in 111 countries across the globe was 4 961 steps. The reason for this disparity could be that Althoff et al., (2017) involved participants from all age groups and anonymously collated large-scale data from Apple iPhone users. In contrast, the sample population in our study included university students between the ages of 17 and 28. Since those in the 18-29 age group were identified as the most physically active (Townsend *et al.*, 2015), it is no surprise that they would achieve a larger number of steps as opposed to the general population.

In our study, the number of steps taken by all participants was measured using a pedometer (Yamax Digiwalker-SW200) over a seven-day period. This was unlike the study by Althoff et al., (2017), in which participants used the Azumio Argos application (a physical- activity and health-tracking application) on their smartphones for at least 10 days. The difference in the average number of steps reported could be because of the difference in the tools measuring the physical activity levels.

Relationship between the number of steps and physical activity levels was assessed. The results showed a moderate correlation (ICC = 0.489) between physical activity levels measured by number of steps and physical activity levels measured by the IPAQ. Comparable results were obtained by Regaieg *et al.*, (2016) in their study to assess the reliability and concurrent validity of the International Physical Activity Questionnaire for Adolescents (IPAQ-A) in Tunisian overweight and obese youths. Their study revealed a significant relationship between the IPAQ-A scores and the pedometer step count ($r=0.66$, $p<0.001$). Therefore, the choice of outcome measures for physical activity depends largely on the objective of the study. Although the pedometer serves as an objective measure of physical activity, it is relatively more expensive than subjective measures such as questionnaires, which are more suitable for large cross-sectional studies. Furthermore, other advanced objective tools such as accelerometers, fit bits and heart rate monitors are being increasingly used to monitor and improve physical activity levels (Heyward and Gibson, 2014).

The use of different technologies such as escalators, television sets, computers and vehicles in developed countries and urban areas may contribute to the increased physical inactivity levels and sedentary behaviour of the residents (Bauman et al., 2009). Dumith et al., (2011) measured the worldwide prevalence of physical inactivity and reported that an estimated 20% of the world's population is inactive. The most recent report of the Human Development Index (HDI) for developed and less-developed countries put the prevalence of physical inactivity at 27.8% and 18.7% respectively, thus indicating that the rate of physical inactivity in developing countries is increasing at a high rate (Larouche, 2014).

Physical activity levels have been measured in Africa and elsewhere using the IPAQ (Pengpid and Peltzer, 2013; Pengpid *et al.*, 2015). The results show that physical inactivity prevalence was highest at 50.5% in Southeast Asia, followed by 37.2% in South America and 37.1% in sub-Saharan Africa.

It may be prudent to be cautious when making deductions about these figures as there is a dearth of data in developing countries as opposed to the extensive data that can be accessed in developed countries. Specifically, physical activity levels among university students vary widely, with 22% reported in Malaysia (Rajappan, Selvaganapathy and Liew, 2015) and 31.2% in Brazil (Fontes and Vianna, 2009). In a cross-sectional study by Pengpid and Peltzer (2013), in which 4 460 participants were recruited from universities in Cameroon, the Ivory Coast, Madagascar, Mauritius, Nigeria and South Africa, the results showed that 37.1% of the undergraduates engaged in a low level of physical activity according to the IPAQ categorization.

The results for low levels of physical activity among university students are comparatively higher than the results from our finding (23.94%): - 10.6% for Nigeria (Awotidebe *et al.*, 2014) and 26.8% for Cameroon (Pengpid *et al.*, 2015), 33% for the University of Limpopo, (Pengpid and Peltzer, 2013), and 33% University of the Free State (Bloemhoff, 2010). Similarly, physical activity levels among undergraduate students in the University of Venda were found to be 34.3%, 61.7% and 4% for the low, moderate and vigorous categories respectively (Mohlala and Ramalivhana, 2014)

One can therefore conclude from the physical activity levels among students generally that South African students are no different when comparisons are made with the prevalence rates of physical activity determined from other studies (Bloemhoff, 2010; Dhurup and Garnett, 2011; Walter, Du Randt and Venter, 2011). Since males had higher physical activity levels (44.68% moderate; 42.55% vigorous) than females (40.76% moderate; 34.60% vigorous) and took more steps (6 497) as opposed to those by females (6 370), this study exposed gender disparities in the prevalence of physical activity. Although this trend is persistently found in the literature (Hands *et al.*, 2016; Telford *et al.*, 2016), the reason for this disparity is unknown. A possible explanation may be that, as opposed to males, fewer females participate in organized sports as a result of the existing gender stereotyping pertaining to sports. Time constraints and cultural demands such as domestic work may also inhibit females from engaging in extra-curricular physical activities.

Besides gender, there are other factors that might influence the participation in physical activities such as age, occupation and geographical location (Hallal *et al.*, 2012; Pengpid *et al.*, 2015). Although the participants in this study were from a single geographical location, variations in physical activity were observed in association with the university department to which they were attached and with their particular class-level. Participants from the Physiotherapy Department, for instance, reported a larger number of steps (7 261) and IPAQ scores (4 515) than students from other departments. This could be because the Physiotherapy degree demands a lot of activity and its practical sessions involve less sedentary activities.

Dabrowska-Galas *et al.*, (2013) reported similar results in their study of physical activity among students at the Medical University of Silesia in Poland. High physical activity levels were reported among 46% of the physical therapy students, 22% of the medical students, 10% of the pharmacy students, and eight percent of the nursing students. However, this does not translate into the fact that physiotherapy students worldwide hold higher physical activity levels than students from other departments. In fact, in a study by Gorner, Boraczynski and Stihec (2009), it was found that physiotherapy students had lower physical activity levels than physical education students. A number of other factors such as age and health status could be responsible for this variation.

Multivariate linear regression revealed that the physical component summary ($\beta=0.146$, $p<0.05$) and the social functioning ($\beta=-0.131$, $p<0.05$) of the SF-12 Health Status Survey are significant predictors of IPAQ scores, while age, department, health status (bodily pain) and waist-to-hip ratio are significant predictors of the number of steps taken. Similarly, among the 1 750 students at the University of Zagreb, (Pedišić *et al.*, 2014) there were reports of a significant positive relationship between leisure-time physical activity and the physical component summary ($\beta=0.10$ and $\beta=0.08$ for males and females respectively). It is important to note that although there is a significant relationship between both variables (physical activity and health status), the Beta coefficient is low ($\beta<0.40$), thereby indicating a weak predictive ability. The reason could be that there are many confounding variables as well as the fact that the students are young and should be relatively healthy.

### 5.3 Health status and anthropometric indices

Our results show that 46.12% of the students in the School of Therapeutic Sciences scored below the mean of the study population (52.02 ± 7.98) for the physical component summary (PCS), while 47.91% scored below the mean of the study population (39.67 ± 9.32) for the mental component summary (MCS). Although these results compare well with the mean PCS scores observed in nine European countries (Gandek *et al.*, 1998), the overall MCS score, on the other hand, was comparatively lower than that observed in the study by Gandek *et al.*, (1998).

Geographical, and therefore contextual differences may therefore be responsible for the differences observed in the research results, as has been shown by the fact that the mean summary scores for Europe and the United States differ (Ware, Kosinski and Keller, 1996a), thus indicating the influence of variations according to the country in question. This hypothesis is supported by Jakobsson (2007) who posited that despite the availability and reliability of the SF-12 Index, the intended structure may differ from the factor structure in some countries.

Among the eight domains making the sub-scales of the SF-12 Survey, participants in this study achieved the highest scores for physical functioning (PF) (51.37) and the lowest scores for role emotional (RE) (39.24), indicating that they fared better at performing moderate activities like moving a table or climbing several flights of stairs but were limited in their work or daily activities as a result of emotional problems.

Similar to this study result is the finding from Oztasan, Ozyrek and Kilic (2016), in which participants scored the highest in the bodily pain (BP) and physical functioning (PF) domain, while the lowest scores were obtained in the mental health (MH) and the role emotional (RE) domains. This finding is consistent with the work of Domantay (2014) among medical students in the Philippines, where it was reported that participants tended to score the highest in the physical functioning (PF) domain.

It is interesting to note that students continue to perform well physically but not emotionally. Literature has shown that many students have reported that they experience an increased prevalence of anxiety, depression and emotional problems (Paro *et al.*, 2010; Domantay, 2014; Oztasan, Ozyrek and Kilic, 2016). These emotional problems if not properly managed may lead to a breakdown in physical and social health (Bhandari, 2012; Domantay, 2014). According to social scientists, emotional support may promote or inhibit physical functioning among individuals (Umberson and Montez, 2010)

Lins *et al.*, (2015) reported comparable results among students from a private medical school in Brazil in which the physical component summary (PCS) and mental component summary (MCS) scores reported were 50.4±6.9 and 42.0±11.7 respectively. In contrast, Fallahzadeh and Mirzaei (2012) reported relatively higher values for the physical and mental composite summary scores (70.1±12.3 and 58.3±11.3 respectively), while lower scores (PCS = 48.92±7.93; MCS = 43.44±9.52) were reported by Oztasan, Ozyrek and Kilic, (2016).

Consistent with almost all of the literature (Paro *et al.*, 2010), however, is the finding that females tend to score lower on the quality of life category than males. Our data revealed that males achieved a mean PCS and MCS score of 53.92±6.63 and 42.83±6.51 respectively, while females achieved a mean PCS and MCS score of 51.57±8.23 and 38.64±9.46 respectively. A possible explanation is that women have worse latent health problems as opposed to men and commonly over report their physical activity limitations (Younsi, 2015).

To establish the health markers that could influence physical activity levels, blood pressure and BMI measurements were taken. The blood pressure of the majority (65.40%) of the participants was normal; 75 (28.52%) of the participants suffered from pre-hypertension, while 5.70% and 0.38% were in Stages 1 and 2 of hypertension respectively. Although a recent study on the prevalence of hypertension across three sites in South Africa reported a 40% prevalence of hypertension among participants (Gómez-Olivé *et al.*, 2017), the finding in our study revealed a lower prevalence probably because our study population involved university students who were between the ages of 17 and 28, as opposed to the results of the study by Gómez-Olivé *et al.*, (2017) in which participants were adults aged 40 to 60 years. Since our study involved a homogenous population of the same age group, low hypertension values were to be expected, bearing in mind that the risk factor for elevated blood pressure increases with age (Pinto, 2007).

Although the BMI is the most widely-used measure of obesity, the increasing prevalence of overweight/obesity globally has led to the development of other measures of adiposity such as the BAI, WC, waist-to-height ratio and waist-to-hip ratio, in order to better assess risks for cardiovascular diseases.

In this study, males were found to have a higher body mass index (BMI), waist circumference (WC) and waist-to-hip ratio (WHR) than females, but a lower body adiposity index (BAI), hip circumference (HC) and waist-to-height ratio when compared to females. This, therefore, indicates that identifying the best measure of adiposity to help predict cardiovascular risk factors is subject to debate.

Lam *et al.*, (2015) found that among adults in Singapore, when stratified by gender, the BMI showed a better correlation with other anthropometric measures than BAI, as the BMI, WHR, and waist-to-height ratios of males were higher than those of females in the same population. Although the reason for this is unknown, other studies found similar results, with overweight/obesity being more prevalent in males than in females (Toriola and Monyeki, 2012; Morgen and Sørensen, 2014; Kumah *et al.*, 2015).

According to the BMI measurements, the prevalence rates for overweight/obesity present in this group were found to be 28.14% and 11.03% respectively. This is in agreement with the work of (Peltzer *et al.*, 2014), in which a 22% prevalence of overweight/obesity was reported in their study involving university students from 22 countries. These results suggest that university students are no exception to the overweight/obesity trends. Although few studies exist on the prevalence of overweight/obesity among university students, Chukwudi, (2016) reported that 20% and 9.5% of students at the University of Venda were found to be overweight and obese respectively. Similarly, among 110 female undergraduate students at the University of the Witwatersrand, overweight and obesity levels were reported as 37.3% and 17.3% respectively (Gradidge and Cohen, 2017). These studies further corroborate the statistic that three out of 10 South Africans are overweight (Sartorius, Kenge and Schutte, 2017).

Currently, there is a rising prevalence of overweight/obesity in Sub-Saharan Africa (Ng *et al.*, 2014). The World Health Organization (WHO) stated that within the past 25 years the number of overweight/obese people in Africa had increased from 5.4 million to 10.3 million (World Health Organization, 2017). In a systematic review on the health impact of obesity in Africa, Adeboye, Bermano and Rolland (2012) highlighted the fact that there are many factors that influence obesity. Examples are environmental factors, socio-economic status, culture, eating habits and physical activity levels.

### 5.4 Relationships between physical activity, health status and anthropometric indices

This study found a significant association between physical activity (measured by the IPAQ) and the mental component summary (MCS) but not between physical activity and the physical component summary (PCS). This disparity was unexpected, as the PCS and MCS both determine the health status of an individual.

Although Jurakić, Pedišić and Greblo, (2010), used the long version of IPAQ and the SF-36 Health Survey to measure the association between physical activity and health status among 1 076 Croatian inhabitants, findings similar to ours were reported in their study. In contrast, Riise, Moen and Nortvedt (2003) reported a positive correlation between occupational physical activity and both the PCS and the MCS. A possible explanation for these differences could be that while our study involved the university population, theirs involved the working-class population between the ages of 40 and 47. Also, while our study assessed physical activity holistically, using the SF-12v2 Index, their study took into consideration leisure time, transportation and occupational physical activity.

The majority of studies conducted to examine the relationship between physical activity and health status use self-reported measures of physical activity. To the best of our knowledge, there are very few studies assessing the relationship between number of steps measured by a pedometer and the health-related quality of life measured by the SF12 Health Survey among university students. Our analysis revealed no significant correlation between the number of steps and the SF 12v2 scores. This is quite confounding considering that there is a large body of literature that supports a positive dose-response relationship between physical activity and health-related quality of life. For instance, results from the Alberta older adult health survey revealed that participants with higher physical activity levels scored higher in both the physical and mental health components of the SF12 Health Survey(Vallance *et al.*, 2016).

Three possible reasons for the difference between the results of the aforementioned study and ours is that firstly, Vallance *et al.* (2016) analysed the SF 12 Health Survey using the norm-based scoring method, while our study applied the standardized scoring method. Secondly, the mean age for the participants in their study was 66.3, compared to ours of 20.48. Thirdly, the participants in our study filled in the SF12 health survey prior to the seven-day duration of wearing the pedometer.

Although no significant association was observed, our study showed an inverse relationship between physical activity and the anthropometric indices. This shows that people who are more active have a smaller waist circumference, BMI, BAI, waist-to-height ratio and waist-to-hip ratio. Although the existing scientific literature on the relationship between self-reported physical activity and waist circumference has shown a positive correlation (Majeed, 2015; Pengpid *et al.*, 2015), Vallance *et al.* (2016) reported that a larger number of steps measured by the pedometer is significantly associated with a smaller waist circumference, but not a lower BMI. This implies that differences in the measuring tools for determining the physical activity levels may produce results that differ.

Also, the factor considered to be the major covariate is also debatable. Thus, the question is: Do people participate in less strenuous physical activity because they have a lower health-related quality of life (HRQoL), or does physical activity determine the HRQoL and their anthropometric indices?

Overall, this study found no significant association between the self-rated HRQoL and the anthropometric indices. The only observed relationship was between the waist-to-hip ratio (WHR) and the mental component summary (MCS), howbeit with a low correlation coefficient of 0.15. Likewise, Tan *et al.* (2013) observed a positive correlation between waist circumference (WC), body mass index (BMI) and the SF-36 Health Survey in women but not in men.

It is therefore necessary to ascertain the other factors that influence health status apart from the anthropometric indices.

## 5.5 Demographic profile of participants

Participants in this study were undergraduate students of the School of Therapeutic Sciences enrolled at the University of the Witwatersrand. The Physiotherapy (30.7%), Occupational Therapy (26.8%), Pharmacy (26.3%), and Nursing departments (13.7%) had more participants than the Biokinetics department (2.4%), as the Biokinetics department only offers second- and third-year courses.

Unlike the study by Ranasinghe *et al.*, (2016), which assessed the level of physical activity among Physiotherapy students only, our study included participants from other programmes of study, thereby presenting the researcher with the opportunity to compare physical activity levels across the various departments and years of study. This study recruited more females (84.47%) than males (15.53%) overall, because certain departments, such as Occupational Therapy and Nursing, had more females than males in each class. Similarly, in a study by Micalos *et al.*, (2017), of the participants recruited from the Nursing department, 75% were females, while 25% were males. A plausible reason is that women have been found to dominate certain occupational fields, such as nursing.

The mean age of participants in the study was 20.39±1.70, which is similar to the mean age observed in other studies (Kemper and Welsh, 2010; Joseph *et al.*, 2014; Afrifa-Anane *et al.*, 2015; Pengpid *et al.*, 2015). This could be because most people complete high school at the age of 18 and are enrolled at a university for their first degree, which usually takes about three to five years to complete. However, in a study evaluating the physical activity levels and health of undergraduates, Micalos *et al.* (2017) reported the mean age of the participants to be 26.17 years

The median age of participants in this study was 20, which has been identified as the mean age in studies involving undergraduates. Despite the number of hours spent in class while listening to lectures, certain students, such as those in the Department of Physiotherapy and the Centre for Exercise Science and Sports Medicine (CESSM), have an affinity for sports and engage in high levels of physical activity and extracurricular sporting activities, thereby reporting high levels of physical activity.

This was also seen in the study by El-Gilany *et al.* (2011), which was carried out in Mansoura University, Egypt, to determine the physical activity levels of students in Medicine, Engineering, Physical Education, Education, Law, the Arts, and Commerce. Their results reveal that students from the Physical Education college had the lowest (0.8%) level of physical inactivity, while those from Medicine and Engineering had relatively higher physical inactivity levels of 19.3% and 13.1% respectively.

## 5.6 Summary of the discussion

This chapter discussed the results of the research data in line with the research objectives, and made inferences by comparing and contrasting the results of other studies. Comparisons were made between the findings from this study and the results from other research studies on physical activity, health status and anthropometric indices. The results of the prevalence studies were generally consistent with the current scientific literature. However, correlation analyses confirmed a variation in the results emanating from this study and others.

# CHAPTER 6: CONCLUSION

## 6.1 Introduction

This study aimed to investigate the physical activity levels and health status of undergraduate students of the School of Therapeutic Sciences at University of the Witwatersrand

The objectives of the study were:

1. To determine the physical activity level of undergraduate students of the School of Therapeutic Sciences at University of the Witwatersrand.

2. To determine the health status and anthropometric indices of undergraduate students of the School of Therapeutic Sciences at University of the Witwatersrand.

3. To determine the relationship between physical activity levels and health status of undergraduate students of the School of Therapeutic Sciences at University of the Witwatersrand.

4. To determine the relationship between physical activity levels and anthropometric indices of undergraduate students of the School of Therapeutic Sciences at University of the Witwatersrand

## 6.2 Conclusions from the study

- There is a moderate prevalence of physical inactivity among undergraduate students of the School of Therapeutic Sciences at University of the Witwatersrand.
- Male students had higher moderate to vigorous physical activity (MVPA) and took more steps than female students
- Undergraduate Students of the School of Therapeutic Sciences walk less than 10,000 steps a day
- The sitting time among Undergraduate Students of the School of Therapeutic Sciences is 378min/day
- Second year students had the highest average sitting time (432min/day) while fourth year students had the least sitting time (316min/day)
- In this population, the health status score is lower than the average normalized score
- Males had higher physical component summary (PCS) and mental component summary (MCS) scores than females.
- Majority of the students had normal blood pressure

- Male students had higher systolic and diastolic blood pressure than female students
- There is a moderate prevalence of overweight/obesity among undergraduate students of the School of Therapeutic Sciences at University of the Witwatersrand.
- There is a low prevalence of underweight among undergraduate students of the School of Therapeutic Sciences at University of the Witwatersrand.
- Females had higher body adiposity index (BAI), waist to hip ratio (WHR) and waist to height ratio (WHtR) compared to their male counterparts
- There was a significant association between physical activity (measured by the IPAQ) and physical component summary (PCS) of health status but not with mental component summary (MCS) among undergraduate therapeutic science students.
- There was no significant association between physical activity and anthropometric indices among undergraduate therapeutic science students.
- There was a weak negative correlation between BMI and physical activity, and between blood pressure and physical activity ($r_s<0.40$)
- There was a significant association between mental component summary (MCS) of health status and waist to hip ratio among undergraduate therapeutic science students. No relationship was found between health status and other anthropometric indices ($p>0.05$). This study found weak correlations between blood pressure, anthropometric indices and SF-12 Health Status

In summary, although participants sitting time was an average of six and half hours per day, and walked less than the recommended average number of steps per day (10,000 steps), the majority of the participants engaged in moderate to vigorous physical activity daily. The work schedule of the students, age as well as the health status of the students are significant predictors of physical activity level.

### 6.3 Limitations of study

- Due to limited pedometers available and variation in school schedule, number of steps taken by participants were not measured at the same time
- The study did not determine the barriers and facilitators to physical activity participation
- The study did not evaluate modifiable risk factors influencing anthropometric variables

## 6.4 Recommendations for research

- Further research should include barriers and facilitators to physical activity participation
- Further studies should evaluate other modifiable risk factors such as diet, smoking and drinking habits
- Demographics of participants should include socioeconomic status
- Intervention studies to improve physical activity levels using physical activity trackers

## 6.5 Recommendations for clinical practice

- Clinicians and health workers should ncourage physical activity among students pursuing health studies
- Parents, lecturers and clinicians should serve as role models, by incorporating healthy habits of regular physical activity into their activities of daily living

## 6.6 Recommendations for public health policies

- Greater awareness is required on the importance of physical activity among university students.
- Health promoting interventions to reduce overweight/obesity levels and encourage healthy lifestyle.

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**Appendix A: Copy of letter sent to Heads of Department/Head of School**

The Head of Department,

Department of _______________,

University of the Witwatersrand

Dear Sir/Ma,

LETTER OF INTRODUCTION AND PERMISSSION TO CONDUCT A RESEARCH

My name is Temitope Ojelade, I am a registered post graduate student for an MSc in Physiotherapy at University of the Witwatersrand. As part of the requirements for a Masters (MSc) degree, I will be working on a study titled “Physical Activity and Health Status among Undergraduate Students of the School of Therapeutic Sciences at University of the Witwatersrand”

The aim of this study is to determine the physical activity level and health status of the participants. It will involve filling a questionnaire that seeks to determine the physical activity level, the health status, measuring the blood pressure and anthropometric variables and wearing a pedometer for seven (7) days. The results of this study will help contribute to the existing knowledge of physical activity levels and health status of university students and may be useful in future intervention studies and health promotion guidelines.

Participants will be undergraduate students of the School of Therapeutic Sciences (Physiotherapy, Occupational therapy, Pharmacy, Pharmacology, Nursing and Biokinetics) from first year to fourth year. The study will extend over a period of six (6) weeks. I do not envisage any negative consequences of participation. Participation is voluntary and students can withdraw at any point in the course of the study and confidentiality will be maintained.

In order to obtain permission from the ethics committee, a written permission to conduct this study is required. I hereby seek your permission to conduct the study and have the students participate in this study.

The study will be supervised by Prof. Hellen Myezwa (Hellen.Myezwa@wits.ac.za) and Ms. Sonti Pilusa (Sonti.pilusa@wits.ac.za) of the Department of Physiotherapy, University of the Witwatersrand, Johannesburg, South Africa.

Thank you for your time

Temitope Ojelade

MSc Candidate
Department of Physiotherapy,
University of the Witwatersrand,
Johannesburg, South Africa
0847577780
1710755@students.wits.ac.za

**Appendix B:** Participant Information Sheet

Good day, my name is Temitope Oluwaseun Ojelade I am a Physiotherapist; I am currently completing a Masters (MSc) degree in Physiotherapy at University of the Witwatersrand. I would like to invite you to consider participating in a research study, titled Physical Activity and Health Status among Undergraduate Students of the School of Therapeutic Sciences at University of the Witwatersrand

Before agreeing to participate, it is important that you read and understand the following explanation of the purpose of the study, the study procedures, benefits, risks, discomforts, and precautions, and your right to withdraw from the study at any time. This information leaflet is to help you to decide if you would like to participate. You need to understand what is involved before you agree to take part in this study.

The purpose of this study is to determine the physical activity level and health status of undergraduate students of the School of Therapeutic Sciences at University of the Witwatersrand. Approximately 333 participants will participate in this study recruited from the school of therapeutic sciences; the total amount of time required for your participation in this study will be a maximum of 7 days. The study entails that you fill a questionnaire, have your height, weight, blood pressure, waist and hip circumference measurements taken. Thereafter, a pedometer and diary will be handed to you to be worn for a period of seven (7) days in order to measure and record the number of steps taken daily

Please note that participation is voluntary and you have the option of withdrawing at any time you feel uncomfortable. All information obtained during the course of this study will be kept strictly confidential. Data that may be reported in scientific journals will not include any information that identifies you as a participant in this study.

I don’t envisage any negative consequences that may occur as a result of you taking part in this study. If you agree to participate in this study, please sign the consent form below and kindly return this form to the researcher.

For further enquiries, kindly contact the Wits Human Research Committee (Medical)

- Chairperson: peter.cleaton-jones1@wits.ac.za
- Administrators: Ms Zanele Ndlovu/Mr Rhulani Mkansi/Mr Lebo Moeng

Tel: 011 717 2700/2656/1234/1252

Email: HREC-Medical.ResearchOffice@wits.ac.za

Thank you very much for your time

Temitope Ojelade

0847577780

1710755@students.wits.ac.za

**CONSENT FORM**

I………………………………………………………. agree / do not agree (please indicate as appropriate) to participate in this research.

The purpose and nature of the study has been explained to me

I am willing to participate voluntarily

I understand that I can withdraw from the study, without repercussions, at any time, whether before it starts or during the study

I understand that anonymity will be ensured in the write-up

I understand that data will be quoted in the dissertation and any subsequent publications if I give permission below

Signed ……………………… Date …………………

**Appendix C:** International Physical Activity Questionnaire

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

**_____ days per week**

No vigorous physical activities ***Skip to question 3***

2. How much time did you usually spend doing **vigorous** physical activities on one of those days?

**_____ hours per day**

**_____ minutes per day**

Don’t know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis?
Do not include walking.

**_____ days per week**

No moderate physical activities ***Skip to question 5***

4. How much time did you usually spend doing **moderate** physical activities on one of those days?

**_____ hours per day**

**_____ minutes per day**

Don’t know/Not sure

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

**_____ days per week**

No walking ***Skip to question 7***

6. How much time did you usually spend **walking** on one of those days?

**_____ hours per day**

**_____ minutes per day**

Don’t know/Not sure

The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the **last 7 days**, how much time did you spend **sitting** on a **week day**?

**_____ hours per day**

**_____ minutes per day**

Don’t know/Not sure

**This is the end of the questionnaire, thank you for participating.**

**Appendix D:** SF-12v2™ Health Survey

## SF-12 Health Survey

This survey asks for your views about your health. This information will help keep track of how you feel and how well you are able to do your usual activities. **Answer each question by choosing just one answer.** If you are unsure how to answer a question, please give the best answer you can.

**1. In general, would you say your health is:**

☐1 Excellent ☐2 Very good ☐3 Good ☐4 Fair ☐5 Poor

**The following questions are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?**

| | YES, limited a lot | YES, limited a little | NO, not limited at all |
|---|---|---|---|
| 2. **Moderate activities** such as moving a table, pushing a vacuum cleaner, bowling, or playing golf. | ☐1 | ☐2 | ☐3 |
| 3. Climbing **several** flights of stairs. | ☐1 | ☐2 | ☐3 |

**During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?**

| | YES | NO |
|---|---|---|
| 4. **Accomplished less** than you would like. | ☐1 | ☐2 |
| 5. Were limited in the **kind** of work or other activities. | ☐1 | ☐2 |

**During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?**

| | YES | NO |
|---|---|---|
| 6. **Accomplished less** than you would like. | ☐1 | ☐2 |
| 7. Did work or activities **less carefully than usual**. | ☐1 | ☐2 |

**8. During the past 4 weeks, how much did pain interfere with your normal work (including work outside the home and housework)?**

☐1 Not at all ☐2 A little bit ☐3 Moderately ☐4 Quite a bit ☐5 Extremely

**These questions are about how you have been feeling during the past 4 weeks.**
**For each question, please give the one answer that comes closest to the way you have been feeling.**

**How much of the time during the past 4 weeks...**

| | All of the time | Most of the time | A good bit of the time | Some of the time | A little of the time | None of the time |
|---|---|---|---|---|---|---|
| 9. Have you felt calm & peaceful? | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |
| 10. Did you have a lot of energy? | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |
| 11. Have you felt down-hearted and blue? | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |

12. **During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting friends, relatives, etc.)?**

☐1 All of the time ☐2 Most of the time ☐3 Some of the time ☐4 A little of the time ☐5 None of the time

Patient name: Date: PCS: MCS:

Visit type (circle one)
Preop 6 week 3 month 6 month 12 month 24 month Other:__________

**Appendix E:** Bio-Data Form

***FOR RESEARCH ASSISTANT ONLY***

SEX:

AGE:

STUDY NUMBER:

BLOOD PRESSURE:

HEIGHT:

WEIGHT:

BODY MASS INDEX (BMI):

WAIST CIRCUMFERENCE:

HIP CIRCUMFERENCE:

WAIST TO HIP RATIO:

PEDOMETER DIARY

| DAY | NUMBER OF STEPS |
|---|---|
| Monday | |
| Tuesday | |
| Wednesday | |
| Thursday | |
| Friday | |
| Saturday | |
| Sunday | |

## Appendix F: Ethics Clearance

R14/49 Miss Ojelade Temitope

**HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)**

**CLEARANCE CERTIFICATE NO. M170424**

| | |
|---|---|
| **NAME: (Principal Investigator)** | Miss Ojelade Temitope |
| **DEPARTMENT:** | Physiotherapy |
| **PROJECT TITLE:** | Physical Activity among Undergraduate Therapeutic Science Students at the University of the Witwatersrand |
| **DATE CONSIDERED:** | 05/05/2017 |
| **DECISION:** | Approved unconditionally |
| **CONDITIONS:** | |
| **SUPERVISOR:** | Prof Hellen Myezwa and Mrs Sonti Pilusa |
| **APPROVED BY:** | Professor P Cleaton-Jones, Chairperson, HREC (Medical) |
| **DATE OF APPROVAL:** | 28/06/2017 |

**This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.**

**DECLARATION OF INVESTIGATORS**

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary in Room 301, Third Floor, Faculty of Health Sciences, Phillip Tobias Building, 29 Princess of Wales Terrace, Parktown, 2193, University of the Witwatersrand. I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in April and will therefore be due in the month of April each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature ____________ Date ____________

**PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES**

## Appendix G: Letters of approval

## H: Approval from Head of School

**School of Therapeutic Sciences**

Faculty of Health Sciences · Private Bag 3, Wits, 2050, South Africa
Tel: +27 11 717 2063/4 · Fax : 27 11 717 2066/086 553 5964 · E-mail: irene.jansevannoordwyk@wits.ac.za · www.wits.ac.za

WITS UNIVERSITY

12 June 2017

To Whom it May Concern

**Project Title: Physical Activity and Health Status among Undergraduate Therapeutic Science Students at University of the Witwatersrand**

**Student Name: Temitope Ojelade (Student No: 1710755)**

I, Professor Judith Bruce, Head of the School of Therapeutic Sciences, hereby give permission to Temitope Ojelade to conduct the above study on students in Therapeutic Sciences on the understanding that all other ethical requirements cited in the protocol will be adhered to.

Kind regards

JBruce

**Professor Judith Bruce**
**Head**
**School of Therapeutic Sciences**

## I: Approval from Physiotherapy department

**Department of Physiotherapy**

WITS
UNIVERSITY

Faculty of Health Sciences, Department of Physiotherapy · Private Bag 3, Wits, 2050, South Africa
Tel: +27 11 717 73702 · Fax : 27 11 7173719 · E-mail: maryanne.cannon@wits.ac.za · www.wits.ac.za

5 June 2017

PERMISSSION TO STUDENT TO CONDUCT IN RESEARCH PROJECT

Temitope Ojelade is a registered post graduate student for MSc in Physiotherapy at University of the Witwatersrand. As part of the requirements for a Masters (MSc) degree, she will be working on a study titled: **"Physical Activity and Health Status among Undergraduate Therapeutic Science Students at University of the Witwatersrand"**

The aim of this study is to determine the physical activity level and health status of the participants. It will involve filling a questionnaire that seeks to determine the physical activity level, the health status, measuring the blood pressure and anthropometric variables and wearing a pedometer for seven (7) days. The results of this study will help contribute to the existing knowledge of physical activity levels and health status of university students and may be useful in future intervention studies and health promotion guidelines.

The study will be supervised by myself and Ms. Sonti Pilusa from Department of Physiotherapy.

Permission is herewith granted to Temitope Ojelade to participate in this study.

Yours sincerely

PROF H MYEZWA
HOD PHYSIOTHERAPY

DEPARTMENT OF PHYSIOTHERAPY
2017 -06- 05
MEDICAL SCHOOL
UNIVERSITY OF THE WITWATERSRAND

THERAPEUTIC
Sciences

## J: Approval from Occupational Therapy department

University
of the Witwatersrand,
Johannesburg

Department of Occupational Therapy

7 York Road, Parktown, 2193 South Africa • Telegrams 'Witsmed' • Tel: +27-11-717-3701 • Fax: +27-11-717-3709
E-mail: franzsend@therapy.wits.ac.za

Temitope Ojelade 19/06/2017

Postgraduate student

Dear Temitope

**Re: Permission to conduct research on students from the Occupational Therapy department.**

Title of the study: physical activity and health status among undergraduate Therapeutic Science students at University of the Witwatersrand

I hereby give provisional permission for you to conduct research on students within the Occupational Therapy department. This permission is conditional to you forwarding the final ethics certificate to the department prior to conducting the data gathering.

Fasloen Adams
Acting HOD
Occupational Therapy Department
School of therapeutic Sciences
Health Science Faculty
University of Witwatersrand
fasloen.adams@wits.ac.za

## K: Approval from Pharmacy and Pharmacology department

**Department of Pharmacy and Pharmacology**
Faculty of Health Sciences · 7 York rd, Parktown 2193, South Africa · Tel: +27 11 717-2052 · Fax: +27 11 642-4355

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

**2 June 2017**

RE: Permission to Conduct Research

Ms Temitope Ojelade is a registered MSc postgraduate student in Physiotherapy at Wits University. As part of the requirements for her degree she will be working on a study entitled "Physical Activity and Health Status among Undergraduate Therapeutic Science Students at University of the Witwatersrand". The study will be supervised by Prof. Hellen Myezwa (hellen.myezwa@wits.ac.za) and Ms. Sonti Pilusa (sonti.pilusa@wits.ac.za) of the Department of Physiotherapy at Wits University.

I hereby provide approval from the Department of Pharmacy and Pharmacology for this study to go ahead.

Yours Sincerely,

Prof. Yahya E. Choonara I Associate Professor of Pharmaceutics
Chairman and Head I Pharmacy and Pharmacology
Senior Research Scientist and Manager I Wits Advanced Drug Delivery Platform
University of the Witwatersrand I Faculty of Health Sciences
7 York Road, Parktown, 2193 Johannesburg, South Africa
E: yahya.choonara@wits.ac.za I W: http://www.wits.ac.za/waddp

## L: Approval from Nursing Department

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

DEPARTMENT OF NURSING EDUCATION

Temitope Ojelade
Department of Physiotherapy,
University of the Witwatersrand,
Johannesburg, South Africa
0847577780
1710755@students.wits.ac.za

Dear Temitope

This serves to confirm that I hereby support the request to conduct a study in fulfillment of a Master's degree. Thereby, allowing undergraduate nursing students to participate in the study.

Title of the research: *Physical Activity and Health Status among Undergraduate Therapeutic Science Students at University of the Witwatersrand"*

Wishing you every success.

Yours sincerely

JE Maree

Professor JE Maree
Head: Department of Nursing Education

Department of Nursing Education | School of Therapeutic Sciences | Faculty of Health Sciences
7 York Road, Parktown, 2193, South Africa, Tel: +27 11 488-4272 | Fax: +27 11 488-4195
www.wits.ac.za/therapeuticsciences/nursing

THERAPEUTIC Sciences

## M: Approval from Centre for Exercise Science and Sports Medicine

WITS UNIVERSITY

**Centre for Exercise Science and Sports Medicine**
and
*FIFA Medical Centre of Excellence*
*and*
FIMS Collaborating Centre of Sports Medicine

School of Therapeutic Sciences,
Faculty of Health Sciences
University of the Witwatersrand, Johannesburg
Director: Professor D Constantinou

FIFA MEDICAL CENTRE OF EXCELLENCE

COLLABORATING CENTER OF SPORTS MEDICINE
FIMS
CCSM

14 June 2017

Prof. Hellen Myezwa
HOD
Physiotherapy

**Temitope Ojelade**

I received your request for your student to conduct research for the study entitled: "Physical Activity and Health Status among Undergraduate Therapeutic Science Students at University of the Witwatersrand" at the Centre.
The Centre gladly gives the student permission to conduct the study, provided that Ms. Ayanda Bendile is consulted beforehand. This will ensure that the study takes place at a suitable time for our students.

Yours sincerely,

Dr. Philippe Gradidge
Acting HOD
Centre for Exercise Science and Sports Medicine

Room 46, Physical Education Building, Wits Education Campus, 27 St Andrews Rd, Parktown, South Africa
Telephone: +27 11 717-3372/1 | Fax: +27 11 717-3379
Postal address: Wits Centre for Exercise Science & Sports Medicine, Wits Medical School, Wits, 2050, South Africa

**Appendix N** Excluded variables in multivariate linear regression for IPAQ scores

**Excluded Variables[a]**

| Model | | Beta In | t | Sig. | Partial Correlation | Collinearity Statistics Tolerance |
|---|---|---|---|---|---|---|
| 1 | general health | .030[b] | .427 | .670 | .026 | .756 |
| | physical functioning | .041[b] | .508 | .612 | .031 | .588 |
| | role physical | -.019[b] | -.239 | .811 | -.015 | .585 |
| | bodily pain | -.031[b] | -.404 | .687 | -.025 | .651 |
| | role emotional | .034[b] | .549 | .583 | .034 | .998 |
| | mental health | .004[b] | .067 | .946 | .004 | .964 |
| | vitality | -.040[b] | -.624 | .533 | -.039 | .937 |
| | social functioning | -.131[b] | -2.131 | .034 | -.131 | .986 |
| | MCS | -.027[b] | -.428 | .669 | -.027 | .938 |
| | dept | -.052[b] | -.842 | .401 | -.052 | .982 |
| | YEAR OF STUDY | .103[b] | 1.677 | .095 | .103 | 1.000 |
| | Gender | .106[b] | 1.719 | .087 | .106 | .992 |
| | AGE | -.003[b] | -.049 | .961 | -.003 | 1.000 |
| | SYSTOLIC | -.024[b] | -.394 | .694 | -.024 | .998 |
| | DIASTOLIC | -.054[b] | -.878 | .381 | -.054 | .997 |
| | HEIGHT (m) | .082[b] | 1.345 | .180 | .083 | .999 |
| | WEIGHT (kg) | .030[b] | .482 | .630 | .030 | .988 |
| | BMI | -.015[b] | -.241 | .810 | -.015 | .978 |
| | BAI | -.024[b] | -.388 | .699 | -.024 | .990 |
| | WaistHeight (%) | .039[b] | .633 | .527 | .039 | .991 |
| | WaistHip | .067[b] | 1.092 | .276 | .068 | 1.000 |
| 2 | general health | .045[c] | .637 | .525 | .040 | .749 |
| | physical functioning | .051[c] | .634 | .527 | .039 | .586 |
| | role physical | .022[c] | .272 | .786 | .017 | .552 |
| | bodily pain | -.003[c] | -.036 | .971 | -.002 | .632 |
| | role emotional | .096[c] | 1.466 | .144 | .091 | .857 |
| | mental health | .049[c] | .750 | .454 | .047 | .875 |
| | vitality | -.009[c] | -.142 | .887 | -.009 | .887 |
| | MCS | .078[c] | 1.007 | .315 | .062 | .616 |
| | dept | -.070[c] | -1.128 | .260 | -.070 | .966 |
| | YEAR OF STUDY | .082[c] | 1.335 | .183 | .083 | .970 |
| | Gender | .113[c] | 1.859 | .064 | .115 | .988 |
| | AGE | -.017[c] | -.275 | .784 | -.017 | .988 |
| | SYSTOLIC | -.029[c] | -.477 | .634 | -.030 | .996 |
| | DIASTOLIC | -.079[c] | -1.271 | .205 | -.079 | .968 |
| | HEIGHT (m) | .098[c] | 1.605 | .110 | .099 | .986 |
| | WEIGHT (kg) | .027[c] | .437 | .663 | .027 | .987 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | BMI | -.027[c] | -.437 | .662 | -.027 | .970 |
| | BAI | -.047[c] | -.755 | .451 | -.047 | .963 |
| | WaistHeight (%) | .030[c] | .482 | .630 | .030 | .985 |
| | WaistHip | .081[c] | 1.321 | .188 | .082 | .990 |

a. Dependent Variable: TOTAL IPAQ SCORE

b. Predictors in the Model: (Constant), PCS

c. Predictors in the Model: (Constant), PCS, social functioning

**Appendix O** Excluded variables in multivariate linear regression for number of steps

**Excluded Variables[a]**

| Model | | Beta In | t | Sig. | Partial Correlation | Collinearity Statistics Tolerance |
|---|---|---|---|---|---|---|
| 1 | general health | .049[b] | .825 | .410 | .051 | .995 |
| | physical functioning | .017[b] | .277 | .782 | .017 | .981 |
| | role physical | -.007[b] | -.123 | .902 | -.008 | .994 |
| | bodily pain | -.119[b] | -1.980 | .049 | -.123 | .962 |
| | role emotional | -.087[b] | -1.464 | .144 | -.091 | .985 |
| | mental health | -.058[b] | -.974 | .331 | -.061 | .988 |
| | vitality | -.081[b] | -1.364 | .174 | -.085 | .984 |
| | social functioning | -.017[b] | -.289 | .772 | -.018 | .980 |
| | PCS | .008[b] | .126 | .900 | .008 | .981 |
| | MCS | -.111[b] | -1.882 | .061 | -.117 | .989 |
| | YEAR OF STUDY | -.070[b] | -1.188 | .236 | -.074 | 1.000 |
| | Gender | .017[b] | .286 | .775 | .018 | 1.000 |
| | AGE | -.114[b] | -1.931 | .055 | -.120 | 1.000 |
| | SYSTOLIC | .047[b] | .789 | .431 | .049 | .981 |
| | DIASTOLIC | -.006[b] | -.101 | .920 | -.006 | .989 |
| | HEIGHT (m) | .052[b] | .875 | .382 | .055 | .994 |
| | WEIGHT (kg) | .026[b] | .444 | .658 | .028 | .998 |
| | BMI | -.001[b] | -.022 | .982 | -.001 | 1.000 |
| | BAI | .026[b] | .430 | .667 | .027 | .996 |
| | WaistHeight (%) | -.048[b] | -.814 | .417 | -.051 | 1.000 |
| | WaistHip | -.133[b] | -2.260 | .025 | -.140 | .992 |
| 2 | general health | .054[c] | .919 | .359 | .057 | .994 |
| | physical functioning | .017[c] | .278 | .781 | .017 | .981 |
| | role physical | -.002[c] | -.040 | .968 | -.002 | .992 |
| | bodily pain | -.119[c] | -2.006 | .046 | -.124 | .962 |
| | role emotional | -.077[c] | -1.307 | .193 | -.081 | .980 |
| | mental health | -.037[c] | -.615 | .539 | -.038 | .961 |
| | vitality | -.076[c] | -1.285 | .200 | -.080 | .983 |
| | social functioning | -.006[c] | -.097 | .923 | -.006 | .973 |
| | PCS | .005[c] | .079 | .937 | .005 | .981 |
| | MCS | -.093[c] | -1.560 | .120 | -.097 | .966 |
| | YEAR OF STUDY | -.065[c] | -1.105 | .270 | -.069 | .998 |
| | Gender | .040[c] | .677 | .499 | .042 | .971 |
| | AGE | -.106[c] | -1.809 | .072 | -.112 | .996 |
| | SYSTOLIC | .078[c] | 1.286 | .199 | .080 | .940 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | DIASTOLIC | -.008[c] | -.139 | .890 | -.009 | .989 |
| | HEIGHT (m) | .082[c] | 1.363 | .174 | .085 | .955 |
| | WEIGHT (kg) | .061[c] | 1.016 | .311 | .063 | .941 |
| | BMI | .021[c] | .353 | .724 | .022 | .973 |
| | BAI | .001[c] | .025 | .980 | .002 | .963 |
| | WaistHeight (%) | .019[c] | .278 | .781 | .017 | .777 |
| 3 | general health | .073[d] | 1.242 | .215 | .078 | .971 |
| | physical functioning | .030[d] | .507 | .613 | .032 | .969 |
| | role physical | .037[d] | .603 | .547 | .038 | .899 |
| | role emotional | -.056[d] | -.933 | .352 | -.058 | .941 |
| | mental health | -.033[d] | -.558 | .577 | -.035 | .960 |
| | vitality | -.052[d] | -.853 | .394 | -.053 | .931 |
| | social functioning | .018[d] | .294 | .769 | .018 | .937 |
| | PCS | .110[d] | 1.529 | .128 | .095 | .651 |
| | MCS | -.086[d] | -1.449 | .149 | -.090 | .962 |
| | YEAR OF STUDY | -.080[d] | -1.358 | .176 | -.085 | .985 |
| | Gender | .043[d] | .721 | .472 | .045 | .971 |
| | AGE | -.116[d] | -1.998 | .047 | -.124 | .989 |
| | SYSTOLIC | .068[d] | 1.136 | .257 | .071 | .934 |
| | DIASTOLIC | -.020[d] | -.345 | .731 | -.022 | .978 |
| | HEIGHT (m) | .101[d] | 1.679 | .094 | .105 | .935 |
| | WEIGHT (kg) | .055[d] | .918 | .360 | .057 | .938 |
| | BMI | .004[d] | .071 | .943 | .004 | .953 |
| | BAI | -.010[d] | -.167 | .868 | -.010 | .954 |
| | WaistHeight (%) | .011[d] | .167 | .868 | .010 | .775 |
| 4 | general health | .074[e] | 1.257 | .210 | .079 | .971 |
| | physical functioning | .032[e] | .542 | .589 | .034 | .968 |
| | role physical | .039[e] | .644 | .520 | .040 | .899 |
| | role emotional | -.055[e] | -.927 | .355 | -.058 | .941 |
| | mental health | -.036[e] | -.612 | .541 | -.038 | .959 |
| | vitality | -.052[e] | -.866 | .387 | -.054 | .931 |
| | social functioning | .005[e] | .088 | .930 | .005 | .927 |
| | PCS | .114[e] | 1.590 | .113 | .099 | .651 |
| | MCS | -.091[e] | -1.535 | .126 | -.096 | .961 |
| | YEAR OF STUDY | .014[e] | .163 | .871 | .010 | .449 |
| | Gender | .051[e] | .859 | .391 | .054 | .967 |
| | SYSTOLIC | .090[e] | 1.490 | .137 | .093 | .909 |
| | DIASTOLIC | -.019[e] | -.318 | .751 | -.020 | .978 |
| | HEIGHT (m) | .100[e] | 1.682 | .094 | .105 | .935 |
| | WEIGHT (kg) | .060[e] | .998 | .319 | .062 | .937 |
| | BMI | .009[e] | .150 | .881 | .009 | .952 |
| | BAI | -.012[e] | -.207 | .836 | -.013 | .954 |

| | | | | | |
|---|---|---|---|---|---|
| WaistHeight (%) | .008[e] | .126 | .899 | .008 | .774 |

a. Dependent Variable: AVERAGE

b. Predictors in the Model: (Constant), dept

c. Predictors in the Model: (Constant), dept, WaistHip

d. Predictors in the Model: (Constant), dept, WaistHip, bodily pain

e. Predictors in the Model: (Constant), dept, WaistHip, bodily pain, AGE