PHYSICAL ACTIVITY AND LIFESTYLE HABITS OF MALE UNDERGRADUATE STUDENTS

by

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Declaration

I, ***Brett Walraven*** declare that this dissertation, for the Degree at the University of the Free State is my own independent work, except to the extent indicated in the reference citations. I also declare that neither the whole work nor any part of it has been, is being, or is to be submitted at another university or faculty for degree purposes. I furthermore cede copyright of the thesis in favour of the University of the Free State.

Signed on this _____day of _____2018.

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Abstract

Introduction: Irrefutable evidence exists that unacceptably low levels of physical activity (PA) exist worldwide in spite of an extensive body of empirical evidence, which demonstrates the physical and psychological health benefits of physical activity. Physical activity is associated with a lower mortality rate for both younger and older male generations. Young male adults attending universities gain increased control over their lifestyles. However, they may not necessarily develop positive behaviours like regular participation in physical activity.

Aims: The main aim of the study was to investigate the PA levels, lifestyle habits and body composition among male students at a university in South Africa. Three objectives were set out for this research: to determine the physical activity levels of male undergraduate students at the University of the Free State, to establish the lifestyle profile and body composition of undergraduate male students at the University of the Free State and to determine the impact of ethnicity on physical activity levels, lifestyle habits and body composition of male students at the University of the Free State.

Methods: A quantitative approach was followed, using a one-time non-randomized cross-sectional study approach. Quantitative methods such as questionnaires and assessments were used. After obtaining ethical clearance, participants were asked to complete the Belloc and Breslow's lifestyle questionnaire. The IPAQ was also completed to determine self-reported fitness levels. Anthropometry testing was then conducted on the participants.

Results: The physical activity levels of the students was determined with 91% participating in PA. However there was a decline in the participation in physical activity through first year (90%) to third year (87.5%). This decline was also evident in the mean MET minutes/week from first year through to third year. The majority of the students were considered to be moderately healthy. There was however no statistically significant associations ($p<0.05$) between ethnicity and year groups and the physical activity and lifestyle habits of male university students.

Conclusion: The students demonstrated high levels of physical activity and are knowledgeable to the health benefits, however there was a decline in the physical activity frequency as well as the mean MET minutes/week from first year through to third year. An interesting finding was a shift in the health categories from low to healthy. There was a slight increase in the body fat percentage of the students which could be attributed to the decline in the mean MET minutes/week.

Keywords: Physical Activity, Lifestyle Habits, Anthropometry, Male Undergraduate Students

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List of Abbreviations

PA:	Physical Activity
BMI:	Body mass index
METS:	Metabolic Equivalent
WHR:	Waist to hip Ratio
CVD:	Cardiovascular disease
CHD:	Coronary heart disease (CHD),
AHA:	American Heart Association
T2DM:	Type 2 Diabetes Mellitus
NIH:	National Institute of Health
CVD:	Cardiovascular disease
CHD:	Coronary Heart Disease
LDL:	Low-density lipoproteins
WC:	Waist circumference
LBM:	Lean body mass
IPAQ:	International Physical Activity Questionnaire
DEXA:	Dual Energy X-ray Absorbtiometry
AHA:	American Heart Association
WC:	Waist Circumference
ACSM:	American College of Sports Medicine
ISAK:	International Society for the Advancement of Kinanthropometry

Chapter 1 – Problem Statement and Objectives

1.1 Introduction

Irrefutable evidence exists that unacceptably low levels of physical activity (PA) exist worldwide (Kwan *et al*., 2012) in spite of an extensive body of empirical evidence, which demonstrates the physical and psychological health benefits of PA (Keating, 2005). Physical activity is associated with a lower mortality rate for both younger and older male generations, a decreased risk of cardiovascular disease mortality in general and coronary heart disease in particular, a decreased risk of colon cancer and a lower risk of developing non-insulin-dependent diabetes mellitus (Warburton, 2006).

Young male adults attending universities gain increased control over their lifestyles. However, they may not necessarily develop positive behaviours like regular PA. In a meta-analysis done by Keating (2005) of male students' PA behaviours, it was found that between 40% and 50% of male university students are physically inactive. Adolescence is considered to be a critical period of development as habits, attitudes and physical morbidity that develop during this phase, may have a pro-found effect on the individual's health and well-being in the long term (WHR, 2010). Desai *et al.* (2008) concurred that male adult's behaviors are shaped during the university years, which makes the time spent at university highly influential with regard to developing a positive PA profile. To make matters worse, longitudinal studies have also demonstrated a decrease in PA during the transitional phase from adolescence (students) to adulthood (Nieman, 2012).

There is limited evidence concerning the health status of young adults (Fletcher *et al*., 2007). Buckworth *et al.* (2003) stated in this regard that there are very few studies that assess the prevalence of exercise behaviour among university students and the factors that may influence the student's decision to participate in exercise. Although several studies were done since 2003 (Buckworth *et al.*, 2003; Bray & Born, 2004) a gap exist in the research regarding the PA levels, lifestyle habits and body composition of male students at South African universities (Pengpid & Pelzer, 2013).

1.2 Problem Statement

According to Bray and Born (2004) there is an increasing need for young adults to participate in some form of PA on a daily basis. University students represent a major segment of the young adult population (Leslie *et al.,* 1999). However, there is very

little recent research which investigates PA levels and lifestyle habits amongst male university students (Pengpid & Peltzer, 2014).

Physical activity levels, lifestyle habits and resulting health status are crucial issues in any society. Low PA is an international phenomenon that must be addressed at all levels of society. This is especially applicable to university students, because young adolescence is considered to be a critical period of development as habits, attitudes and physical morbidity that develop during this phase, may have a pro-found effect on the individual's health and well-being in the long term. This necessitates continuous research on which strategies can be based for the develoment of physical active lifestyles.

1.3 Research Aim and Objectives

The main aim of the study was to investigate the PA levels, lifestyle habits and body composition among male students at a university in South Africa.

The objectives of the study are:

1. To determine the PA levels of male undergraduate students at the University of the Free State.
2. To establish the lifestyle profile and body composition of undergraduate male students at the University of the Free State.
3. To determine the impact of ethnicity on PA levels, lifestyle habits and body composition of male students at the University of the Free State.

1.4 Structure of the dissertation

This dissertation consists of five chapters. Chapter one gives an introduction to the study and provides the reader with an overview of what is to follow. This is followed by a literature review which is presented in Chapter two. The literature review starts broadly on physical activity, body composition and lifestyle habits among the global population. It is later narrowed down to just male university students. The negative effects that physical inactivity has in the long term, and the positive effects that participating in physical activity has on the health and well-being as well as and the need for further research, are addressed. Chapter three discuss the research methodology. This is followed by chapter four which gives a full report of the results of data obtained using the International Physical Activity Questionnaire (IPAQ), Belloc and Breslow Lifestyle Habits Questionnaire, and the Anthropometric assessment. A discussion of the results are provided in Chapter five. Chapter six includes the conclusions drawn and discusses the limitations of the current study in order to provide recommendations for future research. Finally, Chapter seven takes the form of a comprehensive reflection on the research process, and describes some of the researcher's personal experiences and challenges faced in conducting this study.

Chapter 2 – Literature Review

2.1. Introduction

In spite of the positive effects that PA may have on one's health, individuals are adopting a more sedentary lifestyle with a decrease in the PA levels among young people (Bray & Born, 2004; El Ansari *et al.,* 2014). Fountaine *et al*. (2009) stated that College and University is the time when a student has a new found freedom and gain increased control over their lifestyles. According to a study done by El Ansari *et al*. (2014) many behavioral patterns that may have long-term impact on health and chronic disease risk, develop during the transition from adolescents to adulthood. Fountaine *et al.* (2009) concur and state that the most important decision an undergraduate male student has to make in his first year at university, is how to incorporate PA into a busy class schedule to remain physically active and healthy. However, they may not necessarily develop positive behaviors like regular PA during their first years at university. Sailors *et al*. (2010) identified that a major concern in today's general public is the sudden rise in the prevalence in obesity among young male adults, aged 20-39 years. This rise in the prevalence of obesity is associated with a low PA levels.

Weinstein (1987) stated that participation in any form of PA can be used as a trigger mechanism to change other destructive lifestyle habits that someone may have developed. Because of the reducing effect PA has on depression, anxiety and tension, PA can have an indirect effect on the development of several coronary diseases (Braun *et al*., 2010). In order to sustain a good health status, regular PA participation is vitally important. This has been a topic of investigation since the obesity epidemic which has been around for the past 30 years (Prewitt *et al*., 2015).

O'Donnell et al., (2002) defined optimal health as a balance between the physical, emotional, social, spiritual and intellectual health of oneself. Rickert (2010) further stated that the definition of health can be divided into six aspects. These aspects will only be named and not discussed to stay in the context of the study being done. The aspects are:

1. Emotional Health – expressing emotions in a non-destructive and positive manner.

2. Environmental Health – keeping the environment that one lives in clean, food stored safely, and the water and air fresh and clean
3. Mental or Intellectual Health – ability to recognise and cope with the demands of everyday life.
4. Physical health – the way the body functions, this includes, sleeping patterns, regular eating, participation in regular moderate PA, maintaining a recommended body weight, being free of sickness and disease and finally avoiding drugs and alcohol.
5. Social Health – is the quality of the relationships we have with our friends, family, lecturers and others we may have interaction with.
6. Spiritual Health – Living according to ones ethics, morals and values, and maintaining a cohesive relationship with other living things and spiritual direction.

Kowalcze *et al.* (2016) concluded that university students are inclined to be over-burdened with work during their studies which can lead to a decrease in the PA levels and nutritional status.

2.2. Physical Activity

The WHO (2016) defined PA as any movement of the body that is produced by skeletal muscles which requires energy expenditure. Colberg *et al.* (2016) suggests that PA can be divided into aerobic, resistance or strength training, flexibility and balance exercises:

- Aerobic exercise such as walking, jogging, cycling and swimming, all involve a continuous movement of the large muscle groups
- Resistance or strength training exercises involve body weight, free weights and weight machines and resistance bands
- Flexibility exercises aid in improving the range of motion around the joints of the body.
- Balance exercises help prevent falls and aid in improving an individual's GAIT

The WHO (2012) defined inactivity as not achieving a minimum of 30 minutes of moderate intensity PA for five days per week, or at least 20 minutes of vigorous intensity PA for three days per week or a combination. According to a report done by

the World Health Organization, approximately 60% of the global population did not adhere to the minimum daily requirements in 2002 (WHO, 2012). In more recent research done by Sallis *et al.* (2016) the minimum requirements for participation in PA is defined as 150 minutes of moderate intensity PA or 75 minutes of vigorous intensity PA per week. Research showed that there had been a decrease in the prevalence of inactivity among adult populations worldwide, from 31.1% in 2012 to 23.3% in 2016 (Sallis *et al.,* 2016). However this reduction primarily reflects the changes that were made to the minimum requirements rather than an increase in the PA levels worldwide. Further evidence indicates that the epidemic of excess body weight is directly related to an imbalance between dietary intake and low levels of PA, low PA levels which is an international phenomenon (Görner *et al.,* 2009). In a study completed on New Zealand students it was identified that many young adults who attend University do not meet the minimum PA recommendations (Sinclair *et al*., 2005). Recent research done by Sallis *et al.* (2016) in twelve countries, six countries (Argentina, Belgium, Iran, Kuwait, Mongolia and Singapore) reported an increase in the prevalence of physical inactivity . However, the other six countries (Maldives, New Zealand, South Korea, Seychelles, South Africa and the USA) all reported a decrease in the prevalence of PA inactivity (Sallis *et al.*, 2016).

The lack of PA participation has been linked to various medical conditions and impaired brain activity (Prewitt *et al.,* 2015). Alarmingly, reports by the WHO (2012) indicate that physical inactivity is the fourth leading risk factor for the development of global mortality. Increasing levels of physical inactivity are seen worldwide and many lifestyle diseases are developed during the adolescent years. Low levels of PA can lead to an increased risk for the development of the following negative consequences (Eriksson 1986; Kohl *et al.,* 1992, Kampert *et al*., 1996; Wei *et al*., 1999):

- Cardiovascular disease (CVD),
- Coronary heart disease (CHD),
- Hypertension,
- Congestive heart failure,
- Increased atherosclerosis,
- Increase in the low-density lipoproteins (LDL) and triglyceride levels in the blood,

- Overweight and obesity,
- Type-two diabetes mellitus (which is directly influenced by lifestyle habits and obesity).

The question arise what is the minimum requirements to prevent the above-mentioned negative consequences of low PA levels. According to the U.S Department of Health and Human Services (2008) the minimum requirements for PA participation is 150 minutes of moderate intensity PA, or approximately 75 minutes of vigorous intensity PA or a combination of the two (Prewitt *et al*., 2015). The American College of Sports Medicine (ACSM, 2018) along with Prewitt *et al*., (2015) categorized the guidelines set out into four categories and prescribed suggested weekly guidelines (See Table 2.1).

Table 2.1 - Categories of Physical Exercise (ACSM, 2018)

Category	Recommendation
Cardiorespiratory Exercise	30 to 60 minutes of moderate intensity 5 days a week or 20 to 60 minutes of vigorous intensity 3 times per week.
Resistance Exercise	2 to 3 days per week of resistance training with a further breakdown of training prescription including sets, repetitions and intensity level.
Flexibility Exercise	10 to 30 seconds stretches with a total of 60 seconds per movement
Neuromuscular Exercise	2 to 3 days per week of motor skills to help develop everyday physical function.

Lowry *et al.* (2002) mentioned that the best time to establish a positive PA lifestyle is during the university/college phase. Desai *et al.* (2008) concurred that male adult's behaviors are shaped during the university years, which makes the time spent at university highly influential with regard to developing a positive PA profile. The benefits

of such a profile are far reaching. Nolan *et al.* (2011) also stated that there is a positive relationship between regular PA participation and health benefits. Participation in PA is associated with cardiovascular disease prevention and plays a key role in the promotion of good health (Nolan *et al*., 2011). Penedo and Dahn (2005) suggested that there is a positive relationship between PA participation and positive mental and physical outcomes. Hillman (2014) agree, and also indicate that there is growing evidence that emphasizes the role of PA participation on the development and maintenance of an individual's cognitive capacity throughout their lifetime, this argument is supported by Sallis *et al.* (2016) who expressed that there was an improvement in both the cognitive function and scholastic performance among physically active children.

Prewitt *et al.* (2015) conclude that there is a growing need to enhance suitable PA levels, in order to help reverse the ever-increasing trend of obesity and the prevalence of various other health-related diseases. The objective is to increase the students PA levels, however according to Prewitt *et al.* (2015) the primary objective should be to equip students with the necessary knowledge and skills in order to establish lifelong PA participation. Sinclair *et al*. (2005) identified a growing need to develop and implement strategies to promote the benefits of PA, and to encourage university students to participate in some form of PA, in order to reduce the risk of developing lifestyle diseases associated with low PA levels, which were discussed previously in this chapter.

2.3. Body composition

Drenowatz *et al.* (2015) suggested that there is an inverse relationship between moderate to vigorous intensity PA and measures of body composition. The ACSM (2018) states that excess body fat that is located centrally around the abdominal area, is associated with CVD, diabetes mellitus, hypertension, stroke, metabolic syndrome and dyslipidemia. A health-related component of physical fitness such as body composition is distinct to other health-related components. Body composition is not a performance measure and requires no movement (Corbin *et al.,* 2009), although any form of physical movement/activity can have an effect on the body composition of an individual. Body composition can be defined as a relative percentage of body mass that is considered fat and fat-free tissue (Corbin *et al.,* 2009).

The measurement of the body mass index (BMI) in height and weight, circumferences, and skinfolds are used to determine the body composition. Skinfold provides a more accurate estimate of body fatness, than measurements based primarily on height, weight, and circumferences (Thompson *et al.,* 2010). There are various other assessment techniques for body composition (i.e. hydro densitometry, plethysmography, dual energy x-ray absorptiometry (DEXA) etc.). However, for the purpose of this study the following methods were implemented and will therefore be discussed:

- Skinfold Measurements (Fat Percentage and Lean Body Mass);
- Body Mass Index (BMI);
- Circumferences (Waste-to-Hip ratio) (ACSM, 2018)

2.3.1. Skinfold Measurements (Fat Percentage and Lean Body Mass)

As stated in the ACSM's (2018) guidelines for exercise testing and prescription, the principle behind measuring skinfold thickness is that the amount of subcutaneous fat is considered to be proportional to total amount of body fat. It is presumed that nearly a third of the overall body fat is situated subcutaneously (ACSM, 2018).

Heyward and Wagner (2004) further elaborated and that skinfold measurements are considered to be an accurate measure of body fat because 50% of the subcutaneous fat is located under the skin. A skinfold would therefore denote a layer of subcutaneous fat surrounded by two layers of skin. Heyward and Wagner (2004) concur and identified the following advantages when using the basic skinfold measurement technique:

- Measurements are quick and simple to obtain.
- Equipment necessary is considered inexpensive.
- If the correct measurement procedures are followed the results are reliable and it can be taken in the field.
- The method involves low technology and it is relatively simple and easy to use.
- There is little discomfort for the subject, as it is a non-invasive method, which requires little space and time.
- Suitable for large-scale epidemiological surveys.

Skinfold thickness is often used to rank individuals based on relative "fatness", or to assess specific subcutaneous fat deposit sizes (Wells, 2005). Lean body mass (LBM) is defined by Wells (2005) as being comprised of organs, muscle, bones, blood and skin. The LBM compartments (Figure 2.2) is considered to be responsible for the disposal of glucose and the regulation of the metabolism of lipids in the body (Wells, 2005). The LBM compartments is composed of the skeleton, organs, skin and muscle, which are the primary determinants of resting energy expenditure, responsible for whole-body glucose disposal and regulation of lipid metabolism.

Figure 2.1 - Lean Body Mass Compartments (Skeleton, Muscles, Organs, Skin and Blood)

2.3.2. Body Mass Index (BMI)

Body Mass Index (BMI) is determined when the weight of an individual in kilograms (kg) is divided by the height in meters squared (m^2) (kg/m^2) (ACSM, 2018). Wells (2005) suggested that even though BMI is correlated with an individual's fat percentage, BMI can't distinguish between body fat and lean body mass (LBM). The ACSM (2018) indicate that two thirds of the adult population in the USA had been classified as overweight with a BMI greater than $25kg.m^{-2}$, and approximately 33% of those individuals were classed as obese with a BMI greater than 30 $kg.m^{-2}$. There is an increased risk associated with a BMI greater than 30 $kg.m^{-2}$ such as hypertension, sleep apnea, type 2 diabetes mellitus, certain cancers, CVD and mortality (ACSM, 2018). Conversely, an individual with a BMI less than 19 kg.m-2 has an increased mortality risk (ACSM, 2018).

2.3.3. Waist-to-hip ratio (WHR)

The circumference of the waist provides a simple measure of an individual's central fatness. The waist circumference (WC) may be used to predict the risk of lipid profile or insulin resistance developing rather than the total fat (Wells, 2005). Waist circumference is a very delicate and specific measure of the body fat in the upper body and is valuable when classifying overweight and obese adolescents who might be at risk of developing various metabolic conditions (Bacopoulou *et al*., 2015).

The Waist-to-hip ratio (WHR) is defined by the ACSM (2018) guidelines for exercise testing and prescription, as the circumference of the waist (measured above the iliac crest) divided by the circumference of the hips (measured at the maximal circumference of the hip and proximal thigh, just below the gluteal fold). As stated in the ACSM (2018) guidelines for exercise testing the cut off points for WHR are values >0.95 for young men.

2.4. Lifestyle Habits

The relationship between PA and lifestyle can have a significant influence in promoting and maintaining a healthy well-being. An understanding of the relationship between these variables can help the universities create a healthy environment for their students to function in (Stone et al., 2010). Stone et al, (2010) suggests that the investigation of the relationship between PA and sedentary behaviors on the individual's satisfaction with life is most relevant during the individual's university years.

According to a study done by El Ansari *et al.* (2014) on university students in Libya, substantial lifestyle changes were identified that occurred during the time the students attended university. These changes were caused by three main factors namely fast urbanization, high use of automobiles for personal travel and labor-saving appliances in the workplace and residence setting. According to Krishnan and Sharmila (2016) a balanced diet, adequate participation in PA and regular sleeping patterns play an important role in the promotion and maintenance of a healthy lifestyle. Deasy *et al.* (2014) identified that there was a positive relationship between the positive habits of daily living and the participant's healthy life style. However, the question arises what constitutes a healthy life?.

Belloc and Breslow (1972) identified 7 key aspects that impacts on an individual's lifestyle. The aspects are listed below and will subsequently be discusses.

- Eating three meals a day with no in-between snacking
- Eating breakfast
- Participation in moderate PA 2-3 times per week
- No smoking

- Little or no alcohol consumption
- Enough sleep
- Maintaining a healthy body weight

2.4.1. Eating 3 meals per day with no in-between snacking

According to Kowalcze *et al.* (2016) adequate nutrition is one of the vital factors affecting human development and remaining healthy. When starting off at university, students often either need to prepare their own meals or by making use of the facilities on campus (Kowalcze *et al.,* 2016) which may impact negatively on nutrition.

Belloc and Breslow (1972) recommended that meals should have a balance in the nutrients required for daily use. In addition Aragon *et al.* (2015) stated that weight management is predicted based on energy balance. It is important to note, when caloric intake exceeds that of caloric expenditure, an increase in body mass will take place. On the other hand, when caloric expenditure exceeds caloric intake it results in a loss in body mass (Aragon *et al.*, 2015). The excess energy that the body does not make use of is then stored in adipose tissue (Aragon *et al.*, 2015). The energy balance equation is based on the first law of thermodynamics, which states that energy is neither created nor destroyed but instead it is changed from one form to another (Aragon *et al.*, 2015).

Kowalcze *et al.* (2016) found that the most common nutritional or dietary error that university students make was snacking between meals as well as late at night during long study sessions. Belloc and Breslow (1972) stated that snacking between meals only compounds the issue by adding food to the food that is already needed to be digested by the body. However, according to research done by Louis-Sylvestre *et al.* (2003) eating small, frequent meals will enhance fat loss within the body and aides in achieving healthier weight management. This contradicts what Belloc and Breslow (1972) had identified.

2.4.2. Eating Breakfast

Krishnan and Sharmila (2016) referred to breakfast as the first meal to be consumed after a night's sleep, which usually is consumed before the start of the day and is the fuel that keeps the mind, body and brain functioning. Belloc and Breslow (1972) suggested eating breakfast can be considered to be one of the seven healthy habits. They also stated that those individuals who consumed breakfast regularly reported a better quality of life than those who don't eat breakfast. Individuals who do not eat breakfast tend to gain rather than lose weight as they are more liable to over eat later in the day (Krishnan and Sharmila, 2016). The authors maintain that breakfast is considered to be the most important meal of the day, however it is the most ignored meal of the day.

2.4.3. Participation in moderate Physical Activity 2-3 times per week

Belloc and Breslow (1972) identified participation in moderate PA two to three times a week as a healthy lifestyle indicator. This differs from recommendations by various organisations. According to the ACSM (2018) and American Heart Association (AHA) healthy young adults must participate in moderate PA for a minimum of 30 minutes for at least 5 days of the week. However, individuals who want to further improve their physical fitness can exceed the minimum recommendations made by the AHA and the ACSM (2018). Research by Krishnan and Sharmila (2016) indicated that the WHO recommended that individuals participate in at least 150 minutes of moderate intensity PA per week. These recommendations are similar to those made by the AHA and the ACSM (2018).

Belloc and Breslow (1972) identified that participation in any form of moderate intensity PA can have a positive influence on an individual's health. Although the minimum PA duration requirements differ, the necessity and benefits of PA prevails. Several studies have indicated that there are significant risk reductions when an individual partakes in 150 minutes of PA per week which ensure a greater life expectancy (Krishnan & Sharmila, 2016).

2.4.4. No smoking

More than four decades ago Belloc and Breslow (1972) labelled lung cancer is one of the most common epidemics in society which is caused by the smoking of cigarettes. Currently this alarming situation still exists. Jha *et al.* (2013) stated that smoking is a major cause of premature deaths worldwide. Taylor *et al.* (2014) indicated that tobacco is the leading cause of avoidable deaths globally. Krishnan and Sharmila (2016) concur that smoking is responsible for more deaths than adiposity and is considered the largest external cause of non-communicable diseases. However, Nojilana *et al.* (2016) identified that there was a reduction in tobacco smoking in South Africa from 34% in 1995 to 24% in 2009. A more recent study done by Richter and Ellerbeck (2015) found that 17.6% of South Africans smoked tobacco, which is a further reduction from the study done in 2009. This decrease in smoking may be partially attributed to current legislation in South Africa that states that an individual may not smoke any tobacco product in any indoor or partially enclosed area that is open to the public (Sanni *et al*., 2018).

Current cigarette smokers as well as those individuals who have quit smoking within the previous six months is considered to be a CVD risk factor when using the ACSM (2018) guidelines for exercise testing and prescription. In addition Taylor *et al*. (2014) indicate that there is a strong association between poor mental health and smoking.
In contrast, smoking cessation is associated with many mental and physical health benefits and these include the following (Taylor *et al*., 2014):

- Reduction in depression.
- Reduction in stress levels experienced.
- Reduction in anxiety.
- Improvement in the quality of life experienced.

2.4.5. Little/no alcohol consumption

Wikipedia (2018) defined an alcoholic beverage as a drink containing substantial amounts of ethanol (alcohol). Littrell (2014) defined alcoholism as a broad term for any drinking of an alcoholic beverage that may result in either alcohol abuse or alcohol dependence. Research done by the WHO (2016) identified that approximately 208 million people suffer with alcoholism worldwide. A Study done on the South African population showed that approximately 65% of the South African population had never consume alcohol, which is among the highest rates worldwide (WHO, 2016). Alcohol in low doses results in a reduced anxiety levels, and euphoria, however, higher doses of alcohol can lead to intoxication and unconsciousness. Belloc and Breslow (1972) expressed that alcohol consumption can have a negative effect on the bodily functions. Furthermore, consuming alcohol inhibits the process of lipolysis, which is the breakdown of fat in the body as a result there is an increase in the amount of stored fat in the body (Belloc & Breslow, 1972).

White and Hingson (2013) reported that approximately 25 percent of university students in the USA reported various negative consequences of their drinking habits, which include the following:

- Missing classes and lower grades,
- Injuries,
- Sexual assaults,
- Overdoses,
- Memory blackouts,
- Changes in brain function,
- Persistent mental deficits, and
- Death.

A study conducted in South Africa found that there was growing evidence of fairly widespread consumption of alcohol amongst young adults (Chauke *et al.,* 2015). Lategan *et al.* (2017) found that male university students consumed more alcohol than their female counterparts, with 32 percent of male students indicating binge drinking patterns.

2.4.6. Getting Enough Sleep (7-8 Hours)

Wikipedia (2018) defined sleep as a naturally occurring state of body and mind, which is characterized by an altered state of consciousness, inhibited sensory activity, inhibition of all voluntary muscle activity and reduced interaction with surroundings. Belloc and Breslow (1972) indicate that getting an adequate amount of sleep is vital to aid the body in replenishing the energy spent during the day. These benefits are not limited to the replenishing of energy but are far-reaching and diverse. Krishnan and Sharmila (2016) suggested that there are other mental and physical health benefits of getting enough sleep. These include cognitive restitution, processing, learning and memory consolidation. Paruthi *et al.* (2016) conclude that adequate sleep duration is associated with enhanced attention and cognitive function, improved behavior, emotional regulation and physical health among children.

Arora *& Taheri* (2015) also suggested that a lack of sleep may play a significant role in the development of obesity and diabetes, however sleep quality and napping can have a positive impact on the human body. Schlarb *et al.* (2017) found that student's sleeping patterns change significantly at university due to changes in external time triggers such as class schedules and certain lifestyle preferences that are developed when attending university. A study done by Arora *et al.* (2015) identified that sleep duration and quality have emerged as potential contributors to metabolic dysfunction, diabetes and obesity. This study monitored the sleep patterns of 750 Japanese workers without diabetes, and the results showed that the individuals with a poorer overall sleep quality were four times more likely to develop diabetes (Arora *& Taheri*, 2015). Krishnan and Sharmila (2016) avers that individuals who sleep less are more disposed to the following:

- Emotional instability
- Cognitive dysfunction
- Decreased concentration
- Memory loss
- Daytime sleepiness

Table 2.2 display the National Sleep Foundation (2015) recommended sleep range durations based on an individual's age.

Table 2.2 - Sleep Range Recommendations (National Sleep Foundation, 2015)

Category	Revised Sleep Range	Previous Sleep Range
Newborns *(0-3 months)*	Sleep range was narrowed to 14-17 hours per day	12-18 hours per day
Infants *(4-11 months)*	Sleep range was widened to 12-15 hours per day	14-15 hours per day
Toddlers *(1-2 years)*	Sleep range was widened to 11-14 hours per day	12-14 hours per day
Pre-school *(3-5 years)*	Sleep range was widened to 10-13 hours per day	11-13 hours per day
Primary School Children *(6-13 years)*	Sleep range was widened to 9-11 hours per day	10-11 hours per day
High School Children *14-17 years)*	Sleep range was widened to 8-10 hours per day	8.5-9.5 hours per day
Young Adults *(18-25 years)*	Sleep range is 7-9 hours	**New age category*
Adults *(26-64 years)*	Sleep Range is 7-9 hours	No change
Older Adults *(65+ years)*	Sleep Range is 7-8 hours	**New age category*

University students will fit into the young adults section with a suggested seven to nine hours sleep.

2.4.7. Maintaining a healthy body weight

Mchiza *et al.* (2016) defined a healthy body weight as having a BMI of 18.5 – 24.9 kg m^2. The ACSM (2018) expressed that a range of 10-22% body fat has long been viewed as satisfactory for a healthy body weight. Mchiza *et al.* (2016) summarized that there are a large number of underweight and overweight South Africans who are unaware that they are at risk of developing various CVD in the long term.

The ACSM (2018) suggested that individuals who have a BMI greater than 30kg m^2 are at greater risk of developing the following metabolic conditions:

- Increased risk of hypertension,
- Sleep Apnoea,
- Type 2 Diabetes Mellitus (T2DM),
- Certain Cancers,
- Cardiovascular Diseases (CVD) and
- Mortality

Johns *et al.* (2014) suggests that it is unclear what the most effective weight management treatment is. Physical Activity and appropriate dieting have been identified as being important aspects with regard to weight loss (Johns *et al*., 2014). As stated in research done by the National Institute of Health (NIH) the benefits of maintaining a healthy body weight include a reduction in the onset of diseases and conditions, increased energy levels to participate in PA, and an improved self-image (NIH, 2017). Energy balance, which can be defined as a balance between your caloric intake and caloric expenditure, is important when maintaining a healthy body weight (NIH, 2017). The NIH (2017) conclude that for an individual to maintain a healthy body weight one would have to follow a healthy diet, participate in regular PA and limit the amount of time spent being physically inactive or sedentary.

2.5. Barriers of Physical Activity and Lifestyle

In order to gain a better understanding into the PA patterns of university students knowledge of the perceived barriers that students face is essential (Daskapan *et al*., 2006; Gyurcsik *et al*., 2006; Bray, 2007; Ebben & Brudzynski, 2008; Gómez-López *et al*., 2010; El-Gilany *et al*., 2011; Sweeney, 2011; Jackson & Dimmock, 2012). Aumand *et al*. (2009) identified eight factors that motivated an individual to partake in PA. These factors are skill development, fun, friendship, achievement or status, competition or competence, energy release, fitness and situational factors. However, there are various factors that can lead an undergraduate student to adopting a more sedentary lifestyle, rather than participating in PA. Therefore, it is important to identify the barriers that students may face when attempting to participate in PA. A lot of research have been done on barriers in PA participation. Research done by Bloemhoff and Coetzee (2007) indicated that there are three prevalent barriers inhibiting university students from participating in PA. They are in sequence of perceived importance, study responsibilities, lack of time and lack of motivation. Aumand *et al.* (2009) also identified lack of time, followed by social influences, and lack of energy, lack of willpower, fear of injury/re-injury, lack of skill and lack of resources. Prewitt *et al.* (2015) found that the strongest psychological predictors of PA participation were self-efficacy, lack of time, lack of energy, lack of facilities and environmental factors and a change in the social circle. These factors were found to have a negative relationship with PA levels. Aumand *et al.* (2009) identified that male students in Australia experienced perceived barriers to PA greater than the female students did. These barriers include the following: lack of time, social influence, lack of energy, lack of willpower and lack of skill. The importance of lack of time as a perceived barrier is obvious.

Based on research completed by Bloemhoff (2010) at the same institution that this research was done, the following barriers will be discussed: lack of time, lack of energy and lack of facilities.

2.5.1. Lack of Time

Gyurcsik *et al.* (2004) identified that the most prevalent barrier that students face is time management and the amount of work that has to be completed in their first year of university or college. Sinclair *et al.* (2005) also identified increased time pressure through the course workload as a reason why students cease participation in PA at University. Results of a study done by Kwan and Faulkner (2011) identified that many students were lacking confidence in their time management skills; some students found it easier to procrastinate while others professed that they lacked control over time. Daskapan *et al.* (2006) also found similar trends in the barriers faced by university students with lack of time being the most predominant barrier faced.

2.5.2. Lack of Energy

Numerous studies have found that the greatest barrier that students faced in PA was a lack of energy to participate in PA (Daskapan *et al*., 2006; Gyurcsik *et al*., 2006; Bray, 2007; Ebben & Brudzynski, 2008; Gómez-López *et al*., 2010; El-Gilany *et al*., 2011; Sweeney, 2011; Jackson & Dimmock, 2012; Egli *et al*., 2011). Egli *et al*. (2011) also found that students reported a lack of energy as a prevalent barrier to PA participation during their time at university.

2.5.3. Lack of Facilities

It was identified that most universities have the facilities and resources at their disposal to enhance the PA levels and patterns of the students (Suminski *et al*., 2002; Bloemhoff, 2010; Jones & Barrie, 2011). However, Kwan and Faulkner (2011) reported that first year students were overwhelmed because they may not have access to similar facilities than what they were exposed to in high school. Bloemhoff (2010) reported that the potential decline in PA levels of the students occurred in a setting where there was an abundance of opportunities for the students, leading to the under-utilization of facilities.

2.6. Ethnic Differences in PA

South Africa is known worldwide for its ethnic diversity with 11 official languages spoken around the country. Predictions of PA are frequently done according to ethnicity (Wushe *et al.,* 2014) but there is not consensus on the impact thereof. This is confirmed by Keating (2005) who stated that there were inconsistent results when determining the PA levels of the various ethnic groups in the USA. McVeigh *et al.* (2004) recognized that there were substantial racial differences regarding the configuration of activities in the South Africa primary and secondary school systems.

Blanchard *et al.* (2008) summarized that the PA levels were lower for African-American students in the USA. However, research completed at a South African university by Bloemhoff (2010) found that African students demonstrated a higher PA participation levels than the white students. Janse van Rensburg (2018) further identified that African and Coloured students were more likely to participate in the main sporting codes at a South African university. Due to the inconsistent results on the impact of ethnicity on PA the following question arises: is ethnicity a predictor of PA among male South African students?

2.7. Gender Differences in PA

There is very little recent research that has been done on the PA levels of male university students and the impact that gender may have on the PA levels (Pengpid & Peltzer, 2013). Keating (2005) suggested that there were conflicting findings with regard to the impact of gender differences on the PA levels. A study done by Behrens and Dinger (2003) stated that there were no gender differences in PA. However Sallis *et al.* (2016) suggest that prominent differences remain in the prevalence of the level of physical inactivity between males and females, with 137 of the 146 countries showing higher physical inactivity among women. Research by Miller *et al.* (2005) identified that females were considered to be increasingly likely to participate in moderate intensity PA than males. This contradicts the findings of Keating (2005) and Behrens and Dinger (2003) who indicate that males participated in more moderate to vigorous intensity exercises than females.

2.8. Physical Activity Levels of Male Students

If an individual does not understand how important it is to maintain a healthy body weight, or being physically active, or have inadequate knowledge on how to apply these aspects to their everyday lives, it may have long-term effects on their motivation to participate in PA as well as their PA choices (Prewitt *et al*., 2015).

Gyurcsik *et al.* (2004) stated that the transition that a male individual undergoes from secondary school to university is associated with a decrease in PA. Approximately 43% of male college undergraduate students in the United States of America (U.S.A.) reported a sedentary lifestyle (Sailors, 2010). A sedentary lifestyle is characterized as not participating in 30 minutes of PA for 3 days a week for at least 3 months (Gyurcsik *et al.,* 2004). Collings *et al.* (2014) suggested that the healthy benefits of partaking in low intensity PA is largely unknown and additional research is needed to identify the health benefits of low intensity PA among male adolescents (Collings *et al.*, 2014). Research by King *et al.* (2013) found that 9.6% of the male students in the United States who took part in the study reached the minimum PA recommendations of the ACSM (2018) and the AHA. Research completed by DeVahl *et al.* (2005) found that 32% of male university students in Australia were not sufficiently participating in PA.

A review was completed by Irwin in 2004 on students in the U.S.A. and Canada and it was found that 50% of the male students who participated in the study were not physically active (Irwin, 2004). A similar study was done by Sinclair *et al*. (2005) on the first year male students in New Zealand and it was found that 60% of the first year male students were physically inactivity, which can have serious negative implications for their future health and well-being. King *et al.* (2013) identified that approximately 21.4% of male students in the USA met the public health recommendations. The recommendation entails that individuals participate in at least 30 minutes of moderate intensity PA for 5 or more days per week (American College Health Association, 2010; Haskel *et al.*, 2007; King *et al.*, 2013).

2.9. Lifestyle Habits of Male Students attending University

Belloc and Breslow (1972) identified certain lifestyle habits that can help reduce the risk of disease and prolong an individual's lifespan. These include eating at least three meals a day without any in-between snacking, eating breakfast, and participation in moderate PA two to three days per week, no smoking, little or no alcohol consumption getting enough sleep and maintaining a healthy body weight.

University years often correspond with the change from adolescence to adulthood. This is considered to be a vulnerable period where many lifestyle decisions are made (Deasy *et al*., 2014). Stone (2010) identified that a male individual's lifestyle worsens more between the ages of 18-25 years than any other time. A male student's overall satisfaction with life (as influenced by lifestyle habits) plays an important role in maintaining a healthy well-being (Diener & Chan, 2011). Benefits include a decrease in depressive symptoms and an increase in the efficiency of work that the student undertakes. Deasy *et al.* (2014) suggested that the high levels of alcohol consumption among university students is a matter of public health concern. Males were identified to consume larger amounts of alcohol than female students. Deasy *et al.* (2014) conclude that cigarette smoking, unhealthy dieting patterns and low levels of PA are of major concern for the male university student population. These lifestyle indicators are incorporated in the Belloc and Breslow (1972) lifestyle indicators. Stress has also been identified as an underlying cause for the adoption of unhealthy behaviors among male university students (Deasy *et al*., 2014).

It is obvious that the lifestyle that students adopt when attending College or University is questionable and further research is needed in order to develop strategies to improve the lifestyle habits of college and university students.

2.10. Body Composition of Male students

Prewitt *et al.* (2015) indicated that the obesity rate in the US has increased exponentially from 15% to 30% in adults, and 5% to 18% in adolescents. King *et al.* (2013) also stated that the obesity levels among university students in the USA had increased from 20.5% in 1995 to 32.4% in 2011 (American College Health Association, 2011). Table 2.3 below represents the health risk that is associated with the body fat percentage and Body Mass Index (BMI) (ACSM, 2018). As stated in the literature by Goon *et al.* (2014) South African males had a significantly lower percentage body fat (16.1 ± 7.7%, 95% CI = 15.5, 16.8) than females (22.7 ± 5.7%, 95% CI = 22.3, 23.2). Table 2.4 shows the fitness categories for Body Composition (% Body Fat) for Men by Age (ACSM, 2018). It is interesting to note the increase in body fat percentage in the different age categories.

Table 2.3 - Predicted Body Fat Percentage Based on Body Mass Index (BMI) for Male African American and White Adults (ACSM, 2018)

BMI ($kg.m^{-2}$)	Health Risk	20-39 years	40-59 years	60-79 years
<18.5	*Low*	<8%	<11%	<13%
18.6 – 24.9	*Average*	8% - 19%	11% - 21%	13% - 24%
25.0 – 29.9	*Elevated*	20% - 24%	22% - 27%	25% - 29%
>30	*High Risk*	≥25%	≥28%	≥30%

Table 2.4 - Fitness Categories for Body Composition (% Body Fat) for Men by Age (ACSM, 2018).

		Age (Year)					
%		**20-29**	**30-39**	**40-49**	**50-59**	**60-69**	**70-79**
99	**Very Lean [a]**	4.2	7.3	9.5	11.0	11.9	13.6
95		6.4	10.3	12.9	14.8	16.2	15.5
90	**Excellent**	7.9	12.4	15.0	17.0	18.1	17.5
85		9.1	13.7	16.4	18.3	19.2	19.0
80		10.5	14.9	17.5	19.4	20.2	20.1
75	**Good**	11.5	15.9	18.5	20.2	21.0	21.0
70		12.6	16.8	19.3	21.0	21.7	21.6
65		13.8	17.7	20.1	21.7	22.4	22.3
60		14.8	18.4	20.8	22.3	23.0	22.9
55	**Fair**	15.8	19.2	21.4	23.0	23.6	23.7
50		16.6	20.0	22.1	23.6	24.2	24.1
45		17.5	20.7	22.8	24.2	24.9	24.7
40		18.6	21.6	23.5	24.9	25.6	25.3
35	**Poor**	19.7	22.4	24.2	25.6	26.4	25.8
30		20.7	23.2	24.9	26.3	27.0	26.5
25		22.0	24.1	25.7	27.1	27.9	27.1
20		23.3	25.1	26.6	28.1	28.8	28.4
15	**Very Poor**	24.9	26.4	27.8	29.2	29.8	29.4
10		26.6	27.8	29.2	30.6	31.2	30.7
5		29.2	30.2	31.3	32.7	33.3	32.9
1		33.4	34.4	35.2	36.4	36.8	37.2
n=		1844	10099	15073	9255	2851	522

Total n= 39644

[a]Very Lean, no less than 3% body fat is recommended for men

The ACSM (2018) guidelines for exercise testing and prescription indicate that a BMI greater than 25 is classed as overweight, and obesity related health risks increase when an individual's BMI exceeds 25. Table 2.5 ACSM's (2018) shows the classification of and individuals BMI as well as their risk of developing metabolic diseases based on their BMI and Waist circumference.

Table 2.5– Classification of Disease Risk based on BMI and Waist Circumference (Males) (ACSM, 2018)

Class	BMI(kg.m^{-2})	*Disease Risk Relative to Normal Weight and Waist Circumference*	
		Men ≤102cm	**Men >102cm**
Underweight	<18.5	**-**	**-**
Normal	18.5 - 24.9	**-**	**-**
Overweight	25.0 – 29.9	Increased	High
Obesity Class I	30.0 – 34.9	High	Very high
Obesity Class II	35.0 – 39.9	Very high	Very high
Obesity Class III	≥40.0	Extremely high	Extremely high

Wells (2005) conclude that BMI is extensively used as an index of nutritional status, and is used when categorizing the following, overweight/obesity, psychological and eating disorders. The ACSM (2018) also suggested that an individual's health risk increases as the Waist-to-Hip Ratio increases. This is presented in Table 2.6 below.

Table 2.6 – Risk Criteria for Waist Circumferences in Male Adults (ACSM, 2018)

Risk Category	Waist Circumference cm
Very low	<80 cm
Low	80 - 99 cm
High	100 - 120 cm
Very high	>120 cm

2.11. Chapter Summary

According to the WHO (2011), physical inactivity is the fourth leading risk factor for the development of global mortality. Increasing levels of physical inactivity are seen

worldwide and as a result, many lifestyle diseases are developed during the adolescent years. Bray and Born (2004) stated that there is an increasing need for PA among young adults, but the development of positive behaviors like regular PA during their first years at university does not necessarily take place. It is assumed that students who have adequate exposure to a well-structured sport and recreational infrastructure on campuses are increasingly likely to maintain an adequate level of PA than individuals who are not. However, research has indicated that a well-developed sport and recreation infrastructure does not guarantee adequate male student PA levels (Bloemhoff, 2010).

The relationship between PA and the lifestyle habits can have a significant influence in promoting and maintaining a healthy well-being and having a better understanding of the relationship between these variables can help universities create a healthy environment for their students to function in (Stone et al., 2010). However, Prewitt *et al.* (2015) identified many barriers that students faced when attending university. These perceived barriers were found to have a negative relationship with participation in PA.

Peltzer *et al.* (2014) identified that male students were more physically active than female students. According to a study done on South African university students it was identified that there was a higher percentage of male than female students who participated in PA (Janse van Rensburg, 2018). Unfortunately, without other South African studies with which to compare the results, it is difficult to indicate if gender or race can be seen as a predictor of an undergraduate students' PA participation

It is clear from the literature that there is very little recent research available which investigates PA levels and lifestyle habits amongst male university students and future research is needed to assess the PA levels and lifestyle habits of male university students (Pengpid & Peltzer, 2013).

Chapter 3 – Methodology

3.1. Introduction

This chapter will describe the research protocol used to underpin data collection to achieve the aims stated in Chapter 1. A description of the research approach, the participants, all instruments and methods used as well as more detailed information on data processing and analysis will be given. In preparation for this study, literature was collected from electronic databases such as Kovsiekat, Pubmed, EbscoHost, ScienceDirect. Relevant academic journals and textbooks were consulted to inform methodological considerations.

3.2. Study Design

This study could be described as a one-time non-randomized cross-sectional study, based on an available population of male students at the University of the Free State. The research was focused within the descriptive paradigm and intends to document the PA levels, life style habits and anthropometry data of the male students.

3.3. Structure of Methodology

The process that was followed is indicated in Figure 3.1.

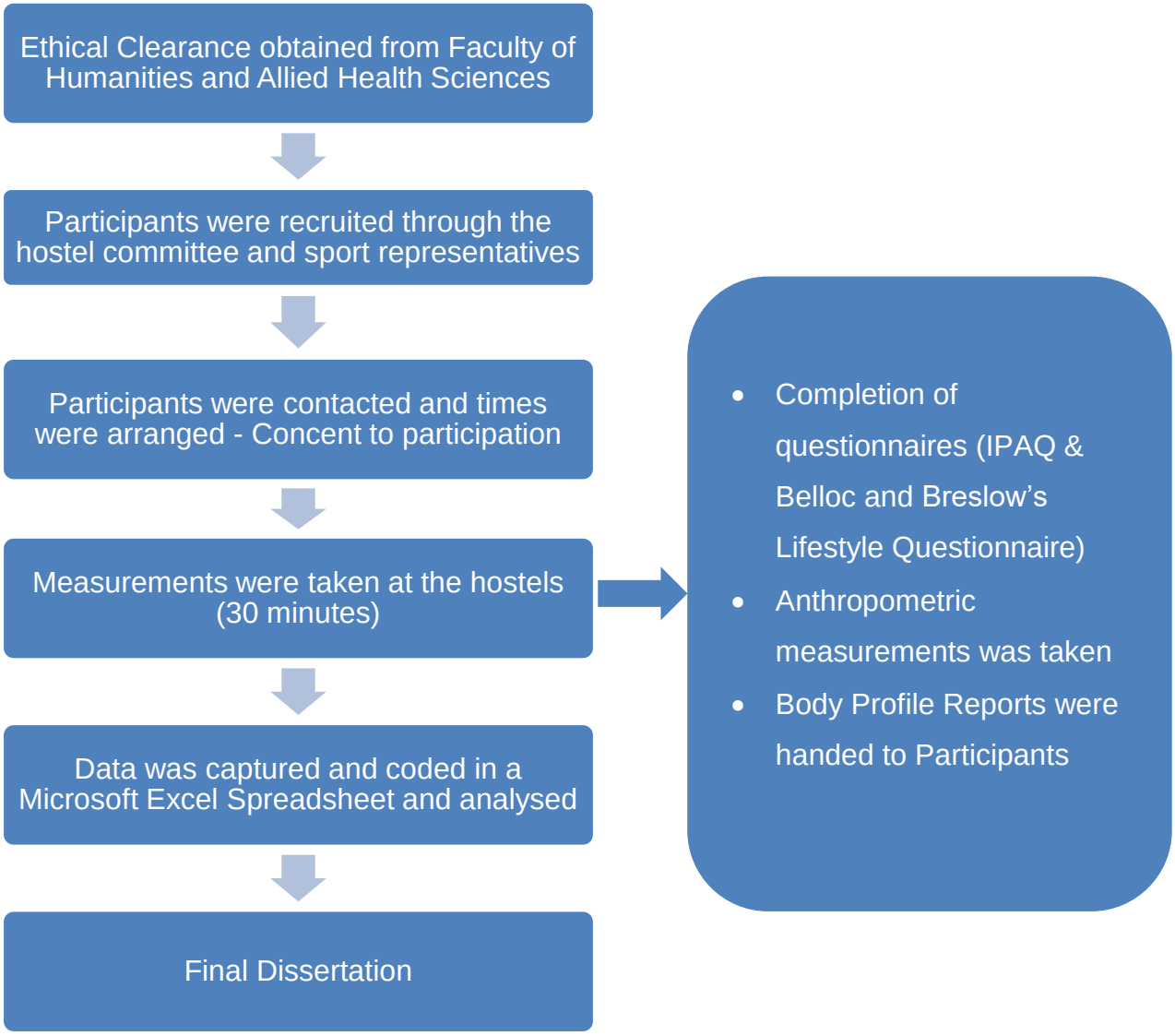

Figure 3.1 - Methodology structure

3.4. Study Participants

3.4.1. Study Population

A convenient sample of male undergraduate students registered at the University of the Free State in their 1st, 2nd and 3rd year of study were invited to participate in the study. The sample consisted of 200 male students. The demographic information will be discussed in Chapter 4.

3.4.2. Sample Selection

Subjects were recruited via the Hostel Committees. Contact was made with the sports representative on the hostel committees through Kovsie Sport and they were involved in the recruiting of participants for the study. An information letter was distributed to all the students residing in the hostels which informed them about the study and the procedures that were involved in the actual assessment. All the subjects who volunteered to participate in the research project received a comprehensive body composition report directly after the completion of the anthropometrical assessments and questionnaires. The report included the participant's muscle mass, leanness, fatness and ideal body weight. The inclusion and exclusion criteria for this project are the following:

3.4.3. General Inclusion Criteria

- Participant must be male.
- Participant must be registered with the University as an undergraduate student.
- The participant must understand English or Afrikaans.

3.4.4. General Exclusion Criteria

- Any student enrolled for an Honours, Masters or PHD degree at the University.
- Not registered at the University of the Free State.
- Female Students.

3.5. Procedures and Instrumentation

The researcher made use of an Information sheet and informed consent form prior to participation. Two questionnaires and a measurement protocol were used to determine the barriers that have an impact on PA participation, the PA levels (IPAQ), the lifestyle habits (Belloc and Breslow), and the body composition (Heath and Carter Anthropometric Assessment) of the students.

3.5.1. Informed Consent

Informed consent was obtained from the students prior to the participation of the research (Appendix E). Each student was presented with an information sheet (Appendix F) outlining the procedures and possible benefits of participation and confidentiality of participation.

3.5.2. The International Physical Activity Questionnaire (IPAQ)

It is well known that physical inactivity is a global concern, however there are diverse physical activity measures in use that prevent international comparisons (Craig *et al*.,2003). The International Physical Activity Questionnaire (IPAQ) was developed by a working group initiated by the WHO (Craig *et al*., 2003).

The IPAQ (Appendix A) was developed as a self-reported measure of PA suitable to facilitate cross-cultural comparisons of PA levels in populations across countries. The repeatability of the IPAQ short form questionnaire was at a satisfactory level, with 75% of the correlation coefficients observed above 0.65 and ranging from 0.88 (USA2 and GU Ub) to 0.32 (rural SA). The pooled data was 0.76 (95% CI 0.73–0.77) (Craig *et al*., 2003).

A review reported reliability correlations which ranged from 0.34 to 0.89, with a median of about 0.80 (Shephard, 2003). The acceptance reliability and validity of the IPAQ resulted in the WHO and the EU using it on both a global and a regional scale. (Appendix A – IPAQ).

The IPAQ is scored in 3 categories from low to high (IPAQ, 2005):

Category 1: Low

This is the lowest level of physical activity. Individuals who do not meet criteria for categories 2 or 3 are considered to have a 'low' physical activity level.

Category 2: Moderate

The pattern of activity to be classified as 'moderate' is either of the following criteria namely:

- 3 or more days of vigorous intensity activity of at least 20 minutes per day, OR
- 5 or more days of moderate intensity activity and/or walking of at least 30 minutes per day, OR
- 5 or more days of any combination of walking, moderate intensity or vigorous intensity activities achieving a minimum total physical activity of at least 600 MET-minutes/week.

Category 3: High

A separate category labeled 'high' can be computed to describe higher levels of participation. The two criteria for classification as 'high' are:

- Vigorous intensity activity on at least 3 days achieving a minimum total physical activity of at least 1500 MET-minutes/week, OR

7 or more days of any combination of walking, moderate intensity or vigorous intensity activities achieving a minimum total physical activity of at least 3000 MET-minutes/week.

MET Levels

Data that was collected by the IPAQ questionnaire was calculated as a continuous measure. This was carried out by weighting each type of PA by its energy requirements defined in METs to yield a score in MET minutes. One MET corresponds to a person's energy expenditure at rest (3.5 ml O_2 kg-1 min -1) and should be considered as an approximate, since specific activities may result in values over or underestimating energy expenditure (Sjöström *et al.,* 2002). A MET minute is calculated by multiplying the MET score of an activity by the minutes performed. MET minute scores are equivalent to kilocalories for a 60-kilogram person. Kilocalories may

be determined from MET minutes using the following equation: MET minutes' x (weight in kilograms/60 kilograms (IPAQ Research Committee, 2005).

As recommended by the IPAQ Research Committee (2005) the following data processing rules were applied:

- All responses to duration (time) were converted into minutes.
- All cases in which the sum total was greater than 960 minutes (unreasonably high), were excluded.
- Only values of 10 or more minutes of activity were included in the calculation of summary scores, the rationale being that scientific evidence indicates that episodes of at least 10 minutes are required to achieve health benefits.

MET minute per Week of the students

The following values were used for the analysis of IPAQ data:

- Walking = 3.3 METs
- Moderate physical activity = 4.0 METs
- Vigorous physical activity = 8METs

Using these values, four scores can be calculated as illustrated in Table 3.1

Table 3.1 - Computation of MET minutes / week (continuous scores)

Activity Level	MET Calculation
Walking *MET – minutes/week*	*3.3* walking minutes * walking days*
Moderate *MET – minutes/week*	*4.0* moderate – intensity activity minutes * moderate days*
Vigorous *MET – minutes/week*	*8.0* vigorous – intensity activity minutes * vigorous intensity days*
Total Physical Activity *MET – minutes/week*	*Sum of Walking + Moderate + Vigorous MET – minute / week scores*

MET Categories

Table 3.2 represents the criteria that was used when categorizing the students MET scores.

Table 3.2 - Categorical scores

Category	*Criteria*
1. Low	Less than 600 MET – minutes/week. (Does not meet the criteria for categories 2 or 3)
2. Moderate	Five or more days of any combination of walking, moderate – intensity or vigorous intensity activates achieving a minimum total physical activity of at least 600 MET- minutes / week.
3. High	Seven or more days of any combination of walking, moderate – intensity or vigorous intensity activities achieving a minimum total physical activity of at least 3000 MET – minutes/week.

3.5.3. Belloc and Breslow's 7 Lifestyle Habits Questionnaire

Belloc and Breslow (1972) described the relationship between physical health status and various health practices as "a striking examination that demonstrates the relationship between the whole spectrum of physical health and actual day-to-day practices." (Wilson & Elinson, 1977). An analysis done by Belloc and Breslow (1972) identified that there was a positive relationship between the positive habits of daily living and the participants healthy life style.

This lifestyle questionnaire (Appendix B) uses seven key aspects that lead to a healthy lifestyle to formulate the questions (Wilson & Elinson, 1977), These include the following:

- Eating 3 meals a day without in-between eating;
- Having breakfast;
- Participating in moderate physical activity for at least 2-3 times per week;
- No smoking;
- Little or no alcohol intake;
- Enough sleep (7-8 hours);
- Maintaining a healthy body weight.

According to Belloc and Breslow (1972) these lifestyle habits are rated according to the amount of habits the individual adheres to:

- ≤ 3 lifestyle habits = poor health lifestyle;
- 4-5 lifestyle habits = moderate health lifestyle;
- 6-7 lifestyle habits = healthy lifestyle.

3.6. The Heath and Carter Anthropometric Assessment

Carter (2002) identified that an anthropometric profile of an individual can be used to identify possible PA levels. The purpose of completing this assessment was to ascertain the possible anthropometric profile of male undergraduate students and to determine any relationships between the PA levels and lifestyle habits and the anthropometric profile of the students.

The measurements were taken on the right side of the body in an upright standing position, with exception of the Medial Calf, which was taken in the sitting position, (Carter & Heath, 1990) and two measurements at each site. Should there be a significant difference between the two measurements then a third measurement was taken and the mean value of the three measurements then stood as the final measurement (Carter, 2002).

The reliability and validity of the measurements comes down to the accuracy and ability of the measurer (Carter, 2002). The assessment was carried out by a level one anthropometrist (the researcher), who made use of the guidelines outlined by the International Standards for Anthropometric Assessment (ISAK). The completion of the questionnaires and the anthropometrical assessments did not exceed 30 minutes per subject. (Appendix A – Heath and Carter Assessment Sheet).

According to the ACSM (2018) a consensus opinion for an exact body fat percent value associated with healthy lifestyle is yet to be defined, however a range of 10% - 22% is viewed as satisfactory.

Basic Measurement

Height and weight was also part of the variables measured.

- Height was measured with two flexible steel (anthropometric) tapes each 1.5m long placed against the wall to measure the individuals' height.
- Weight was measured with calibrated and standardized scale.

Skinfold Measurement

The following skin fold measurements were performed according to the Heath and Carter Anthropometric Assessment protocol:

- Triceps
- Subscapular
- Suprailliac
- Abdominal/Para-Umbilicus
- Anterior Mid-Thigh
- Medial Calf.

Triceps

Definition: The most posterior part of the Triceps when viewed from the side at the marked Mid-acromiale-radiale level.

Subject position: When marking the sites for the Triceps skinfold the subject assumes the anatomical position.

Location: The Triceps skinfold site is marked over the most posterior part of the Triceps when viewed from the side at the marked Mid-acromiale-radiale level.

Subscapular

Definition: The site 2 cm along a line running laterally and obliquely downward from the Subscapular landmark at a 45° angle.

Subject position: The subject assumes a relaxed standing position with the arms hanging by the sides.

Location: Use a tape measure to locate the point 2 cm from the Subscapular in a line 45° laterally downward.

Suprailliac

Definition: The site at the center of the skinfold raised immediately above the marked Iliocristale.

Subject position: The subject assumes a relaxed position with the left arm hanging by the side and the right arm abducted to the horizontal.

Location: This skinfold is raised immediately superior to the Iliocristale. Align the fingers of the left hand on the Iliocristale landmark and exert pressure inwards so that the fingers roll over the iliac crest. Substitute the left thumb for these fingers and relocate the index finger a sufficient distance superior to the thumb so that this grasp becomes the skinfold to be measured. Mark the center of the raised skinfold. The fold runs slightly downwards anteriorly as determined by the natural fold of the skin.

Abdominal/Para-Umbilicus

Definition: The site 5 cm to the right hand side of the omphalion (midpoint of the navel).

Subject position: The subject assumes a relaxed standing position with the arms hanging by the sides.

Location: This is a vertical fold raised 5 cm from the right hand side of the omphalion.

Anterior Mid-Thigh

Definition: The site at the mid-point of the distance between the Inguinal fold and the anterior surface of the patella (Anterior patalla) on the midline of the thigh.

Subject position: The subject assumes a seated position with the torso erect and the arms hanging by the sides. The knee of the right leg should be bent at a right angle.

Location: The measurer stands facing the right side of the seated subject on the lateral side of the thigh. The site is marked parallel to the long axis of the thigh at the mid-point of the distance between the Inguinal fold and the superior

margin of the anterior surface of the patella (while the leg is bent). The Inguinal fold is the crease at the angle of the trunk and the thigh. If there is difficulty locating the fold the subject should flex the hip to make a fold. Place a small horizontal mark at the level of the mid-point between the two landmarks. Now draw a perpendicular line to intersect the horizontal line. This perpendicular line is located in the midline of the thigh. If a tape is used be sure to avoid following the curvature of the surface of the skin.

Medial Calf.

Definition: The site on the most medial aspect of the calf at the level of the maximal girth.

Subject position: The subject assumes a relaxed standing position with the arms hanging by the sides. The subject's feet should be separated with the weight evenly distributed.

Location: The level of the maximum girth is determined and marked with a small horizontal line on the medial aspect of the calf. The maximal girth is found by using the middle fingers to manipulate the position of the tape in a series of up or down measurements to determine the maximum girth. View the marked site from the front to locate the most medial point and mark this with an intersecting vertical line.

Circumference Measurements

The following circumference measurements were performed according to the Heath and Carter Anthropometric Assessment protocol:

- Waist
- Hip
- Arm (relaxed)
- Arm tensed (flexed)
- Calf (Maximum)

Waist

Subject position: The subject assumes a relaxed standing position with the arms folded across the thorax.

Method: This girth is taken at the level of the narrowest point between the lower costal (10th rib) border and the iliac crest. The anthropometrist stands in front of the subject who abducts the arms slightly allowing the tape to be passed around the abdomen. The stub of the tape and the housing are then both held in the right hand while the anthropometrist uses the left hand to adjust the level of the tape at the back to the adjudged level of the narrowest point.

The anthropometrist resumes control of the stub with the left hand and using the cross-hand technique positions the tape in front at the target level. The subject is instructed to lower their arms to the relaxed position. The tape is then readjusted as necessary to ensure it has not slipped and does not excessively indent the skin. The subject should breathe normally and the measurement is taken at the end of a normal expiration (end tidal). If there is no obvious narrowing the measurement is taken at the mid-point between the lower costal (10th rib) border and the iliac crest.

The ACSM (2018) risk criteria for waist circumference in male adults is scored into 4 different risk categories from very low to very high:

Very low:	<80cm (<31.5 in)
Low:	80 – 99cm (31.5 – 39.0 in)
High	100 – 120cm (39.5 – 47.0in)
Very High	>120cm (>47.0 in)

Hip

Subject position: The subject assumes a relaxed standing position with the arms folded across the thorax. The subject's feet should be together and the gluteal muscles relaxed.

Method: The girth is taken at the level of the greatest posterior protuberance of the buttocks which usually corresponds anteriorly to about the level of the symphysis pubis. The anthropometrist passes the tape around the hips from the side. The stub of the tape and the housing are then both held in the right hand while the anthropometrist uses the left hand to adjust the level of the tape at the back to the adjudged level of the greatest posterior protuberance of the buttocks. The anthropometrist resumes control of the stub with the left hand, and using the cross-hand technique, positions the tape in front and the sides so that the tape is held in a horizontal plane at the target level. The tape is then readjusted as necessary to ensure it has not slipped and does not excessively indent the skin.

Arm (Relaxed)

Subject position: The subject assumes a relaxed standing position with the arms hanging by the sides. The subject's right arm is abducted slightly to allow the tape to be passed around the arm.

Method: The girth of the arm is measured at the marked level of the Mid-acromiale-radiale. The tape should be positioned perpendicular to the long axis of the arm.

Arm (Tensed/Flexed)

Subject position: The subject assumes a relaxed standing position with the left arm hanging by the side. The subject's right arm is raised anteriorly to the horizontal with the forearm supinated and flexed at about 45-90° to the arm.

Method: The flexed and tensed arm girth is measured at the level of the peak of the contracted Biceps. The measurer stands to the side of the subject and with the tape loosely in position. The subject is asked to partially tense the elbow flexors to identify the probable peak of the contracted muscles. The subject is encouraged to contract the arm muscles as strongly as possible and hold it while the measurement is made at the peak of the Biceps. If there is no

obvious peak of the Biceps this girth should be measured at the level of the Mid-acromiale-radiale landmark.

Calf (Maximum)

Subject position: The subject assumes a relaxed standing position with the arms hanging by the sides. The subject's feet should be separated with the weight evenly distributed.

Method: The maximum girth of the calf at the marked Medial calf skinfold site. The subject stands in an elevated position. The elevated position will make it easier for the measurer to align the eyes with the tape. The anthropometrist passes the tape around the calf and then slides the tape to the correct plane. The stub of the tape and the housing are both held in the right hand while the anthropometrist uses the left hand to adjust the level of the tape to the marked level. The anthropometrist resumes control of the stub with the left hand and using the cross-hand technique positions the tape so that it is held in a plane perpendicular to the axis of the leg. The tape is then readjusted as necessary to ensure it has not slipped and does not excessively indent the skin.

Bone Breadths

The bone breadths were measured to the nearest 0.1 cm with a large sliding caliper (Campbell 54cm: Rosscraft). In cases where the measurement errors of the first two readings were greater than 2 mm, a third measurement was taken. The median of the three measurements was then taken as the final value (Marfell-Jones *et al.,* 2006).

The following breadths were also measured to calculate the average bone breadths of the students.

- Bi-epicondylar Humerus
- Bi-epicondylar Femur

Bi-epicondylar Humerus

Subject position: The subject assumes a relaxed standing or seated position. The right arm is raised anteriorly to the horizontal and the forearm is flexed at right angles to the arm.

Method: The distance is measured between the medial and lateral epicondyles of the humerus. With the small sliding caliper gripped correctly, use the middle fingers to palpate the epicondyles of the humerus, starting proximal to the sites. The bony points first felt are the epicondyles. Place the caliper faces on the epicondyles and maintain strong pressure with the index fingers until the value is read. Because the medial epicondyle is normally lower than the lateral epicondyle the measured distance may be somewhat oblique (Marfell-Jones *et al*., 2006:116).

Bi-epicondylar Femur

Subject position: The subject assumes a relaxed seated position with the palms resting on the thighs. The right leg is flexed at the knee to form a right angle with the thigh.

Method: The distance is measured between the medial and lateral epicondyles of the femur. With the subject seated and the caliper in place, use the middle fingers to palpate the epicondyles of the femur beginning proximal to the sites. The bony points first felt are the epicondyles. Place the caliper faces on the epicondyles and maintain strong pressure with the index fingers until the value is read (Marfell-Jones *et al*., 2006).

3.7. Data Analysis

The researcher captured the data from the questionnaires and processed it electronically on a Microsoft Excel spreadsheet. Further data analysis was done by a statistician. In order to investigate the normality of the numerical data the Shapiro-Wilk test (Alva & Estrada, 2009) was used. Frequencies and percentages were calculated for all the categorical data. For the numerical data that was evenly distributed, the mean and standard deviations were determined. Should the data be skewed the medians and percentiles were calculated and interpreted.

The Chi-Square statistics of Fischer's- exact test (Thomas *et al*., 2011) was used to investigate relative differences between the year groups and ethnic groups. In order to investigate the median differences between the year groups and ethnic groups the Kruskal-Wallis test (Thomas *et al*., 2011) was used. A significance level of ($p < 0.05$) was used throughout the research study. Where no significant difference is achieved a level of ($p = > 0.05$) was used.

3.8. Ethics

Before the study commenced and the participants were recruited, the study was approved by the Humanities Research Ethics Committee of the University of the Free State (UFS-HUM-2014-63). Informed consent forms approved by the Ethics Committee of the University of the Free State was handed out and had to be signed by the participants (Appendix E; Appendix F). The form contained all the necessary information and basic elements as specified by Thomas *et al*. (2011).

3.9. Minimising Methodological and Measurement Errors

Anthropometric Profiling

Errors were minimised by utilising the protocol as set out by ISAK (Marfell-Jones *et al*., 2006). Measurements were undertaken in the same facility and the same equipment was used for all participants. Participants were asked to not exercise prior to having anthropometric measurements taken (Marfell-Jones *et al*., 2006).

Questionnaires

All the questionnaires were distributed by the researcher, hence all were explained, administered and assessed by the same individual (the researcher) in order to ensure consistency and reliability.

3.10. Limitations of the Study

It is important to acknowledge the limitations to this study. The sample that was selected was a convenient sample from one university in South Africa, thus limiting the generalizability of the data. However the findings of this study can provide insight into the PA levels and lifestyle habits of male undergraduate students within South Africa. The second limitation was the sample size (n=200). The third limitation to the study was female students being excluded from the study, however this does open the opportunity for a comparative study between the genders to address the impact of gender on PA.

Chapter 4 - Results

4.1. Introduction

The aim of this study was to compile a PA, lifestyle and body composition profile of male undergraduate students registered at the University of the Free State. Data was gathered with regard to the following:

- Demographics
- Physical Activity levels,
- Lifestyle habits and
- Body composition

All respondents were required to provide information regarding their year of study, age, physical activity level (current and future intentions to participate in any form of physical or recreational activities), and the lifestyle they maintain. An anthropometric assessment was also done on the students. The data was compared based on the year of study and the student's ethnicity (White, African and Coloured) to determine if there was any impact/effect on PA levels, lifestyle habits and body composition. A total of 200 anthropometric assessments and questionnaires were completed and gathered for data processing, constituting a 100% response rate.

4.2. Demographic Information

Various demographic data was collected from the students. These included data about the students' age, ethnicity, and year of study.

Table 4.1 shows the mean age of the students (n=200) and characterized by students' ethnic and year groups. The average age was 20.3 years. When stratified by ethnic group and year of study, the mean ages were 20.3 years for the White students, 20.2 years for the African and 20.4 years for the Coloured students; the mean ages for the different year groups were 19.5 years (1st Years), 20.3 years (2nd Years) and 21.3 years (3rd Years).

Table 4.1 - Age in Years: Ethnic and Year Group Comparison

Groups		Mean Age *(Years)*	STD	Lower Limit	Upper Limit
All Students	n=200	20.3	1.2	18	25
Ethnic Groups:	**White Students** *(n=99)*	20.3	1.3	18	25
	African Students *(n=61)*	20.2	1.1	19	24
	Coloured Students *(n=40)*	20.4	1.1	19	23
Year Groups:	**1st Year Students** *(n=70)*	19.5	1.1	18	25
	2nd Year Students *(n=81)*	20.3	0.9	19	24
	3rd Year Students *(n=40)*	21.3	1.0	19	24

4.2.1. Ethnic distribution

The three major ethnic groups on the campus who were willing to participate in this study were compared. The students were classed into three categories, namely White, African and Coloured. The majority of the students were White students (49%), with African students accounting for 31% and Coloured students 20%.

4.2.2. Year of study

The majority of the students were in their 2nd year with 40%. The 3rd year students consisted of 25% and 1st year group consisting of 35% of the students. The students who were registered in their 1st year of study consisted of 24% African students, 19% Coloured students and majority of the group were White constituting 57% of the group. The 2nd year students consisted of 35.8% African students, 20.4% Coloured and 43.2% White males. A similar trend can be seen in the 3rd year group with the majority of the group consisting of 49% White students, followed by 30.6% African students and 20.4% Coloured students.

4.3. Participation in Physical Activity (Sport and Recreational)

The IPAQ questionnaire determined the perceived PA profile of undergraduate students. Data was recorded based on the PA levels at university. Students were also asked to indicate whether they would participate in PA once they had graduated from university. The total number of students who participated in any form of sports or physical activity was 91%.

4.3.1. Physical Activity Participation at University

The results of the student's participation in PA (sport or recreational) were categorized based on the students' ethnicity and year of study and are presented in Table 4.2. 88.9% of White students, 96.7% of African Students and 87.5% of Coloured students participated in some form of PA.

A large percentage of students across the year groups participated in PA, with 90% of the 1st years, 93.8% of the 2nd years and 87.8% of the 3rd years.

4.3.2. Physical Activity Participation after University

As an add-on to the IPAQ questionnaire, students were asked whether they would take part in PA following their graduation from University. The data is presented in Table 4.2. Seventy four point eight (74.8%) of White students, 72.1% of African students and 80% of Colored students indicated that they would like to participate in PA following their graduation.

Table 4.2 - PA Participation at University and After University: Ethnic and Year Group Comparison

Groups		PA Participation of the Students			
		At University		After University	
		Yes	*No*	*Yes*	*No*
Ethnic Groups:	**White Students**	*88 (88.9%)*	*11 (11.1%)*	*74 (74.7%)*	*25 (25.2%)*
	African Students	*59 (96.7%)*	*2 (3.3%)*	*44 (72.1%)*	*17 (27.9%)*
	Coloured Students	*35 (87.5%)*	*5 (12.5%)*	*32 (80%)*	*8 (20%)*
Year Groups:	**1st Year Students**	*63 (90%)*	*7 (10%)*	*56 (80%)*	*14 (20%)*
	2nd Year Students	*76 (93.8%)*	*5 (6.2%)*	*62 (76.5%)*	*19 (23.5%)*
	3rd Year Students	*43 (87.8%)*	*6 (12.2%)*	*32 (65.3%)*	*17 (34.7%)*

4.3.3. Activity in mean MET-minutes per week

Table 4.3 shows the mean activity in minutes per week for all the students (n=200), and categorized by students' ethnic and year groups. The average activity was 514.3 minutes per week of PA. African students participated on average 543.6 minutes per week, while White and Coloured students particiated in on average of 486.8 minutes and 530 minutes, respectively. When stratified by year of study, average activity for the year groups was similar, with 1st year students partaking on average 526.9 minutes of PA per week, 2nd year students 513.2 minutes, and 3rd year students 501.9 minutes per week.

Table 4.3 - Activity/min/week: Ethnic and Year Group Comparison

Groups		Mean Activity /min /week	STD	Lower Limit	Upper Limit
All Students:	n=200	514.3	229.6	75	915
Ethnic Groups:	**White Students** *(n=99)*	486.8	217.8	75	882
	African Students *(n=61)*	543.6	233	75	915
	Coloured Students *(n=40)*	530.1	251.1	75	840
Year Groups:	**1st Year Students** *(n=46)*	526.9	226.8	75	880
	2nd Year Students *(n=62)*	513.2	246.1	75	915
	3rd Year Students *(n=41)*	501.9	210.6	75	900

4.3.4. MET Levels

Table 4.4 shows the MET minute per week results of the students. The data has been categorized based on the students ethnic and year groups. The mean MET minute per week of all the students was 2891.1 minutes, the White students 2753.5 minutes, African students 3021.1 minutes and the Coloured students a mean of 2999 minutes.

Further analysis shows that the 1st year students had a mean MET minute per week score of 3045.7 minutes, the 2nd year students 2870.7 minutes and the 3rd year students a mean of 2748.3 MET minutes per week.

Table 4.4 - MET/min/week: Ethnic and Year Group Comparison

Groups		Mean MET/min/week	STD	Lower Limit	Upper Limit
All Students:	n=200	2891.1	1552.9	247.5	5925.5
Ethnic Groups:	**White Students** *(n=112)*	2753.5	1527.5	247.5	5925.5
	African Students *(n=61)*	3021.1	1460.9	247.5	5607.5
	Coloured Students *(n=40)*	2999	1781.0	247.5	5607.5
Year Groups:	**1st Year Students** *(n=70)*	3045.7	1616.3	247.5	5607.5
	2nd Year Students *(n=81)*	2870.7	1611	247.5	5925.5
	3rd Year Students *(n=49)*	2748.3	1405.9	247.5	5607.5

MET Category Scores of the Students

Table 4.5 indicates the MET categories based on the categories set out in sub heading 3.2 (Chapter 3) it is noticeable that a large percentage of the White (63.6%), African (62.3%) and Coloured (72.5%) students were classed in the high MET category. Further analysis of the year group data shows a decline in METS (72.9% of the 1st year students, 64.2% of the 2nd year students and 55.1% of the 3rd year students).

Table 4.5 - MET Categories: Ethnic and Year Group Comparison

Groups		MET Category of the Students		
		Low n *(%)*	**Mod** n *(%)*	**High** n *(%)*
Ethnic Groups:	**White Students** *(n=99)*	3 *(3.0%)*	33 *(33.3%)*	63 *(63.6%)*
	African Students *(n=61)*	3 *(4.9%)*	20 *(32.8%)*	38 *(62.3%)*
	Coloured Students *(n=40)*	4 *(10%)*	7 *(17.5%)*	29 *(72.5%)*
Year Groups:	**1st Year Students** *(n=70)*	3 *(4.3%)*	16 *(22.9%)*	51 *(72.9%)*
	2nd Year Students *(n=81)*	4 *(4.9%)*	25 *(30.9%)*	52 *(64.2%)*
	3rd Year Students *(n=49)*	3 *(6.1%)*	19 *(38.8%)*	27 *(55.1%)*

4.3.5. Sports and Physical Recreation Activity Participation

Figure 4.1 illustrates the sports and recreational activities that the students participated in at University. The top three sporting codes that students participated in were rugby with 35.5%, soccer with 28.5% and hockey with 26%.

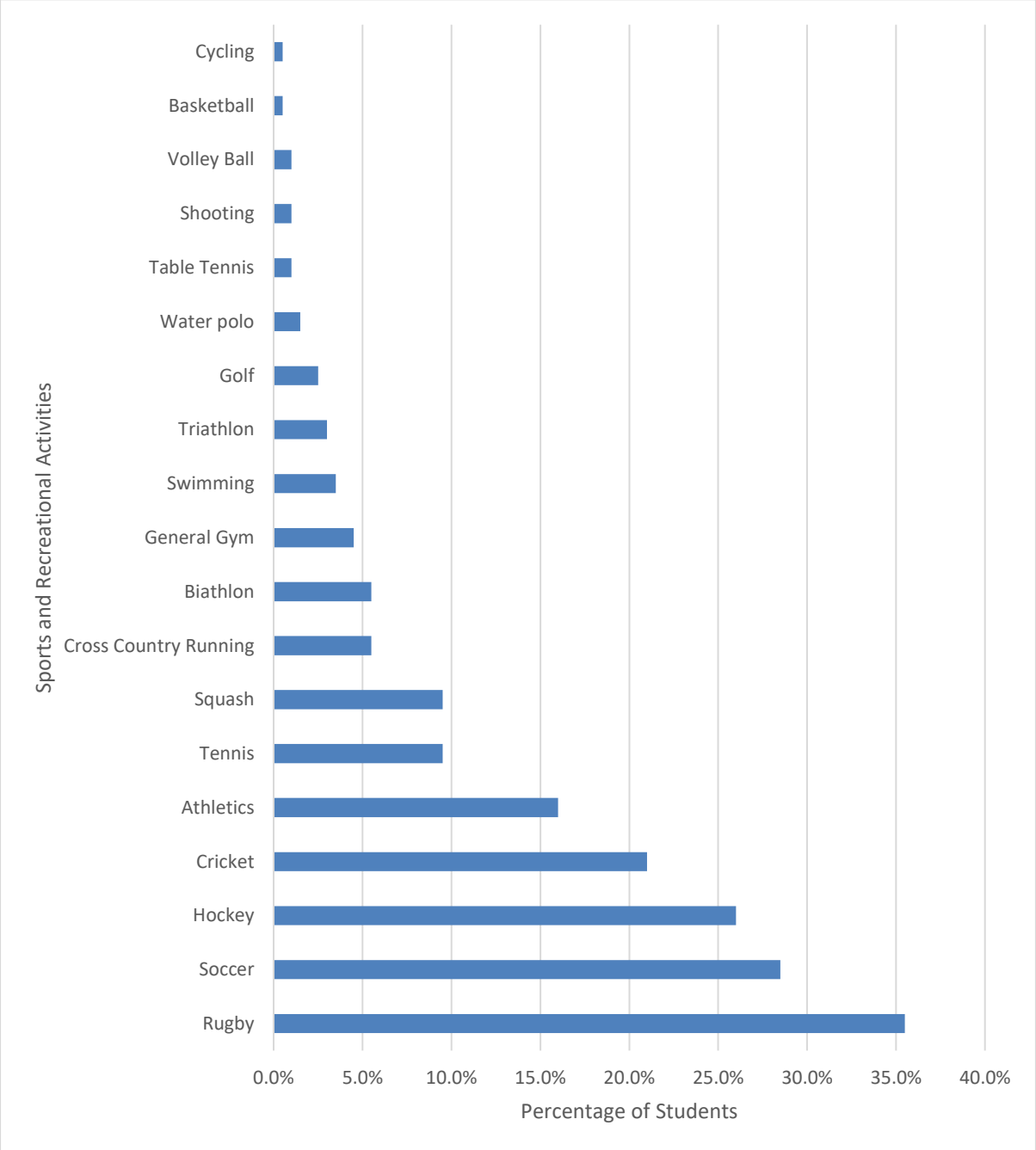

Figure 4.1. - Sports and Recreational Activity Participation at University

4.4. Anthropometric Profile

The results of the anthropometric data that was gathered during the assessment are displayed in tables and graphs below.

4.4.1. Stature Measurements

The data presented in Table 4.6 represents the mean, median, lower and upper quartile values of weight and height.

Table 4.6 – Stature Measurements

MEASUREMENT	MEAN	MEDIAN	LOWER QUARTILE	UPPER QUARTILE
Weight (kg)	78.2	76.0	52.0	123.0
Height (cm)	177.3	178.0	160.0	192.2

The results revealed that the average undergraduate male student weigh 78kg and is 177.3cm in length.

4.4.2. Skinfold Measurements

Table 4.7 below represents the skinfold measurements that were taken during the anthropometric assessment.

Table 4.7 - Skinfold Measurements

MEASUREMENT	MEAN	LOWER QUARTILE	UPPER QUARTILE	MEDIAN
Triceps *(mm)*	10.1	4.4	23.0	9.0
Subscapular *(mm)*	10.5	5.6	26.4	9.5
Supra-illiac *(mm)*	12.9	5.0	43.0	11.1
Abdominal *(mm)*	15.6	5.6	44.0	14.2
Mid-Thigh *(mm)*	11.3	3.8	28.0	10.0
Medial Calf *(mm)*	8.9	3.2	20.4	8.4

The results reported that the mean skinfold thickness measurements were triceps 10.1mm, subscapular 10.5mm, supra-illiac 12.9mm, abdominal 15.6mm, mid-thigh 11.3mm and medial calf 8.9mm.

4.4.3. Circumference Measurements

The data presented in Table 4.8 indicates the circumference measurements that were taken during the assessment. The results revealed a mean waist circumference measurement of 80cm, a hip circumference of 99.6cm, and a calf maximum contraction circumference of 36.6cm, an arm relaxed circumference of 33.4cm and a mean flexed arm circumference of 35.0cm.

Table 4.8. - Circumference Measurements

MEASUREMENT	MEAN	MEDIAN	LOWER QUARTILE	UPPER QUARTILE
Waist (cm)	80	80.1	64.0	113.0
Hip (cm)	99.6	100.2	85.0	126.0
Calf (Max) (cm)	36.6	36.0	29.0	45.5
Arm (Relaxed) (cm)	33.4	33.6	26.5	44.5
Arm (Flexed) (cm)	35.0	35.2	27.0	46.0

4.4.4. Bone Breadth Measurements

Table 4.9 shows the bone breadths measurements that were taken during the assessment. The mean humerus bone breadth of the students was 7.2cm with a range between 6.5cm and 8.5cm. The mean femur bone breadth was 9.6cm with a range between 8.5cm and 11.0cm.

Table 4.9. - Bone Breadths

MEASUREMENT	MEAN	MEDIAN	LOWER QUARTILE	UPPER QUARTILE
Humerus (cm)	7.2	7.2	6.5	8.5
Femur (cm)	9.6	9.5	18.5	11.0

4.4.5. Body Composition Results

Table 4.10 below represents the mean, median, lower and upper quartile for the body composition anthropometric data.

Table 4.10 – Summary of Anthropometric data

MEASUREMENT	MEAN	MEDIAN	LOWER QUARTILE	UPPER QUARTILE
Fat Percentage (%)	9.9	9.2	5.9	20.0
Lean Body Mass (LBM) (kg)	70.2	69.3	48.2	98.4
Body Mass Index (BMI)($kg.m^{-2}$)	24.8	24.8	18.2	35.9
Wasit-to-hip Ratio (W:H Ratio)	0.8	0.8	0.6	0.9

All anthropometric measurements will subsequently be broken down into ethnic and year group categories.

Body Fat Percentage

Table 4.11 provides an ethnic and year group breakdown of the body fat percentage presented in Table 4.10. The average fat percentage of the students was 9.9%. The mean White student's fat percentage was 9.8% with the African and Coloured student's having a mean body fat percentage of 10.2% and 9.4% respectively. The 1st year students had a mean of 9.3%, and both 2nd year and 3rd year students a mean 10.2% body fat.

Table 4.11. - Body Fat Percentage (%): Ethnic and Year Group Comparison

Groups		Mean Body Fat *(%)*	STD	Lower Limit	Upper Limit
All Students	n=200	9.9	2.7	5.9	20
Ethnic Groups:	**White Students** *(n=99)*	9.8	2.5	6	20
	African Students *(n=61)*	10.2	2.9	6.1	17.5
	Coloured Students *(n=40)*	9.4	2.6	5.9	17.6
Year Groups:	**1st Year Students** *(n=70)*	9.3	2.4	5.9	20
	2nd Year Students *(n=81)*	10.2	2.7	5.9	17.6
	3rd Year Students *(n=49)*	10.2	2.8	6	17.5

Lean Body Mass (LBM)

The data presented in Table 4.12 illustrates a breakdown LBM. The mean LBM of the students was 70.2kg, the White student's LBM was 70.8kg, and the African and Coloured student's having a mean LBM of 70.3kg and 68.7kg respectively. The 1st year students had a mean LBM of 69.7kg, 2nd year students 70.7kg and 3rd year students a LBM mean of 70.2kg LBM.

Table 4.12 - Lean Body Mass (LBM): Ethnic and Year Group Comparison

Groups		Mean LBM *(kg)*	STD	Lower Limit	Upper Limit
All Students:	n=200	70.2	8.7	48	98
Ethnic Groups:	**White Students** *(n=99)*	70.8	8.7	48	98
	African Students *(n=61)*	70.3	8.8	52	96
	Coloured Students *(n=40)*	68.7	8.6	49	87
Year Groups:	**1st Year Students** *(n=70)*	69.7	9.0	48	98
	2nd Year Students *(n=81)*	70.7	9.3	49	96
	3rd Year Students *(n=49)*	70.2	7.2	52	83

Body Mass Index (BMI)

Table 4.13 display a breakdown of the BMI results presented in Table 4.12. The mean BMI of the students was 24.8kg.m$^{-2,}$ with the White student's BMI of 24.8kg.m^{-2} and the African and Coloured student's a mean BMI of 25.2 kg.m^{-2} and 24.2 kg.m^{-2}

respectively. The 1st year students had a mean BMI of 24.2 kg.m^{-2}, 2nd year and 3rd year students had a mean BMI of 25.1 kg.m^{-2} and 24.9 kg.m^{-2} respectively.

Table 4.13 - Body Mass Index (BMI): Ethnic and Year Group Comparison

Groups		Mean BMI *(kg.m^{-2})*	STD	Lower Limit	Upper Limit
All Students	n=200	24.8	3.1	18	36
Ethnic Groups:	**White Students** *(n=99)*	24.8	3.1	18	36
	African Students *(n=61)*	25.1	3.2	18	34
	Coloured Students *(n=40)*	24.2	2.9	20	32
Year Groups:	**1st Year Students** *(n=70)*	24.2	3.4	18	36
	2nd Year Students *(n=81)*	25.1	3	20	34
	3rd Year Students *(n=49)*	24.9	2.9	19	32

4.5. One way and Multi-way ANOVA (BMI, Fat % and LBM)

Table 4.14 below represents the ANOVA test done to determine the effect that the independent variables (ethnicity, MET category, Belloc and Breslow category, Year of Study and PA participation) have on the dependent variables (BMI, Fat Percentage and LBM). No significant ($p < 0.05$) effects were found.

Table 4.14 - ANOVA of Male: BMI, Fat % and LBM

One-way and multi-way ANOVA of Male: BMI, Fat Percent and LBM

Dependent variable	Independent variable	df	One-way ANOVA		Multi-way ANOVA	
			F-statistic[1]	P-value	F-statistic[1]	P-value
Body Mass Index (BMI)	Ethnicity	2	1.11	0.3325	0.90	0.4077
	MET category	2	0.01	0.9900	0.03	0.9696
	Belloc category	2	0.99	0.3752	1.46	0.2339
	Year of study	2	1.64	0.1960	1.75	0.1769
	Participation in Sport					
	School	1	0.53	0.4689	0.03	0.8629
	University	1	1.18	0.2784	0.39	0.5338
	After University	1				
Fat percent	Ethnicity	2	1.19	0.3074	1.01	0.3655
	MET category	2	1.16	0.3147	1.10	0.3357
	Belloc category	2	2.28	0.1053	2.75	0.0664
	Year of study	2	2.41	0.0925	2.46	0.0878
	Participation in Sport					
	School	1	0.04	0.8441	0.11	0.7386
	University	1	0.85	0.3564	1.03	0.3110
	After University	1				
Lean body mass	Ethnicity	2	0.84	0.4341	0.77	0.4639
	MET category	2	0.57	0.5653	0.32	0.7248
	Belloc category	2	0.61	0.5457	0.84	0.4318
	Year of study	2	0.24	0.7836	0.30	0.7423
	Participation in Sport					
	School	1	3.57	0.0603	1.40	0.2377
	University	1	2.68	0.1030	0.11	0.7377
	After University	1				

4.6. Lifestyle Habits

4.6.1. Belloc and Breslow Lifestyle Scores

A total of 200 Belloc and Breslow Lifestyle questionnaires were handed out and completed. The results are presented in Table 4.15. The data reveals the mean, minimum and maximum values of the students based on their ethnic and year groups. The mean score of the questionnaire amongst the total 200 students was White students presented with a mean score of 4.5, the African and Coloured students had mean scores of 4.4 and 4.4 respectively. The mean score for the Belloc and Breslow questionnaire among the 1st year students was 4.2, with the 2nd year students scoring 4.7 and the 3rd year students scoring 4.6.

Table 4.15 - Belloc and Breslow Scores of Male Students: Ethnic and Year Group Comparison

Groups		Mean Score	STD	Min	Max
All Students	n=200	4.5	1.3	1	7
Ethnic Groups:	**White Students** *(n=112)*	4.5	1.3	1	7
	African Students *(n=61)*	4.4	1.4	1	7
	Coloured Students *(n=40)*	4.4	1.1	3	7
Year Groups:	**1st Year Students** *(n=70)*	4.2	1.3	1	7
	2nd Year Students *(n=81)*	4.7	1.3	1	7
	3rd Year Students *(n=49)*	4.6	1.4	1	7

Figure 4.2 represents a comparison of the Belloc and Breslow lifestyle scores between the ethnic groups that took part in the research.

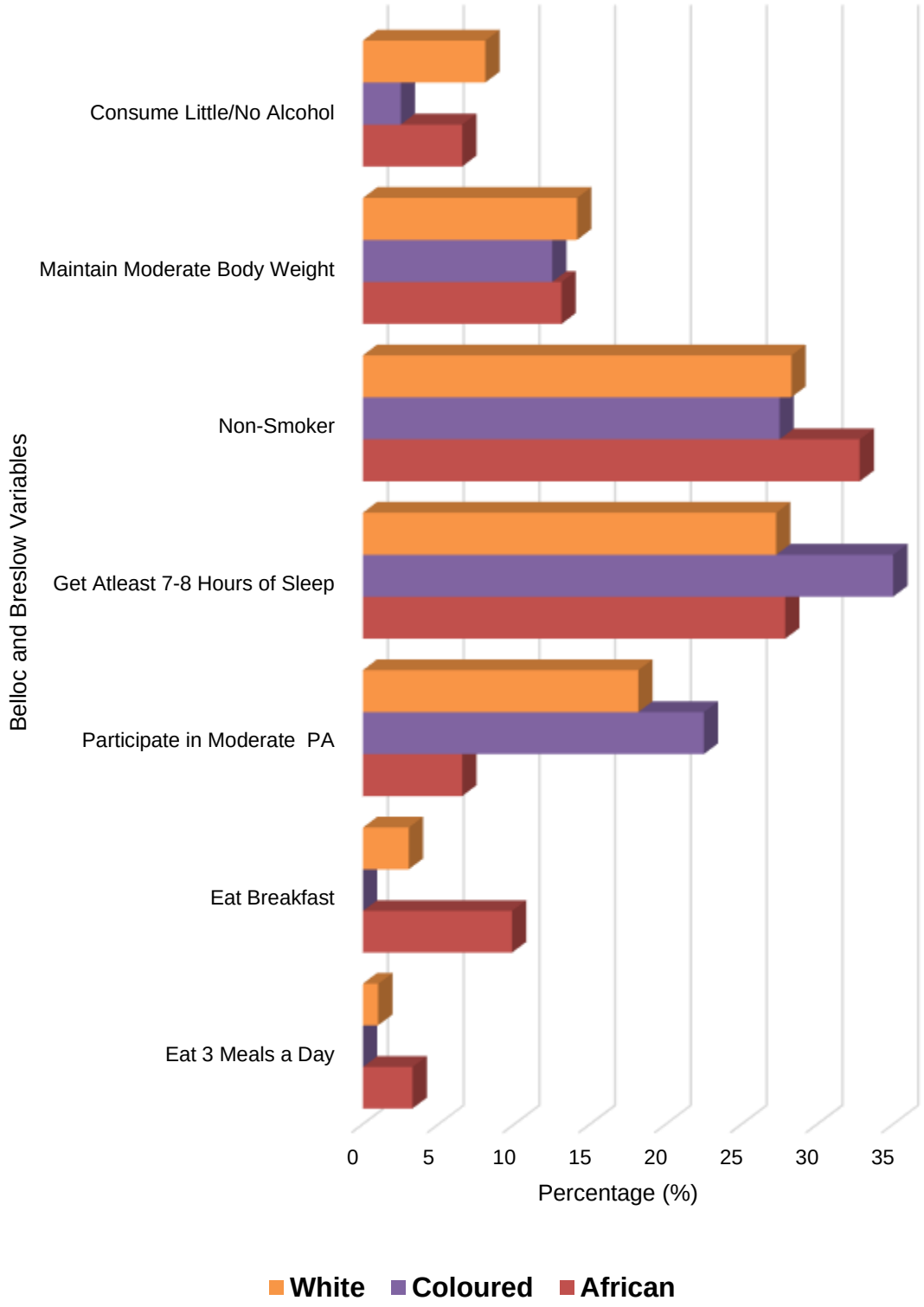

Figure 4.2 - Belloc and Breslow Lifestyle Score Comparison between Ethnic Groups

Figure 4.3 represents a comparison of the Belloc and Breslow Lifestyle scores between the year groups that took part in the research.

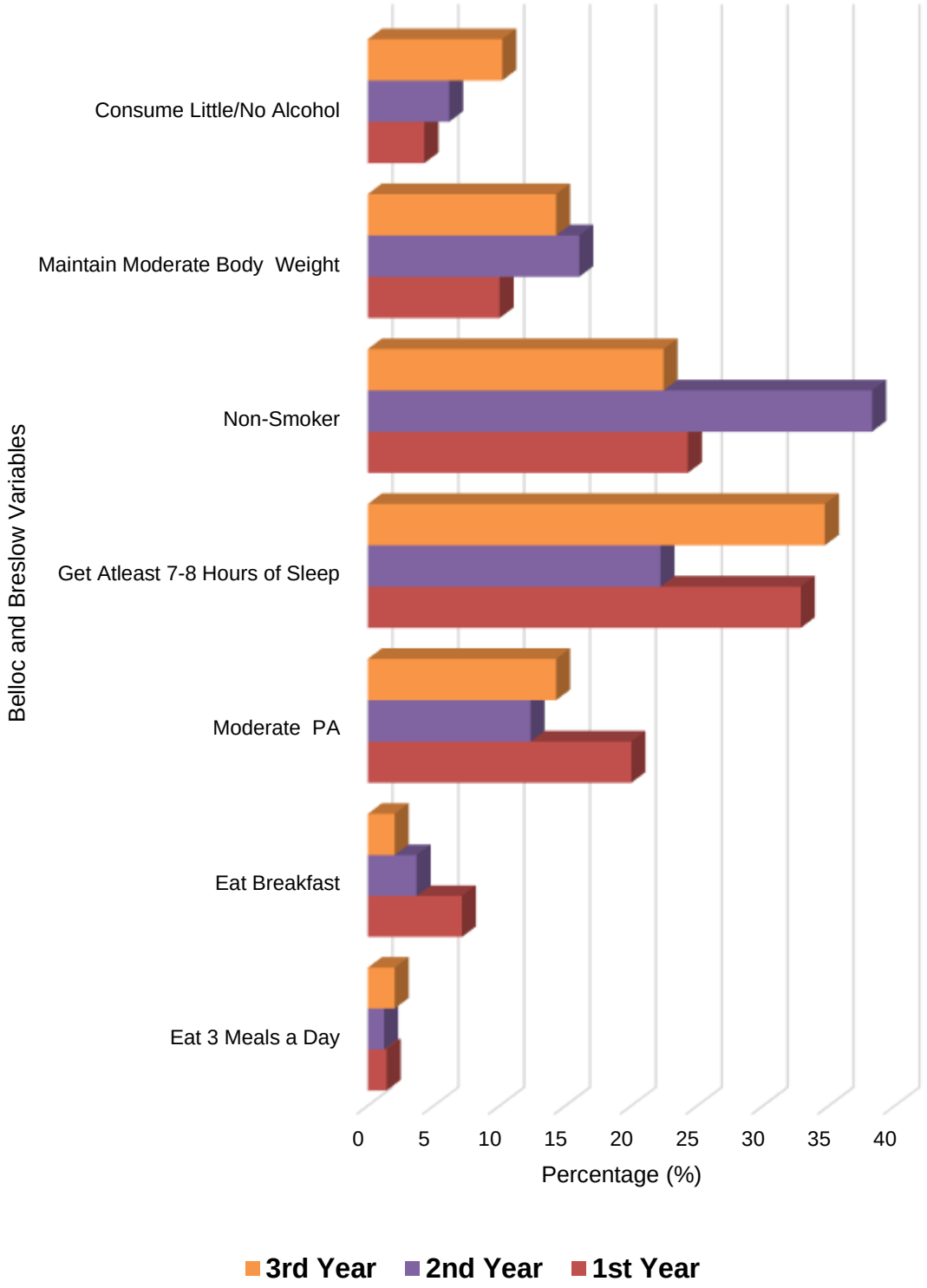

Figure 4.3 - Belloc and Breslow Lifestyle Score Comparison between Year Groups

4.6.2. Belloc and Breslow Health Categories

Table 4.16 provides the student's health categories based on their ethnic and year groups. The data was recorded and the results were categorized into three different groups namely poor, moderate and healthy. According to the Belloc and Breslow categories, only 22.2% of White students can be classified as healthy, with 19.7% of the African students and 15% of the Coloured students falling into the same category. The results show that a portion of the students were considered to be following a healthy lifestyle with 14.3% of the first year students, 22.2% of the second year students and 24.5% of the third year students.

Table 4.16 - Belloc and Breslow Health Categories: Ethnic and Year Group Comparison

Groups		**Belloc and Breslow Health Category**		
		Poor	**Mod**	**Healthy**
		n	n	n
		(%)	*(%)*	*(%)*
Ethnic Groups:	**White Students**	*22*	*55*	*22*
	(n=99)	*(22.2%)*	*(55.6%)*	*(22.2%)*
	African Students	*12*	*37*	*12*
	(n=61)	*(19.7%)*	*(60.7%)*	*(19.7%)*
	Coloured Students	*9*	*25*	*6*
	(n=40)	*(22.5%)*	*(62.5%)*	*(15%)*
Year Groups:	**1st Year Students**	20	40	10
	(n=70)	*(28.6%)*	*(57.1%)*	*(14.3%)*
	2nd Year Students	14	49	18
	(n=81)	*(17.3%)*	*(60.5%)*	*(22.2%)*
	3rd Year Students	9	28	12
	(n=49)	*(18.4%)*	*(57.1%)*	*(24.5%)*

4.7. Barriers Faced

The total number of students who experienced barriers to participation in PA at University was 33.5%. Figure 4.4 displays the various barriers that the students experienced. The most common barrier was study responsibilities (52.2%) followed by injuries (50.8%). Lack of knowledge was the barrier that was least experienced by the students with a mere 1.5%

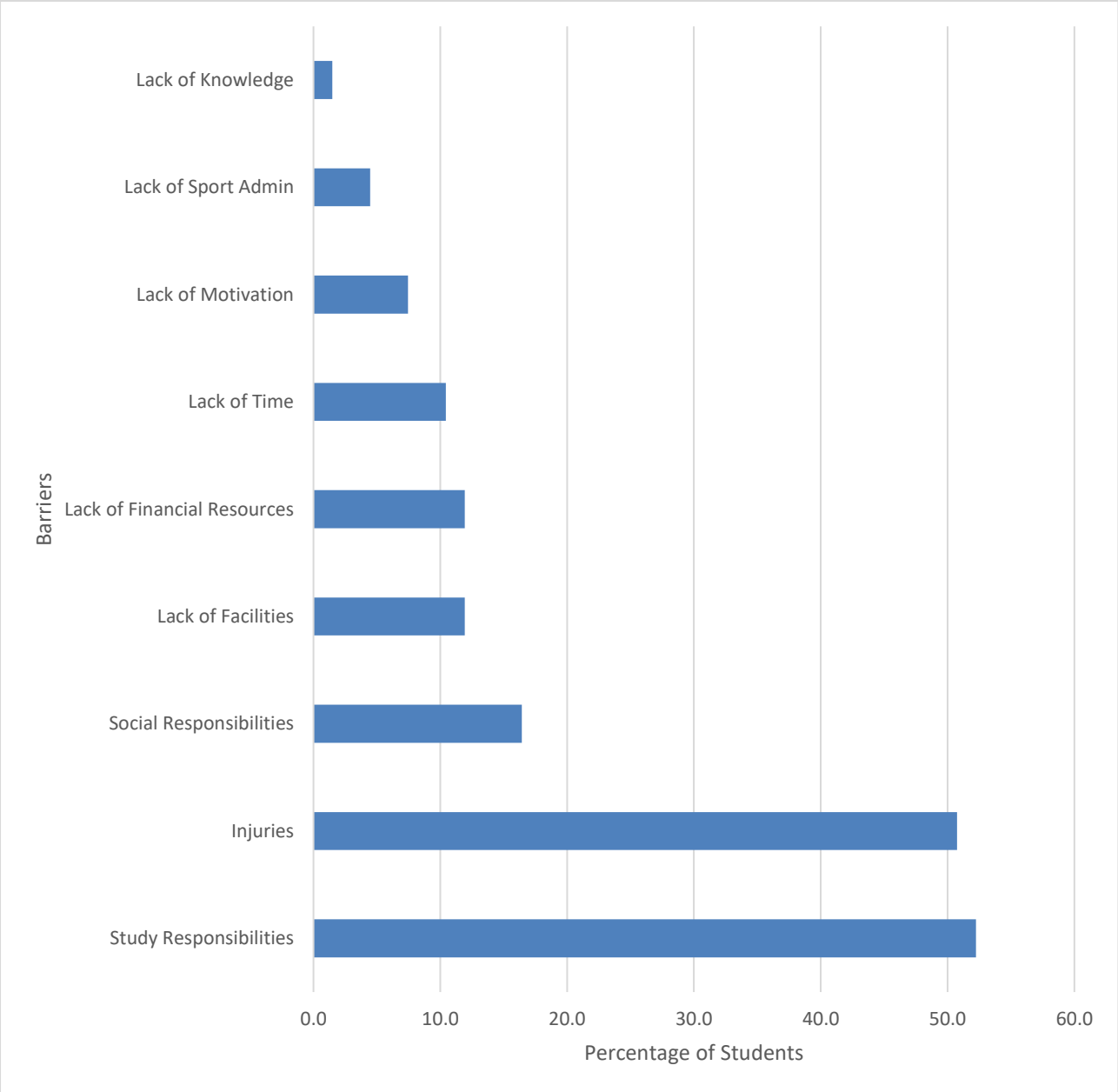

Figure 4.4 - Barriers to PA participation at University

4.8. Association between Ethnic and Year Groups

Table 4.17 below represents the association between ethnic and year groups and MET category, Belloc and Breslow category, and sport and PA participation at school, university and after university. No significant associations were found.

Table 4.17 - Association of Ethnic and Year Groups

Comparison of Male ethnic groups and year groups with respect to MET category, Belloc category, and Sport Participation (School / University / After University)

Group variable	Analysis variable	Chi-square statistic[1]	df	P-value
Year of study	MET category	3.2563	1	0.0711
	Belloc category	3.3050	1	0.0691
	Participation in Sport			
	School	0.0222	1	0.8816
	University	0.0824	1	0.7741
	After University	3.0925	1	0.0787
Ethnicity	MET category	0.2066	2	0.9018
	Belloc category	0.4318	2	0.8058
	Participation in Sport			
	School	2.5196	2	0.2837
	University	3.5572	2	0.1689
	After University	0.8004	2	0.6702

[1]Year of study: Mantel-Haenszel correlation test; Ethnicity: Mantel-Haenszel row mean score test

Chapter 5 – Discussion of Results

5.1. Introduction

There is an extensive body of empirical evidence which demonstrates the physical and psychological health benefits of PA (Keating 2005). Physical activity is associated with a lower mortality rate for both younger and older male generations, a decreased risk of cardiovascular disease in general and coronary heart disease in particular, a decreased risk of colon cancer and a lower risk of developing non-insulin-dependent diabetes mellitus.

Young male adults attending universities gain increased control over their lifestyles. However, they may not necessarily develop positive behaviors like regular PA. Adolescence is considered to be a critical period of development as habits, attitudes and physical morbidity that develop during this phase, may have a pro-found effect on the individual's health and well-being in the long term (WHR, 2010). Desai *et al.* (2008) concurred and further stated that a male adult's behaviors are shaped during the university years, which makes the time spent at university highly influential with regard to developing a positive PA profile.

The main aim of this study was to investigate the PA levels, lifestyle habits and body composition among male university students at a South African university. Therefore the objectives that were identified for the study were:

1. To determine the PA levels and lifestyle habits of male undergraduate students at the University of the Free State.
2. To establish the lifestyle profile and body composition of undergraduate male students at the University of the Free State.
3. To determine the impact of ethnicity on physical activity levels, lifestyle habits and body composition of male students at the University of the Free State.

5.2. Demographic Information

5.2.1 Age

The mean age of the students who participated in this study was 20 years of age. This coincides with a study done by Peterson *et al*. (2018) who ascertained that the average male undergraduate university student is 20.3 years of age. The range of the student's age was between 18-25 years. The possible reason for this could be that majority of the students leave school at the age of 18 to start their studies at University. The maximum range of 25 years of age could be due to long study courses that the students have undertaken, extended courses and gap years taken following school completion.

Although 76.2% of the student population at the UFS was Black (EDCM, 2018) White students comprised the majority of the sample. This can be attributed to the willingness of students to participate in this project . As indicated in **Table 4.1**, the White students were 49%, with African students accounting for 31% and Coloured students 20%.

5.3. Physical Activity Frequency

5.3.1 Physical Activity Frequency at University

Physical inactivity is a growing concern worldwide, this along with the increasing obesity rate projections by the World Health Organization (WHO) indicated that globally at least 400 million adults were inactive and obese (WHO, 2016). Previous studies have shown that there was a large percentage of university students who were insufficiently active. DeVahl *et al.* (2005) found that 68% of male university students in Australia were physically active. The results of this study showed that 91% of the students took part in some form of sport and or physical recreational activities during their time at University of the Free State. The majority of the research indicate various PA frequencies with Shaikh *et al.* (2010) reporting that 71% of students physically active and Bloemhoff (2010) who stated that 67% of students were physically active irrespective of gender and racial group. A study completed by Peterson *et al.* (2018) on the effects of sedentary behavior in university students found that the 93.1% of the students took part in PA. The similar high percentages between Peterson *et al,* (2018)

(93.1%), and this study (91%), may be indicative of a positive rise in PA frequencies at universities.

5.3.1.1 Intended PA Frequency after university

The relative high percentage (91%) of students who currently participate in PA at university, will decline to 75.6% after completing their studies (**See Table 4.2**). There is also an alarming decrease in the intended PA frequencies after university from year one (80%) to year three (34.7%). This (intended) alarming decrease of participation in PA is a concern and should be addressed in future research.

The results of this study reflect a positive increase in the PA levels of male university students over the undergraduate years. This may be attributed to accessibility of the sport and recreation infrastructure found throughout campus. However when looking at the data it is evident that there is a decline in the participation in PA at university to after university of the students from year 1 (80%) to year 3 (65.3%), a possible reason for this is the increased course work (**See Table 4.3**).

The perceived barriers that may impact on PA frequencies will be discussed further in section 5.11 (Barriers to PA experienced).

5.4. Mean MET-minutes

According to the IPAQ guidelines, an adult classified as participating in PA is considered to be achieving between 600 (Moderate PA) and 1500 (Vigorous PA) MET-minutes per week. This coincides with the ACSM (2018) which suggest that most adults should strive to achieve a target of 500-1000 MET minutes per week.

The positive results (mean MET minutes per week) are /overshadowed by the decline in the mean MET minutes per week from first year through to the third year (**See Table 4.4**). The first year students reporting 3045.7 MET-minutes/week and the second and third year students reporting 2870.7 and 2748.3 MET-minutes/week. This decline in the MET minutes per week (although on par with the guidelines set out by the ACSM

(2018)), must be viewed in line/in conjunction with the decline in PA frequencies from year one to year three.

The African students who participated in the study were found to have had a higher mean MET minutes per week (3021.1 MET-minutes/week) than the other ethnic groups with the White and Coloured students achieving 2753.5 and 2999 MET-minutes/week respectively. This concurs with Bloemhoff (2010) who found that African students had a higher mean MET-minutes per week score (3756.1 MET-minutes/week) than the white students (2698.6 MET-minutes/week). It should be noted that this is well above the minimum requirement stipulated by the ACSM (2018).

5.5. MET Categories

The students PA levels were categorized according to the IPAQ guidelines into three different unit's namely low, moderate and high intensity PA levels. The results of this study showed that there was 4.3% of the first years, 4.9% of the second years and 6.1% of the third years fell into the low category. It is apparent that there was a rise in the total number of students partaking in moderate PA and a reduction in the total number of students in the low intensity PA category, through 1st year to third year. This could be as a result of the students gaining a better understanding and becoming aware of the benefits of partaking in PA and leading a more positive and healthy lifestyle throughout their years at university.

Previous research done in the same institution found that a relatively equal percentage of the African and White male students fell into the low MET category (33%) (Bloemhoff, 2010). The results of this study indicate that there are 5% of African and 3% of White students who were categorized into the low MET category. We can conclude that there is a definite improvement when comparing the in the MET levels of male university students when comparing the results (**See Table 4.4 & 4.5)**.

5.6. Sports and physical Recreational Activities at University

The results of this study showed in **Figure 4.1** that the top three sporting codes that students participated in were rugby (35.5%), soccer (28.5%) and hockey (26%). These results differ to a study done by (Janse van Rensburg, 2018) at a South African university who found that hockey (16.1%), soccer (15.3%) and tennis (13.8%) were the top three sporting codes. Varsity cup Rugby, Soccer may be one of the reasons for this high percentage male students participating in Rugby and Soccer.

5.7. Anthropometric Data

The analysis of body composition is an essential component when it comes to PA (Zanovec *et al.* 2009). It provides reliable information for accurately evaluating the efficiency of lifestyle habits and PA levels. The results revealed that the average undergraduate male student weighs 78.2kg and is 177.3cm in length (**See Table 4.6**). It must be mentioned the lower and upper quartile values in weight (52-123Kg) and height (160-192 cm) is wide, but the median is 76.0Kg for weight and 178 cm for height.

5.7.1. Skinfold Assessment

A study done by Hervás *et al.* (2018) in the USA identified that the mean thigh skinfold among male university students was 23.6mm. The results of this study show (See **Table 4.7**) a lower result with 11.3 mm measured for the mid-thigh skinfold. When comparing the results of the rest of the skinfold sites with Hervás *et al.* (2018), the current study had a consistently lower mean per site. This may be attributed to higher PA levels due to increased efforts by the university in promoting a healthy lifestyle as well as intrinsic motivational factors in the current population.

5.7.2. Bone Width

The results of this study identified that the mean humerus and femur bone width of the participants were 7.2cm and 9.6cm respectively (**See Table 4.9)**. The bone width data was used as a component of the anthropometric profile.

5.7.3. Waist Circumference and Waist-to-hip Ratio

The results of this study showed that the mean waist circumference amongst the participants was 80cm **(See Table 4.8)**. This coincides with a study done by Peterson *et al.* (2018) where it was reported that the mean waist circumference amongst the male students was 85cm. When comparing the results of this study to the norms set out by the ACSM (2018), the students are considered to be in the **"low risk category**".

The ACSM (2018) indicate that individuals are at high health risk if their waist-to-hip ratio is >0.95, the results of this study shows that the mean waist-to-hip ratio of the students was 0.8, therefore there is a low health risk (**See Table 2.5**).

5.8. Body Composition

Body composition formed another aspect of the anthropometric profile which was established. The components body fat percentage, body mass index (BMI) and lean body mass (LBM) were measured. The results of the One way and Multiway ANOVA showed us that there was no statistically significant effect of the independent variables (Ethnicity, MET category, Belloc category, and year of study and PA participation) on the student's body fat percentage, LBM and BMI **(See Table 4.14)**.

5.8.1. Body Fat Percentage

Body fat percentage was calculated using skinfold assessments in determining thickness of the superficial adipose tissue surrounding the body. The results of this study showed that the mean body fat percentage of all the students was 9.9%. This was relatively lower than a study done by Hervas *et al*. (2018) where it was found that the mean body fat of the male university students was 12.8%. When comparing the results to the ACSM (2018) norms the students are considered to be in the excellent range for body fat percent of the age range 20 – 29 years (**See Table 2.4**).

When assessing the differences between the ethnic groups it is evident that the African students had a slightly higher body fat percentage with a mean of 10.2% White and Coloured students had similar mean body fat percentage scores of 9.8% and 9.4%.

However, when comparing to the norms set out by the ACSM (2018) **(Table 2.4)**, all the ethnic groups fall into the excellent range for body fat percent of the age range 20 – 29 years.

A similar trend can be seen when looking at the various year groups with first year students having a slightly lower body fat of 9.3% compared to that of the second and third year students who both demonstrated mean body fat percentages of 10.2%. First year students tend to be more active and want to participate in various activities within the hostels and residences, however the slight increase in the body fat percentage over the years of study could be attributed to the decline in the mean MET minutes per week from first year (3045.7) through to third year (2748.3) found in this study. This negative relationship between body fat percentage and mean MET minutes is confirmed by a study done by Zanovec *et al.* (2009) among students.

5.8.2. Lean Body Mass

The lean body mass of the students was reported as being 70.2kg (**See Table 4.12**). In a study done by Zanovec *et al.* (2009) the students had a mean lean body mass of 65.0kg. Zanovec *et al.* (2009) further elaborated and stated that students who participated in higher levels of PA presented lower LBM compared to the students who had lower PA levels.

5.8.3. Body Mass Index (BMI)

Body Mass Index calculated by taking the individuals weight in kilograms (kg) and dividing it by the height (cm) squared, then dividing it by the individual's height and is presented as $kg.m^{-2}$. The mean stature and body weight of the students who participated in the study were 177.3 cm and 78.2kg (**See Table 4.13**). The students BMI was then calculated with these values and the mean BMI of the students in this study was 24.8 $kg.m^{-2}$. This coincides with results of a study done by Hervás *et al.* (2018) where it was established that the mean BMI of the male students was 22.7 $kg.m^{-2}$. In similar studies done by Peterson *et al.* (2018) and Anderson and Good (2017) the mean BMI score for the male university students was 23.3 $kg.m^{-2}$ and 25.1 $kg.m^{-2}$ respectively. According to the ACSM (2018) classification of disease risk the BMI of students in this study (24.8 $kg.m^{-2}$) fall into the normal range **(See Table 2.5).**

The mean BMI values for the various ethnic groups shows that there were no major differences between the ethnic groups **(Table 4.13).** The White and Coloured students displayed a very similar mean BMI of 24.76 $kg.m^{-2}$ and 24.2 $kg.m^{-2}$ respectively. Both the White and Coloured students fall in the normal range set out by the ACSM (2018). The African students had a slightly higher BMI with a mean of 25.15 $kg.m^{-2}$ and this placed them into the overweight range according to the ACSM (2018). The differences between the different year groups showed minor differences between the year groups with 1st and 3rd year students having a very similar mean BMI score of 24.23 $kg.m^{-2}$ and 24.94 $kg.m^{-2}$ respectively and the 2nd year students had a mean BMI score of 25.12 $kg.m^{-2}$. The ACSM (2018) norms places the first and third year students BMI in the normal, however the 2nd year students mean BMI places them in the overweight classification.

5.9. Lifestyle Habits

The relationship between lifestyle habits, PA levels and the anthropometric profile can have a significant influence in promoting and maintaining a healthy well-being among the students (Stone, 2010). Belloc and Breslow (1972) identified a positive relationship between the habits of daily living and a healthy life style. The habits of daily living include eating habits, sleeping habits, smoking habits and alcohol consumption.

5.9.1. Eating Habits

According to Belloc and Breslow (1972) eating three meals a day with no snacking in-between is recommended in order to maintain a healthy lifestyle. Weight management is predicted based on energy balance: when the caloric expenditure exceeds the caloric intake (Aragon *et al.*, 2015). This study indicated that the minority of students consumed three meals a day, with 3.2% of African, 0% Coloured and 1% of White students doing so **(See Figure 4.2).** This is in stark contrast with the findings of a study done by Kyrkou *et al.* (2018) that indicated that at least 70% of the university students in the United States consumed 3 meals a day.

When investigating the results over the different year groups (**See Figure 4.2**), there is noticeably lower percentages of the students stating that they did not consume three meals a day with 1.4% of first year students, 1.2% of second year students and 2% of third year students. This could be due to financial reasons with the students being on a tight budget. Lifestyle changes like being responsible for one's own meals and time constraints can also be contributing factors.

5.9.2. Sleeping Habits

Schlarb *et al*. (2017) suggested that inadequate or irregular sleeping patterns can have a direct detrimental impact on the physical and mental health of students. The results of this study showed that 30% of the students reported that they achieved a minimum seven-nine hours of sleep per night. These results do not meet the requirements set out by the National Sleep Foundation (2015) which requires individuals aged between 18-25 years to get at least 7-9 hours of sleep per night. According to Schlarb *et al.*

(2017) there is a prevalence for sleep difficulties in American college students and this ranges from 5% - 73% of students.

When assessing the sleeping patterns of the different ethnic groups within (**See Figure 4.3**) this study, 27.9% of African, 27.3% of White students and 35% of Coloured students reported that they got seven to nine hours of sleep a day. There is a slightly different trend among the year groups with 32.9% of first year students reporting 7-9 hours or sleep. This percentage decreases with the second year students with 22.2% of the students reporting the 7-9 hours of sleep, there is a slight decrease between second and third year with 34.7%.

Low sleeping hours could be due to a number of reasons. Schlarb *et al.* (2017) suggested that academic demands, part-time jobs, friends, family, relationships, lectures and free-time activities have an impact on the sleep patterns of university students. Some of these factors may be more relevant to first year student. The new freedom (especially no supervision of parents) may also have a negative impact on first year students sleeping hours. The consequences of lack of sleep can be severe. In a study by Sharmila (2016), lack of sleep was found to be associated with emotional instability, cognitive dysfunction, decreased concentration, memory loss and daytime sleepiness.

5.9.3.Smoking Habits

A study done by Ganz (2016) found that 17.6% of South Africans smoke tobacco. The results of this study identified that 78.8% of the students who participated were non-smokers **(See Figure 4.3)**. This concurs with the findings of Kyrkou *et al.* (2018) who found that 83.4% of male university students were non-smokers.

When taking a more in-depth look at the results between the different ethnic groups, 78.7% of the African students, 78.8% White students and 75% of the Coloured students reported that they were non-smokers **(See Figure 4.3)**. There is no data comparing the difference of smoking of male university students in South Africa.

When assessing the results based on the students year of study one can see that there is a slight increase in the percentage of students who become non-smokers, with 75.7% of first year students stating that they did not smoke, there was a higher number of second and third year students reporting that they did not smoke with 80.3% and 77.8% respectively. There are a number of factors that could lead to the increased numbers of students who smoke. The new found freedom from home, peer pressure and stress could contribute an increased number of smokers during a student's first year at university. However with the increase in number of non-smokers through the years this could possibly be attributed to an increased awareness in the effects that smoking has on one's health and the new legislation implemented by the South African Government. A concern is the percentage of students who smoke is more than the percentage of the general population in South Africa as identified by Ganz (2016).

5.9.4. Alcohol Consumption

Alcohol consumption is evident during students' university years (Kyrkou *et al*., 2018). The results of this study showed that 61% of students reported little or no alcohol consumption. This is significantly higher than the 13% of male university students that indicated that they occasionally consuming alcohol during their time at University found in a study done by Kyrkou *et al*. (2018).

When analysing the data based on the different year groups a trend can be noticed **(See Figure 4.3)**. As the students' progress through university the alcohol consumption decreases, 57.1% of first year students reported little/no alcohol consumption, this percentage increases to 61.7% of second year students and 63.3% of third year students reporting little/no alcohol consumption. This decrease in alcohol consumption could be attributed to an increase in course work and external pressures from family members, relationships and an increased sense of responsibility and maturation.

5.10. Belloc and Breslow Health Categories

Students were categorized according to Belloc and Breslow's (1972) three lifestyle habits categories namely poor, moderate and healthy. According to the results of this study **(See Table 4.16)** the majority of students fell into the moderate health category (59.6%). The increased responsibilities when attending university can be one of the factors contributing to the low percentage of first year students (14.3%) classified as healthy, there is a slight increase in this percentage over the years of study with 22.2% of the second year students and a further increase 24.5% of third year students. When taking a more in-depth look at the data, based on the student's ethnic group it is evident that a mere 19.7% of African students, 22.2% of White Students and 15% of Coloured students were classified as being healthy.

There is a decline in the poor category from 28.6% in 1st year to 18.4% in third year and an increase in the healthy category from 14.3% to 24.5% respectively. This could be attributed to the university environment having a positive impact on the lifestyle of the students.

5.11. Barriers to Physical Activity

Research by Bloemhoff and Coetzee (2007) in the same institution identified that study responsibilities was raised as the major barrier faced by university students. This supports the findings of this research **(See Figure 4.3)** with study responsibilities (52.2%) and injuries (50.8%) being the two most common barriers to PA that the male students faced during their time at university. Eleven percent of the students reported that social responsibilities were a barrier to participating in PA at University. The barriers that the students least experienced was lack of motivation (7.5%), lack of sport admin (4.5%). Similar to the results of this study, research by Abdullah et al. (2018) reported that the barrier that students least reported was lack of motivation (14%).

The results of this study showed that the least experienced barrier was lack of knowledge (1.5%) this shows that the students are knowledgeable about PA opportunities and benefits and they demonstrate high PA levels.

Because of the high number of students reporting study responsibilities as a barrier to PA, time management courses and ease of access to study facilities can aid the students in their management of time and maintaining a healthy physically active lifestyle.

5.12. Association between Ethnic and Year groups

The research set out to provide possible answers pertaining to the association between the ethnic groups and PA participation and lifestyle habits. The results of this study showed that there was no statistically significant associations between the independent variables (Met Category, Belloc category and PA participation) and the dependent variables (Year of study and Ethnicity) **(See Table 4.17).**

Chapter 6 – Conclusion and Future Research

6.1. Introduction

There is an extensive body of empirical evidence, which demonstrates the physical and psychological health benefits of physical activity (Keating 2005). However Prewitt *et al.* (2015) stated that there is a growing need to enhance suitable PA levels, in order to help reverse the ever-increasing trend of obesity and the prevalence of various other health-related diseases. Research done by Sailors *et al*. (2010) identified that a major concern in today's general public is the sudden rise in the prevalence in obesity among young male adults, aged 20-39 years. This rise in the prevalence of obesity is associated with a low PA levels. Drenowatz *et al.* (2015) suggested that there is an inverse relationship between moderate to vigorous intensity PA and measures of body composition. What is the impact if any of ethnicity on PA? Research by Wushe *et al.* (2014) suggested that there is no consensus on the impact of ethnicity on PA levels. The objectives of this study were to determine the physical activity levels, lifestyle habits and body composition profile of university students, as well as to determine if there was an impact on the PA levels, the lifestyle habits and body composition by ethnicity, these objectives will be discussed further.

6.2. Conclusion

The objectives of the study are:

1. To determine the physical activity levels of male undergraduate students at the University of the Free State.
2. To establish the lifestyle profile and body composition of undergraduate male students at the University of the Free State.

3. To determine the impact of ethnicity on physical activity levels, lifestyle habits and body composition of male students at the University of the Free State.

The various objectives are addressed individually and concluded in this chapter followed by the research recommendations.

6.2.1. The physical activity levels of male undergraduate students at the University of the Free State.

The study set out to determine the PA levels of male undergraduate students, the results of the current study showed that there was a high percentage (91%) of the students participating in some form of PA while at university. There is a decline in the PA levels within the year groups, with 90% of the first year students, 93.8% of the second year students and 87.5% of the third year students participating in PA. This decline is also evident in the MET minutes per week, with the first year students reporting 3045.7 MET-minutes/week, the second year students 2870.7 MET-minutes/week and the third year students 2748.3 MET-minutes/week, however the MET-minutes/week of the students are considered to be well above the recommended levels set out by the ACSM (2018). An alarming finding of this study is the decrease in the willingness of the students to participate in PA after graduating from University, with 80% of first year students, 76.5% of the second years and then subsequently decreasing to 65.3% of third year students expressing the willingness to participate in PA after university.

6.2.2. Lifestyle Habits and Body Composition Profile

Based on the results of this study in determining the lifestyle profile of the students, it is evident that majority (59.6%) of the students were considered to be moderately healthy. An interesting finding was the decreased number of students in the low category and an increase in the number of students in the healthy category. A part of the objective of the study was to determine the body composition profile of the students, In conclusion the students had a mean body weight of 78.2kg, a mean height of 177.3cm, a mean LBM of 70.2kg, a mean BMI of 24.8kg.m^{-2}. And a mean body fat of 9.9% which places the students in the excellent range for body fat percent (ACSM, 2018), There was a slight increase in the body fat percentage over the years, this could be attributed to the decline in the mean MET minutes/week from first year (3045.7) to third year (2748.3).

6.2.3. Impact of Ethnicity on the PA levels, Lifestyle habits and body composition

This study has provided an initial insight into the impact of ethnicity on the PA levels, lifestyle habits and body composition. No statistically significant impact of ethnicity on the PA levels and lifestyle habits of the university students. What is evident is the African students had a higher mean MET-mintues/week (3021.1) than the White (2753.5) and Coloured (2999) students, however it is interesting to notice that a larger number of White students (22.2%) were categorized into the healthy category than the African (19.7%) and Coloured (15%) students. There was not statistically significant impact on ethnicity and lifestyle habits however based on the results we can see that a larger percentage of African students reported that they had an average of 3 meals a day in comparison to the white (1%) and coloured students (0%). Based on the results of this study, it is evident that there was no statistically significant impact of ethnicity on body composition. However notable is that the African students had a slightly higher mean BMI of 25.15 $kg.m^{-2}$ than the other ethnic groups.

Not many studies have been conducted to compare the difference in the PA levels between the different ethnic groups, in a previous study, it was reported that regarding the differences in physical activity levels between the ethnic groups, Bloemhoff (2010) reported that African male students demonstrated significantly higher levels of PA than white students. The results of this study showed that there was no significant difference in the PA levels between the ethnic groups however there is a decline in the percentage of students who participate in PA at university to after university.

6.3. Recommendation for Future Research

Pengpid and Peltzer (2013) stated that there is very little recent research which investigates PA levels and lifestyle habits amongst male university students. Therefore future research should set out to further investigate the PA levels and lifestyle habits of male university students to provide insight in to possible negative PA patterns that may be developing at university. This will allow universities to implement strategies to counter any negative patterns that may be developing. The prevalence of low PA levels on campuses will call for strategic intervention by the relevant role players to promote optimal health.

Chapter 7 – Reflection

7.1 Introduction

Research in its own can be a very intimidating and frustrating process. However, research gives us the opportunity to have an in depth look at a certain question or hypothesis and the answers to the question provides us with the knowledge to excel in your field of practice. Many professionals' careers stagnate because there is a lack of continued education and research for evidence based practice.

Like Albert Einstein once said: *"The important thing is not to stop questioning."* That in short was the driven force behind this project. I wanted to know more about the physical activity levels and lifestyle habits of male undergraduate students and to identify areas how the University can help these students achieve an active and healthy lifestyle.

7.2 Reflecting on the research process

At the start I was unaware of where to start and how to begin the entire research process. The School of Allied Health Professions provided a post graduate course to aid us in doing the research project. I also turned to the internet and googled: "How to do a research project?" and came across a simple 6 step plan:

Step 1: Find the right supervisor
Step 2: Don't be shy, ASK!
Step 3: Select the right topic
Step 4: Keep your plan realistic
Step 5: Prepare a project timeline
Step 6: Write, write, write…

Step one: Find the right supervisor

The first step was relatively easy. Choose someone to guide you during the research project and that is an expert in the field. So the relationship between Prof H.J Bloemhoff and me started. It really was an easy choice if you consider the research that Prof H.J Bloemhoff had completed in the same field, he was the one that was going to guide me, challenge my thought process and through this research project we were able to learn from each other. The next addition to the team was Prof. F.F Coetzee, his knowledge and experience in the research field was the reason I wanted

to have his guidance through this research. Prof R. Schall was the final addition to the team. His experience, expertise and knowledge of his field of practice must be mentioned. Collecting the data is one thing, but to present it in a highly professional manner require skills from the very best. All three supervisors played a huge part in the final product and their guidance helped me to deliver and to present it in such a good manner.

Step 2: Don't be shy, ASK!

"Mistakes might not give you answers. But they give you questions for a great answer."

Initially I was too shy to ask questions and I tried figuring things out on my own, but as the research process started I realized that I needed the help and guidance from my study leaders. I started asking the right questions challenging both myself and my study leaders to find the right way forward.

Step 3: Select the right topic

This could be an overwhelming process when you are unsure of the WHAT and WHY of your research project. I was fortunate enough to have had an idea of what I wanted to do the research on, and having Prof H.J Bloemhoff as a study leader, who has completed research in the past on a similar topic, I was able to come to the conclusion on a topic that both interested me and through which I could bring and add value to the University.

Step 4: Keep your plan realistic

Know what questions you want to be answered at the end of the project and try to stick to that. It is easy to get carried away when reading through the literature and collecting the data. Remember what was the question you need to be answered and find the answers to that.

Step 5: Prepare a project timeline

Time management was probably the most challenging aspect of this research, having travelled the world playing hockey finding the time to sit and do the research was a challenging aspect of the entire process. I would recommend setting up a project time line and give yourself deadlines that you need to either hand in or be done with certain

chapters at certain stages throughout the research and try your best to stick to it. Hold yourself accountable to finishing the project.

Step 6: Write, write, write…

This was a big learning curve for myself as the researcher, research comprises of identifying what other researchers have previously investigated and how you could use that knowledge to help you through your research project. The Literature review was extremely time consuming and frustrating at times, but this was where I asked myself why was I doing this research project. The literature review also helped me understand the shortcomings of the previous research. That created an opportunity do individualise the research project. The writing the results and coming to a conclusion an interesting and exciting time. You finally have your own findings with which you can compare to the previous research done.

7.3 Personal remarks

To conclude there was a lot of personal growth throughout this research journey. I have gained valuable knowledge through doing this research which has helped me grow as an individual as well as a biokineticist. I have learnt to write, to regularly save your work and keep backups up to date and keep a copy of your work online.

Good professional friendships were formed during the research project. As mentioned above, I have the biggest respect for my supervisors, Prof H.J Bloemhoff, Prof Derik Coetzee and Prof Robert Schall. Without their knowledge, experience and guidance this research journey would have been a rough road.

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Appendix A – International Physical Activity Questionnaire (IPAQ)

YOUR PHYSICAL ACTIVITY LEVEL

A. VIGOROUS ACTIVITIES

1. During the last 7 days, on how many days did you do vigorous physical activities (for at least 10 minutes)? Days:_____ ⌊_⌋ 107

2. How much time in total did you usually spend on one of those days doing vigorous physical activities (average time per day)?
   Average minutes per day:_____ ⌊_⌋⌊_⌋⌊_⌋ 108 - 110

B. MODERATE ACTIVITIES

3. During the last 7 days, on how many days did you do moderate physical activities (for at least 10 minutes)? Days:_____ ⌊_⌋ 111

4. How much time in total did you usually spend on one of those days doing moderate physical activities (average time per day)?
   Average minutes per day:_____ ⌊_⌋⌊_⌋⌊_⌋ 112 - 114

C. WALKING (for recreation, exercise, sport or leisure)

5. During the last 7 days, on how many days did you walk for at least 10 minutes at a time? Days:_____ ⌊_⌋ 115

6. How much time in total did you usually spend walking on one of those days (average time per day)?
   Average minutes per day:_____ ⌊_⌋⌊_⌋⌊_⌋ 116 - 118

7. At what pace did you usually walk?
   - A vigorous pace that makes you breath much harder than normal……___
   - A moderate pace that makes you breath somewhat harder than normal……___
   - A slower pace where there is no change in your breathing……___

   ⌊_⌋ 119

D. SITTING (work or leisure)

8. During the last 7 days, how much time in total did you usually spend sitting on a **WEEKDAY** (average minutes sitting per day)?
   Average minutes sitting per day:_____ ⌊_⌋⌊_⌋⌊_⌋ 120 - 122

9. During the last 7 days, how much time in total did you usually spend sitting on a **WEEKEND DAY** (average minutes sitting per day)?
   Average minutes sitting per day:_____ ⌊_⌋⌊_⌋⌊_⌋ 123 - 125

Appendix B – Belloc and Breslow Lifestyle Questionnaire

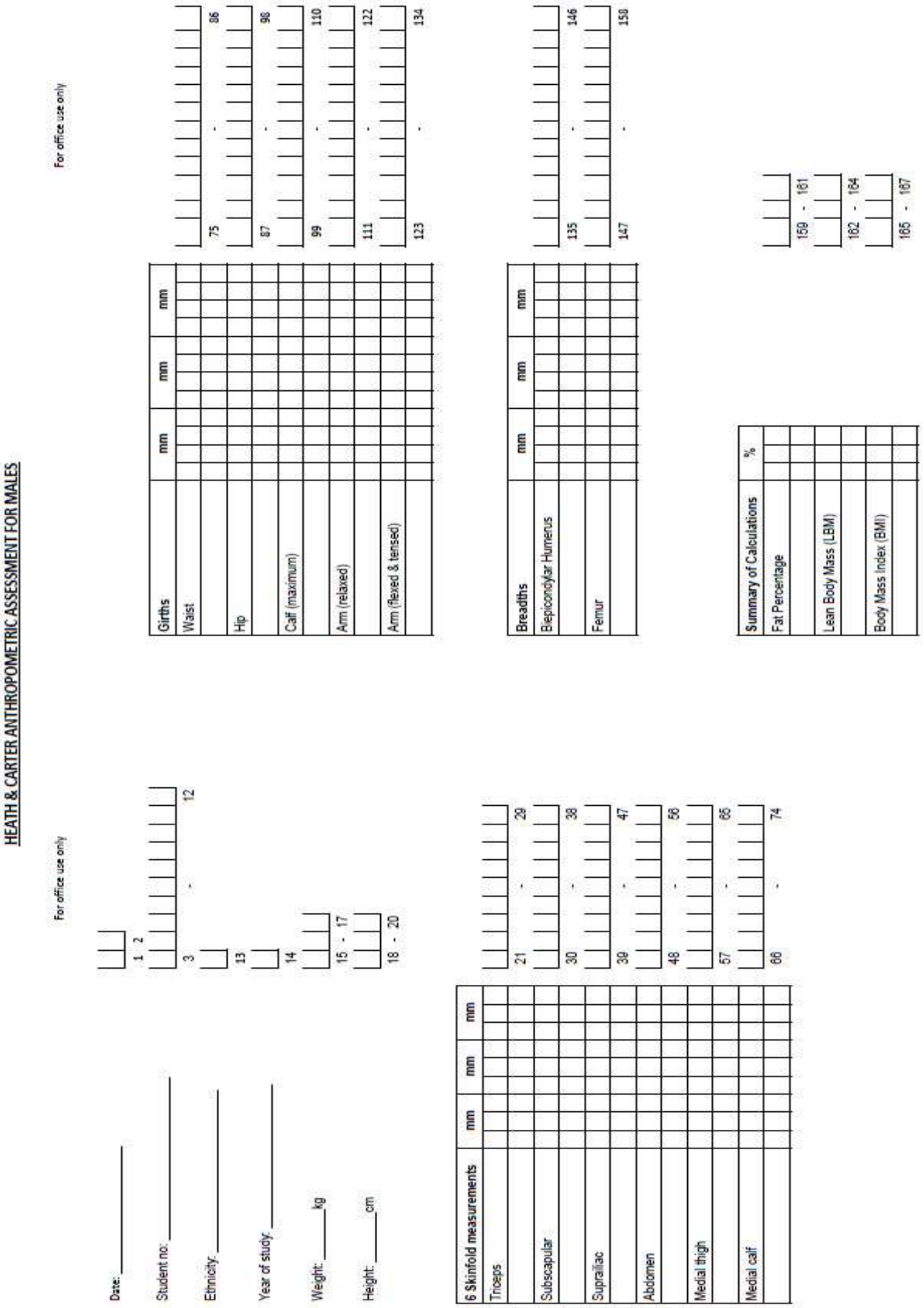
Belloc & Breslow Lifestyle habits

For each of the following statements mark the applicable space with an X (Yes or No) that indicates your current lifestyle habits.

	YES	NO	For office use only
Do you eat three meals a day at regular times with no sncaks in-between			168
Do you eat breakfast everyday? *			169
Do you participate in moderate exercise two or three times a week?			170
Do you get 7 to 8 hours sleep a night?			171
Are you a non-smoker?			172
Do you maintain a moderate body weight?			173
Do you consume little or no alcohol?			174

*Coffee or tea with a rusk and/or toast is, for the purpose of this study, not accepted as a breakfast

Appendix C – Heath and Carter Anthropometric Assessment



Appendix D – Informed Consent Form

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA

UFS·UV
HEALTH SCIENCES
GESONDHEIDSWETENSKAPPE

Informed consent

Physical Activity and Lifestyle Habits of the Male Population of Undergraduate Students attending the University of the Free State

I_____, (full name and surname) herby give consent that the data gathered about the physical activity and lifestyle habits may be used for this research project. It is my understanding that participation is voluntary and the information gathered through the completion of the questionnaires and anthropometric assessment will be evaluated to determine the physical activity profile and lifestyle habits of the male population of undergraduate students attending the University of the Free State.

The researcher will take precaution to protect and preserve the confidentiality of the research data. Data reports will be without the identification of the participant.

_____ _____
Subject's signature Date

_____ _____
Brett Walraven Date
Biokineticist

Appendix E – Information Document

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA

UFS·UV
HEALTH SCIENCES
GESONDHEIDSWETENSKAPPE

Informed consent

Physical Activity and Lifestyle Habits of the Male Population of Undergraduate Students attending the University of the Free State

I_____, (full name and surname) herby give consent that the data gathered about the physical activity and lifestyle habits may be used for this research project. It is my understanding that participation is voluntary and the information gathered through the completion of the questionnaires and anthropometric assessment will be evaluated to determine the physical activity profile and lifestyle habits of the male population of undergraduate students attending the University of the Free State.

The researcher will take precaution to protect and preserve the confidentiality of the research data. Data reports will be without the identification of the participant.

_____ _____
Subject's signature Date

_____ _____
Brett Walraven Date
Biokineticist

Appendix F – Ethical Clearance Letter (1)

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA

UFS·UV
STUDENT AFFAIRS
STUDENTESAKE
DITABA TSA BAITHUTI

08 September 2014

Faculty of Humanities
University of the Free State

Dear Prof. Bloemhof

CSA Research Committee: Study approval and registration

With reference to your application for approval by registration with the College of Student Affairs (CSA) Research Committee of your study, *Physical activity levels and life style habits of undergraduate students at a South African university,* submitted on 14 July 2014. I am pleased to report that committee approval has been granted for your study to engage the student population for purposes of the research.

Your study is registered with the CSA Research Desk for its full duration, which desk is appointed to offer you support in further detailing access to and data collection among students. Also, please note that Dr. WP Wahl is appointed to serve as your principal contact and you are requested to please contact him for further arrangements.

Kindly also note upon completion of the study to schedule the submission of the required report of findings to the Research Desk.

Please do not hesitate to contact Mr Vhugala Nthakheni, CSA Secretary, with further queries or requests for support.

Yours sincerely,

B Rudi Buys VDM,
Dean of Student Affairs

cc: Prof. FF Coetzee
Dr. L Lange
Dr. WP Wahl
Mr. V Nthakheni

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Bloemfontein 9301
South Africa/Suid-Afrika

205 Nelson Mandela Drive/Rylaan, Park West/Parkwes
Bloemfontein 9301, South Africa/Suid-Afrika
PO Box/Posbus 339
Bloemfontein 9300
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Appendix G – Ethical Clearance Letter (2)

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA

UFS·UV
HUMANITIES
GEESTESWETENSKAPPE

18 August 2016

Prof H.J. Bloemhoff
Department of Exercise and Sport Sciences
UFS

Application for extension for ethical clearance: Physical activity levels and life style habits of undergraduate students at a South African university (UFS-HUM-2014-63)

Dear Prof Bloemhoff

With reference to your application for extension for ethical clearance with the Faculty of the Humanities, I am pleased to inform you on behalf of the Research Ethics Committee of the faculty that you have been granted extension with the assumption that there are no major changes with regards to the study.

Thank you for submitting the application for extension. We wish you every success with your research.

Yours sincerely,

Prof Robert Peacock
Chairperson: Research Ethics Committee
Faculty of the Humanities

Copy: Charné Vercueil
Officer: Research Co-ordinator
Faculty of the Humanities

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South Africa/Suid-Afrika
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Appendix H – Example Report

ANTHROPOMETRY REPORT

University of the Free State Biokinetics Center

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA
UFS UV

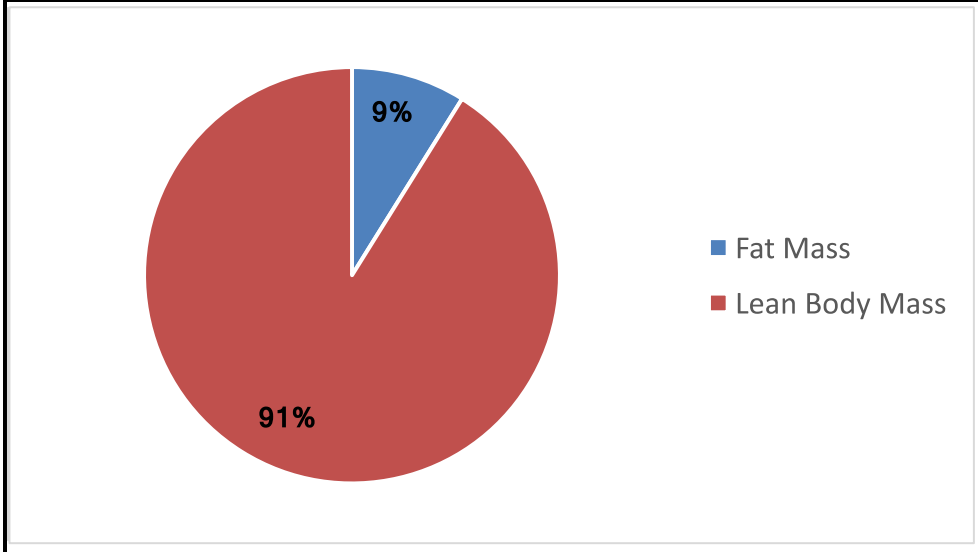
Name:	x	**Weight:**	85 kg
Surname:	123456789	**Height:**	185 cm
Date:	x	**Age:**	x
Gender:	Male	**Sport:**	x

SKINFOLD MEASUREMENTS			
Sub Scapula	10	**Abdominal**	10
Triceps	10	**Medial Calf**	10
Supra Illiac Crest	10	**Frontal Thigh**	10

GIRTHS			
Arm Relaxed	33	**Hip**	105,5
Arm Tensed	35	**Calf**	38
Waist	63		

BREADTHS			
Humerus	7,5	**Femur**	10

RESULTS		
Sum of 6 Skinfolds	60 cm	**Very Good**
Fat Percentage	8,9 %	
Fat Mass	8 kg	
Lean Body Mass	77 kg	
Waist to Hip Ratio	0,8	**Low Risk**
BMI	25	**Normal**



BIOKINETICIST: _____