PHYSICAL ACTIVITY AND LIFESTYLE HABITS OF FEMALE UNDERGRADUATE STUDENTS

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Declaration

I, Line Malan 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 _____2019.

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Abstract

Introduction: There is an extensive body of empirical evidence which demonstrates health benefits of physical activity. PA is associated with lower mortality rates for female students. Young female adults attending universities gain increased control over their lifestyles, however don't necessarily develop positive behaviours like regular PA.

Aims: To determine PA levels and lifestyle habits of female undergraduate students.Three objectives were set out for this research: (1) To identify PA levels of the female undergraduate students at the University of the Free State campus using a validated self-reported measure instrument; and (2) To establish the lifestyle profile and body composition of undergraduate female students attending this Tertiary Institution and (3) to determine the impact of ethnicity on PA levels, lifestyle habits and body composition of undergraduate female students attending a tertiary institution.

Methods: A quantitative approach, using a one-time non-randomized cross-sectional study approach was used. Ethical clearance was obtained and participants completed the Belloc and Breslow's lifestyle questionnaire and IPAQ questionnaire. Anthropometric testing was then conducted on the participants.

Results: The PA levels of the students was determined with a total of 68% participating in PA. There was an increase in the participation in PA from first year (62.3%) to third year (79.4%). This increase 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 were however no statistically significant associations in PA and lifestyle habits between ethnicity and year groups.

Conclusion: An increase in the PA frequency as well as the mean MET minutes/week from first year to third year was found. The ethnic groups on the other hand didn't show significant differences among their lifestyle habits, PA levels and body composition

This proved that students improved to high levels of PA and are aware of the health benefits.

Keywords: Female Undergraduate Students, Physical Activity, Anthropometry, Lifestyle Habits.

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List of Abbreviations

The following list will provide the terms abbreviated in this protocol:

PA	Physical Activity
IPAQ	International Physical Activity Questionnaire
CVD	Cardio Vascular Disease
CHD	Coronary Heart Disease
LDL	Low Density Lipoprotein
WHO	World Health Organization
EU	European Union’
U.S.A.	United States of America
ACSM	American College of Sports Medicine
BC	Body composition
BMI	Body Mass Index
LBM	Lean Body Mass
WHR	Waist-Hip-Ratio
WC	Waist Circumference
HC	Hip Circumference
HSFSA	Heart and Stroke Foundation South Africa
AHA	American Heart Association
MPA	Moderate Physical Activity
VPA	Vigorous Physical Activity
CDD	Centre for disease control and prevention
EU	European Union

Chapter 1 – Problem Statement and Objectives

1.1 Introduction

1.2 Problem Statement

1.3. Research Aim and Objectives

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1.1. Introduction

The American College of Sports Medicine (ACSM, 2011), defines physical activity (PA) as any bodily movement produced by the contraction of skeletal muscles that results in a substantial increase over resting energy expenditure. Physical activity consists of large muscle aerobic activities, such as walking, cycling, and many recreational activities and sports. In addition, other forms of PA include muscle strength and balance training (Garber *et al*. 2011).

The WHO (2013) reported that 60% of the world does not adhere to the minimum recommendation of 30 minutes of moderate intensity PA per day. When there is a lack of PA, it increases the risk of developing CVD, CHD, obesity, type-two diabetes mellitus, osteoporosis, depression and cerebral stroke (Kohl *et al*. 2011)

A study done by Desai *et al*, (2008) suggested that more than half of the population in the U.S.A. is overweight or obese, with large percentages accumulating considerably over the last 15 years. Many university students are overweight or obese, and fail to meet the minimum physical activity levels (Desai, *et al*, 2008). This may place them at significantly high risk for a number of lifestyle-related chronic cardiovascular diseases (CVD), including diabetes mellitus, hyperlipidaemia, hypertension, and cardiovascular disease.

Physical inactivity is reaching epidemic proportions in countries all over the world, with over 1 billion adults globally with a body mass index (BMI) which is above 25 and considered obese (Stovitz and Batt, 2010). The occurrence of physical inactivity and obesity in university students, strongly suggests that this population should be considered to be outstanding candidates for programs designed to advance nutritional and dietary habits and an increase in daily physical activity.

According to Penedo and Dahn (2005) there is a positive relationship between the participation in physical activity and the improved quality of life. Being physically active has been associated with positive mental and physical health outcomes (Penedo and Dahn, 2005). A study done by Kwan *et al,* (2013) identified that there is a decline in the PA levels in young adults during their transition to adulthood when entering

university. Young adults attending universities gain increased control over their lifestyles. However, they may not develop positive behaviours like regular participation in PA. PA can have a positive influence on one's health and according to Robbins *et al* (1994), PA consists of 5 health related components, namely:

- Cardio respiratory endurance
- Muscle strength
- Muscular endurance
- Flexibility and
- Body composition

Participation in PA is associated with a decreased risk of cardiovascular disease mortality in general and coronary heart disease, a decreased risk of colon cancer and a lower risk of developing non-insulin-dependent diabetes mellitus (Keating, 2005).
A study done by Bloemhoff (2010) in South Africa on PA levels of undergraduate students found that gender was a strong correlate of overall PA, with females identified as being more physically inactive than male students.

1.2 Problem statement

The problem is that physical inactivity is considered a global health concern and no standardised approach to measurement exists and international comparisons and global surveillance is difficult (Craig *et al*. 2003). Little research has been done on PA levels and lifestyle habits of female students in South Africa which is problematic, because information is needed for interventions by relevant professionals in higher educational institutions.

1.3. Research Aim and Objectives

The main aim of the study was to determine the PA levels and lifestyle habits of the undergraduate female students attending the University of the Free State.

The objectives of the study were: (1) To identify PA levels of the female undergraduate students at the University of the Free State campus using a validated self-reported measure instrument; and (2) to establish the lifestyle profile and body composition of undergraduate female students attending this tertiary institution and (3) to determine

the impact of ethnicity on PA levels, lifestyle habits and body composition of undergraduate female students attending this tertiary institution.

1.4. Necessity of the Research

Students' PA levels as a research topic is well known to be neglected (Keating *et al.* 2005). Numerous studies have been done on this topic since 2005, but there is a growing need for the understanding of the pattern and amount of PA among female undergraduate students attending a tertiary institution to plan specific demand driven intervention programs (Görner *et al.* 2009).

1.5. Structure of the dissertation

This dissertation consists of seven chapters. Chapter one provides an overview of the dissertation and what the reader can expect. In chapter two, a literature review is provided which presents a flow and detailed review on PA and lifestyle habits of a global population which then gets collapsed to only female students. During the literature review, many topics are discussed such as the implications of physical inactivity as well as the positive effects that PA has on health and wellbeing. Chapter three elaborates on the research methodology. Chapter four provides us with a report of the results of the data which was acquired using the International Physical Activity Questionnaire (IPAQ), Belloc and Breslow Lifestyle Habits Questionnaire, and the Anthropometric assessment. Followed by this is Chapter five which is a discussion of the results. Chapter six is a complete conclusion of the dissertation which provides the limitations and recommendations for future research. Lastly, Chapter seven is a reflection on the research process and provides an overview on the researchers personal experiences during the research process.

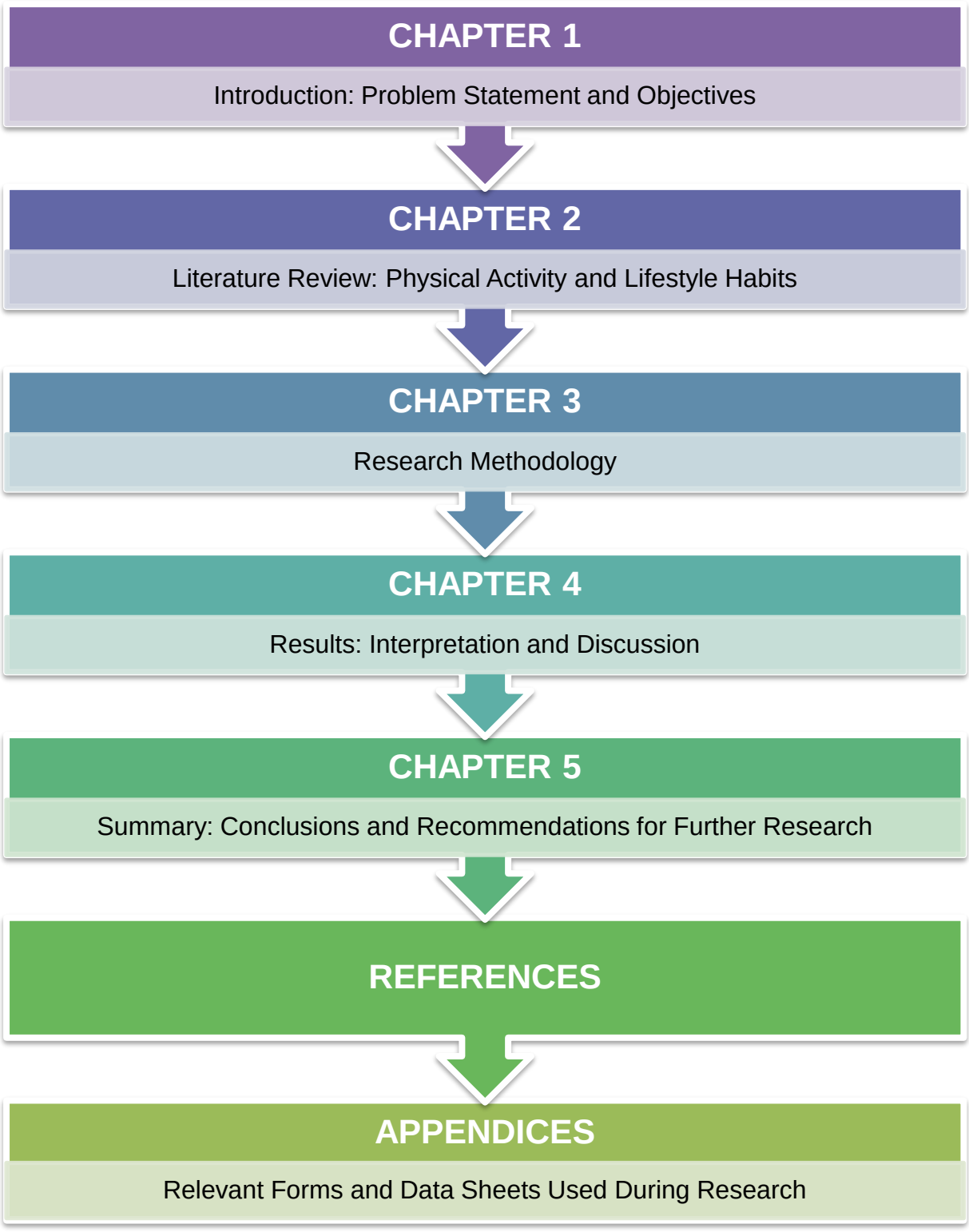

Figure 1- Dissertation structure

Chapter 2 – Literature Review

2.1. Introduction

A rapid rise in chronic diseases and unhealthy lifestyles is a stern threat to health and longevity in developing countries (Nugent, 2008). The World Health Organization (WHO, 2013) reported that physical inactivity is the fourth leading risk factor for worldwide deaths. Physical inactivity was proven to be responsible for the following:

- 6% of the occurrence of coronary heart disease,
- 7% of type 2 diabetes,
- 10% of breast cancer, and
- 10% of colon cancer.

According to a report by the World Health Organization (2002) approximately 60% of the global population does not adhere to the minimum daily recommendation of 30 minutes of moderate intensity PA. Further evidence states that the epidemic of excess body weight is directly related to an imbalance between dietary intake and PA (Görner *et al. 2009*). If the number of physically inactive people decrease and their lifestyle habits improve by at least 25%, then more than 1.3 million deaths could be avoided annually (Görner *et al. 2009*).

In this ever-changing and modernized world it has been acknowledged that remaining healthy is essential for everyday living. A healthy lifestyle can consist of many aspects but according to Belloc and Breslow (1972) PA/physical fitness, following good eating habits, getting enough sleep, consuming little to no alcohol, avoid smoking, and maintaining a healthy body composition are important factors in maintaining one's health.

A study done by the World Health Organization (WHO) identified that many lifestyle diseases are developed during the adolescent years (WHO, 2013). This makes the time that a student spends attending university vital in developing an adequate PA profile (Desai *et al*. 2008). The most important factor regarding regular PA is that it provides greater health benefits and improves not only physiological well-being but psychological well-being as well.

2.2. Physical Activity (PA)

The American College of Sports Medicine (ACSM, 2011), defines PA as any bodily movement produced by the contraction of skeletal muscles that results in a substantial increase over resting energy expenditure. PA consists of large muscle aerobic activities, such as walking, cycling, and many physical recreational activities and sports. In addition, other forms of PA include muscle strength and balance training. (Garber *et al*. 2011).

Physical inactivity has been reported as the fourth leading risk factor contributing to deaths and disease worldwide (Lee *et al*. 2012). According to Keating *et al.* (2005), 40-50% of college students are physically inactive. In the UK, it was reported that students revealed that they spent at least 8 hours per day on sedentary behaviour, due to a lack of interest in PA (Deliens *et al*. 2015). Physical inactivity can increase the risk for the development of the following: hypertension, dyslipidemia, CVD, CHD, breast and colon cancer, overweight and obesity and type-two diabetes mellitus (Lee *et al.* 2012). However, lower levels of physical inactivity and higher levels of PA have been proven to be associated with beneficial health-related outcomes across a wide diverse population (Younis, 2014). Deliens *et al.* (2015) further stated that remaining physically active and avoiding any form of sedentary behaviour has been proven to be influential on a student's weight and general health.

The ACSM (2011) classified the guidelines set out for PA into four classifications and recommended weekly procedures (Prewitt *et al*. 2015). These guidelines are presented in Table 1.

Table 1 - Classifications of Physical Activity

Physical Activity	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.

Nunan *et al*. (2013) further expresses that significant weight loss can only be achieved when following the ACSM (2011) recommendations that exercise programs need to exceed 225 minutes per week. There are many benefits that can be achieved by participating in regular PA. A few of these benefits include: preventing CVD and diabetes, reducing mortality risk, preventing hypertension and reducing the risk of breast and colon cancer (Batty, 2002; Chodzko- Zajko *et al*. 2009; Vogel *et al.* 2009). PA has also been proven to reduce the risk of a stroke during later stages in life. (Goldstein *et al*., 2006; Wannamethee and Shaper, 2014). Furthermore, healthy biological and functional aging can be managed through regular PA. (Chodzko-Zajko *et al.* 2009).

Evolving evidence is starting to prove that PA can influence and even improve cognitive ability in students. It can provide improvements to avoid students from developing dementia in the long term. (Angevaren *et al.* 2008; Blondell, *et al*. 2011). According to the WHO (2011), an estimate of 47,5 million people have been diagnosed and been living with dementia. Sixty to seventy percent of these people have developed dementia from Alzheimer's disease, where 12,7% of most cases could be avoided worldwide if PA was encouraged more and physical inactivity was eliminated.

In a few cross sectional (Burns *et al.* 2010) and prospective cohort studies (Boyle *et al.* 2009), it has been proven that a low muscle mass and strength have also been

linked to cognitive impairment. Regular PA is of vital importance in order to prevent or minimize any form of cognitive impairments. Norton *et al.* (2014) suggests that physical inactivity appears to be a preventable risk factor for Alzheimer's dementia. Growing evidence supports the role of PA in developing and maintaining cognitive capacity throughout life (Sallis *et al*. 2016).

One of the most significant methods that will help decrease the risk of disease is to increase PA (Bauman *et al.* 2016). Crimmins (2015) further suggested that PA is the most important determinant of active aging and has a major role in improving the quality of life and in reducing disability. PA has been the main contributor to fruitful healthy aging, including clinical, psychological, and social benefits. (Lee *et al*. 2016). A few of the social and psychological benefits include reduced stress and anxiety levels, increased self-image, increased self-esteem and a reduction in depression (Kipp, 2016).

The collection of PA monitoring has vastly increased over the past few years, however the problem that arises is that PA is not increasing worldwide. Many studies have proven and shown that PA can enhance brain health, improving dementia and alzheimer's, however the new knowledge still hasn't been brought into action (Sallis *et al*. 2016).

2.3. Body composition

Body composition can be defined as a relative percentage of body mass that is considered fat and fat-free tissue (Scott, 2016). An individual's body composition is also considered to be a health-related component of physical fitness which is distinct to other health-related components, as it is not measured based on performance and requires no movement for the measurement to take place (Corbin *et al*. 2009), although any form of physical movement/PA can have an effect on body composition of an individual.

Body composition is comprised and worked out using the body mass index (BMI), circumferences, and skinfolds (Thompson *et al.* 2010). The higher the body composition, the higher the risk factors are for chronic diseases such as metabolic syndrome and CVD. As body composition changes, it may result in an increased prevalence of overweight/obesity (Hong, 2014).

Many rely on the measurement of BMI in height and weight. However, circumferences and skinfold measurement on the other hand provide a more accurate estimate of body fatness (ACSM, 2010). According Hong (2014), PA is known to provide body composition benefits, namely body fat percentage reduction, an increase in Lean Body Mass (LBM) and a firmer muscle tone.

There are techniques used worldwide to assess body composition, however for the aim of this study the following methods were applied and therefore will be further discussed:

- Skinfold Measurements (Fat Percentage and LBM);
- Body Mass Index (BMI);
- Circumferences (Waste-to-Hip ratio)

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

Scott (2016) defined body fat percentage as the total amount of fat on your body excluding that of fat free mass. Fat free mass consists of muscle, bone, water and connective tissue. The body is comprised of two different types of fat, namely subcutaneous fat and visceral fat. Subcutaneous fat is situated under the skin, where visceral fat on the other hand is situated around your organs and is often referred to as "belly fat". In most clinical settings, body composition is routinely assessed to identify whether individuals are at risk due to excessive low or high levels of body fat. (Heyward, 2002). According to the ACSM (2011), it is well recognized that an excessive amount of body fat, especially when situated around the abdomen, is associated with hypertension, metabolic syndrome, type 2 diabetes mellitus, stroke, CVD and dyslipidemia.

According to the ACSM (2011), the purpose of skinfold testing is that the quantity of subcutaneous fat is comparative to the total amount of body fat. There are a few advantages that have been presented of the use of skinfold testing and these include:

- Equipment is inexpensive,
- Results are reliable if the correct procedures are followed,
- Low technology is necessary,
- Simple and easy to use,
- Subject experiences little discomfort and
- Suitable for large scale epidemiological surveys

MedicineNet (2012) on the other hand defined LBM as the total amount of body mass minus the body fat. LBM consists of everything else in the body that is comprised of mass excluding body fat. These include organs, blood, bones, muscle and skin. Erlandson *et al.* (2013) suggests that LBM enhances bone mineral density through mechanical load forces, however the total LBM on bone mineral density may differ by age, gender, race, and skeletal site. Erlandson *et al.* (2013) also stated that LBM is associated with lower risk of bone fractures.

2.3.2. Body Mass Index (BMI)

According to ACSM (2011), BMI is calculated as body weight in kilograms (kg) divided by height in metres squared (kg ÷ m^2). It is also extensively used as an index of relative weight to height. When a BMI is 25 or higher, it is classified as overweight whilst a BMI of 30 or greater is classified as obese (Wells, 2005). BMI has been proven to be a global index of nutritional status, used to categorize the following:

- Overweight/obesity
- Eating disorders
- Psychological criteria.

BMI have been documented as a factor that could have an influence on an individuals' health status, (US Department of Health and Human Services USDHHS, 2001). According to Sparling and Snow (2002), there is a positive influence on a students' lifestyle if PA levels and BMI values are maintained. BMI can give an individual a basic idea of possible health problems, however it's difficult to determine what the weight of an individual is comprised of.

2.3.3. Waist-to-hip ratio (WHR)

Scott (2016) defined the waist to hip ratio as a measurement of the size of your waist compared to the size of your hips. According to ACSM (2011), the WHR consists of the girth of the waist divided by the girth of the hip. Waist circumference (WC) provides a simple measure of central fatness. By placing a tape measure around the narrowest part of an individual's waist will provide you with the WC measurement. By placing a tape measure around the widest part of the hips will provide you with the hip circumference (HC) measurement.

2.4. Lifestyle Habits

When young adults start attending university, many changes occur in their lifestyles that may contribute as obstacles to regular PA (Pengpid and Peltzer, 2013). Increased time pressures through high course workload and social conquests have been reported as motives for students ceasing participation in PA and sport in their first year of college and/or university. The students gain an increased control over their life when

attending University. This, paired with the increased stresss due to course work, may lead the student to engage in health-risk behaviours (Kwan *et al.* 2013).

There are many health-risk behaviours and these include smoking, excessive alcohol intake and inadequate nutritional status. These behaviours all have a direct link to chronic diseases (Kwan *et al*. 2013). All these risk factors have an impact on the students physical health and lifestyle habits (Belloc and Breslow 1972). With over one billion people considered obese globally with a BMI score greater than 25 , it is important to gain an understanding as to what lifestyle habits the students follow as well as their PA levels (Bloemhoff, 2010). Understanding these lifestyle habits can lead to strategies being developed and implemented in order to promote the health status of students.

According to Belloc and Breslow (1972) there is a strong relationship between the physical health status of an individual and seven life-style practices for physical health. Belloc and Breslow (1972) designed a questionnaire using seven key aspects which lead to a healthy lifestyle. The following are the seven key aspects outlined by Belloc and Breslow (1972):

- 3 meals a day with no eating between meals,
- Eating breakfast,
- Regular moderate physical activity (2-3 times per week),
- No smoking,
- Moderate or no alcohol use,
- 7 to 8 hours of regular sleep
- Maintaining a healthy weight

These seven health habits have been used to evaluate health practices, and to test the association between health practices and health status (Noguchi *et al.* 2015). All of the above mentioned lifestyle habits will be discussed separately.

2.4.1. Eating three meals per day without in-between eating

Belloc and Breslow (1972) suggested that eating three meals a day without any in-between snacking can be beneficial. By eating three meals per day and avoiding in-

between eating can improve digestion in the body in the 24 hour cycle, making it easier for the body to breakdown all food consumption. Well-spaced meals and a balanced diet has been recommended as a requirement for daily benefits (Aragon *et al.* 2015).

Smallberger (2006) found that the African students reported a decrease in PA, but an increase in food consumption including protein, carbohydrate and fats. By decreasing PA and increasing food consumption unfortunately increases the risk of chronic diseases which can include hypertension, diabetes mellitus, heart diseases and overweight/obesity (Smallberger, 2006). According to Krishnan and Sharmila (2016), the main occurrence of obesity happens when the energy consumed exceeds that of the amount utilized for PA.

Amongst the young population, overweight/obesity has drastically increased due to the food market in the modernized world (Yahia *et al.* 2008). A study done by Smallberger (2006) indicates that there is a lack in the consumption of fruits and vegetables in young women, which doesn't provide adequate vitamins and minerals which is known to be a necessity in any diet. According to Nicklas (2013) snacking has been understudied, however it has been proven that several snacking patterns are associated with overweight/obesity in contrast with no snacks resulting in lower abdominal obesity and an improved body composition.

2.4.2. Eating Breakfast

Krishnan and Sharmila (2016) mentioned that breakfast is considered the most important meal of the day. However, it has also been proven to be the most neglected meal of the day. Sharkey and Gaskill (2007) stated that eating breakfast has a significant positive influence on an individuals' metabolism. The earlier an individuals' metabolism starts to kick in, the more food will likely be digested and broken down in the body throughout the day (Belloc and Breslow, 1972). Belloc and Breslow (1972) suggests that breakfast eaters tend to have an increase in physical health. Breakfast has also been proven to provide fuel to the brain and the body throughout the day. Krishnan and Sharmila (2016) further suggests that eating breakfast can influence behavioural and cognitive performance.

According to Vargas *et al*. (2016) weight can be maintained by eating breakfast, and individuals who skip breakfast tend to have a positive relationship with weight gain. As mentioned during the importance of three meals a day, it is important to eat breakfast to consume the necessary vitamins, minerals and nutrients which cannot be compensated by any other meals (Smallberger, 2006). It is obvious that consuming breakfast every morning has a positive influence on an individuals' body composition, mental health and dietary needs necessary to function throughout each day (Sharkey and Gaskill, 2007).

2.4.3. Participation in moderate PA 2-3 times per week

The ACSM (2011) stated that PA is classified as a health-related fitness, because it has been proven to improve general health and improve every day activities. In 2008, the Heart and Stroke Foundation of South Africa (HSFSA) highlighted that individuals who were inactive were at a higher risk of developing heart problems or die of a heart attack. According to the WHO (2013), 150 minutes per week, 50min per session, 3 times per week of PA of moderate-to-vigorous intensity is recommended. Multiple studies have been implemented to support PA and the influence it has on health. It has been suggested that a minimum of 150 minutes of moderate intensity per week can have a significant influence on risk reductions and can ensure better quality of life as well as a greater longevity (Krishnan and Sharmilla, 2016).

2.4.4. No smoking

During recent studies, it was found that 17.6% of South Africans smoke tobacco (Ganz, 2016). Prabhat, *et al.* (2014) is of opinion that smoking is the major cause of death worldwide. Taylor *et al.* (2014) concur and estimated that tobacco misuse has been identified as the leading global cause of lung cancer, with almost 5 million deaths a year and is predicted to increase each year. Lung cancer caused by the smoking of cigarettes was identified more than four decades ago as one of the most common epidemics in society. (Belloc and Breslow, 1972). Amongst women, cigarette smoking and death occurrence is currently increasing (Pirie *et al*. 2013).

According to Ibisevic *et al.* (2015), the younger smoking population (aged between 18-22 years old) has drastically increased and it has been proven that the young

population smoke more than 50 cigarettes per day which in return increases the risk of coronary heart disease, peripheral vascular disease which could lead to gangrene and eventually to amputation.

A study done by the American Heart Association (AHA) (2008) further supplied alarming statistics on individuals smoking above the age of 18:

- 18.1% Females smoke
- 20% White women smoke
- 17.3% Black women smoke

Cessation of smoking consists of many health benefits as indicated by the Heart and Stroke foundation of SA (2008):

- Oxygen and Carbon dioxide normalize in the blood – after 8 hours
- Heart attack and Stroke risks can decrease – within 24hours
- A decrease in the formation of blood clots
- Participation in PA can become easier – after 3 weeks
- Blood circulation increases – after 1-3months
- Risk in developing lung cancer can decrease by half – within 5 years.
- The risk to develop heart diseases are the same as a non-smoker – within 5-15 years after cessation.

2.4.5. Little/no alcohol consumption

Alcohol is defined by Varvil-Weld *et al.* (2013) as a psychoactive substance that has been traditionally used for many centuries amongst many cultures. Littrell (2014) defined alcoholism is a form of excessive amounts of alcohol intake which could lead to alcohol abuse and alcohol dependence causing social, physical and emotional harm amongst students.

Belloc and Breslow (1972) amidst that alcohol consumption prevents the breakdown of fat in the body which then causes an increase in the total amount of body fat. Weld *et al.* (2013) indicated that there are excessive amounts of alcohol being consumed amongst university students. A data survey reveals that male students outpace female students when it comes to binge drinking. A low dosage of alcohol in students can reduce stress levels, however higher dosages of alcohol can lead to alcoholism and blackouts (Littrell, 2014).

According to Varvil-Weld *et al.* (2013) and Holmes (1994) students who excessively drink could lead to memory blackouts, anxiety and depression, assaults, lower grades, overdoses, injuries and study disruptions. Varvil-Weld *et al.* (2013) stated that intoxication of alcohol could possibly lead to various problems, including:

- Decision making ability
- Motor skill impairment (balance and coordination)
- Cognitive ability impairments

Mukamal (2006) showed that alcohol users are predisposed to smoking which has been proven to increase the risk of coronary heart disease. Sutfin *et al*. (2009) has recommended the use of strategies to reduce alcohol abuse amongst students. These strategies include avoiding drinking games, alternating alcoholic drinks with non-alcoholic drinks and mixing less alcohol and more soft drink.

According to the WHO (2013), there are strategies in place to reduce the amount of alcohol abuse and intake amongst the world population, and according to them, there will be a significant drop by 2025. Surprisingly Varvil-Weld *et al.* (2013) found that drinking levels have remained fairly stable amongst American university students over the last 30 years. Alcohol use is however a complex behavior. No single measure will capture all the relevant aspects of alcohol use. (Sutfin *et al*. 2009).

2.4.6. Enough Sleep (7-8 Hours)

Moorcrof (2005) states that when an individual is in an unconscious condition in a relaxed manner, it is referred to as sleep. Belloc and Breslow (1972) suggested that in order to replenish energy used during the day, an adequate sleeping pattern should be followed by students. Healthy sleep requires adequate duration, appropriate timing, good quality, regularity, and the absence of disturbances and disorders (Krishnan and Sharmila, 2016).

Sleeping the recommended number of hours (7-8 hours per night) on a regular basis, has proven to be associated with improved health outcomes. These outcomes include improved cognitive function, concentration, mental health, quality of life and physical health (Paruthi *et al.* 2016). Paruthi *et al*. (2016) further suggests that sleep deprivation can contribute to the risk of obesity, hypertension, diabetes, depression and accidents. Insufficient sleep amongst students on the other hand can lead to decreased concentration, daytime sleepiness, emotional instability, depression and suicidal thoughts and attempts (Nadolski, 2015).

The rate of obesity and type 2 diabetes mellitus is rapidly increasing globally. Sleep duration as well as sleep quality have emerged as possible contributors to metabolic dysfunction, diabetes and obesity (Buxton and Marcelli, 2010; Arora *et al.* 2011; Buxton *et al.* 2012; Hung *et al.* 2013; Reutrakul *et al.* 2013; Wan Mahmood *et al.* 2013). On the other hand, Robbins *et al*. (2005) suggests that individuals whom participate in PA, tend to experience a more refreshing sleep pattern, which has a positive influence on their health.

Table 2 presents the sleep duration recommendations based on an individual's age according to the National Sleep Foundation (2015).

Table 2 - Sleep recommendations

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*

In 2015 the Harvard Medical School for Sleep Medicine provided benefits of sleeping the recommended amount of hours per night. These benefits include improved immune function, improved metabolism, better cognitive function, an increase in learning as well as an improvement in other vital functions. By improving sleep quality, in turn, could aid weight loss and its maintenance a healthy body weight (Arora *et al*. 2015).

2.4.7. Maintaining a healthy body weight

According to the American Heart Association (AHA) obesity has been reclassified as a risk factor for coronary heart disease, however it has been proven modifiable (Eckel and Krause, 1998). Sturm (2002) further found that many behavioural risk factors like low PA and eating disorders have been proven to cause diabetes mellitus, CVD and certain cancers. When the energy you consume exceeds that of the energy burnt, it will cause weight gain (Smallberger, 2006). This necessitated PA, lifestyle and behavioural choices like low PA and eating disorders made during youth years has been identified to have a negative effect on the individuals health status during adulthood (Rachette, *et al*. 2005, Adlafet *et al*. 2005).

Body dissatisfaction and irregular eating patterns have been proven higher in females than males. Due to the above-mentioned reason, more females tend to follow a diet to improve body image which has been proven to enhance weight control. Individuals

who see themselves as overweight on the other hand are more likely to partake in PA than those who don't perceive themselves as overweight. (Krishnan and Sharmila, 2016)

Teamflex (2011) mentions a few healthy lifestyle habits to enhance a healthy body weight, these include:

- Temptations to snack should be avoided as much as possible
- Drinking water is of vital importance, try and carry a bottle of water throughout the day.
- Exercise is important, try walking for 15-30minutes per day.
- Get a friend who can help you follow a healthy lifestyle by eating healthy foods.
- Get involved with a trainer who can assist and can present physical activity classes
- Engage in a physical hobby maintain a healthy lifestyle, eg. Hiking

The necessity of PA is highlighted in the recommended lifestyle habits. According to National Institute for Health (2016), maintaining a healthy body weight has proved to provide many benefits including the prevention and control of many diseases. These include obesity which could lead to Type 2 diabetes, hypertension, heart problems or certain cancers.

2.5. Barriers to Physical Activity and Lifestyle

Wikipedia (2016) defined a barrier as anything that restrains or obstructs progress. Many students on campus perceive barriers to PA. Understanding what barriers the students experience or perceive they experience will help the university promote a healthy and active lifestyle.

Sousa *et al.* (2013) suggested that the main barriers to PA are a lack of motivation, lack of self-confidence (internal or personal barriers), lack of environmental and social support (relative outside barriers) and a lack of time or time management. The highest mentioned barrier has been shown to be the lack of time (Sousa *et al*. 2013).

Although students complained of a lack of time (highest mentioned barrier), they acknowledged that they may have had plenty of time, but it was never managed correctly and accordingly (Sousa *et al*. 2011). Baumeister *et al.* (1994) suggested that there is a link between time management and self-regulation. According to Wikipedia (2016), time management can be defined as the ability to use one's time effectively or productively and self-regulation can be defined as the ability for a person to control their behaviour without external control or supervision (Muraven and Baumeister, 2000; Rovniak *et al.* (2008)**.** Oettingen *et al.* (2015) suggests that the link between time management and self -regulation is simple, it's all about setting achievable goals and managing your time to achieve them.

Gómez-lópez *et al.* (2010) stated that it is important to identify that barriers to PA do vary depending on gender and age, however no statistical significant results in the latter variable have been found. According to Gómez-lópez *et al.* (2010) , this can be due to the small difference in age amongst the students.

Due to a lack of support and structure, the problem arises that students do not seek information or opportunities to become physically active during academic related activities (Kwan and Faulkner 2011). As the students are in a phase during their lives where they can still change their ways, it is important that intervention programmes be implemented to help to find ways to overcome certain barriers (Kwan and Faulkner, 2011).

2.6. Ethnicity

Ethnicity is defined as the fact or state of belonging to a social group that has a common national or cultural tradition (Cojanu, 2014). It was recognized by McVeigh, *et al.* (2004) that substantial racial differences were present concerning the composition of PA activities in primary and secondary school curriculums in South Africa. It has been proven that white children were more active than African children, more likely to partake in physical education lessons at schools and watched less television than African children. According to Keating *et al*. (2005), inconsistent results were found relating to the PA levels of the various ethnic groups.

There has been very little ethnic influence on overweight and obesity amongst females; however, the obesity rates were shown highest in African women (Reddy *et al. 2*008). Along with that, PA levels of African students may be higher than white students. Szabo and Allwood (2006) suggested that African female students in South Africa have a similar figure preference to be thinner to that of the white female student.

Research has revealed that PA patterns can vary by race, ethnicity and socioeconomic status. By examining PA and inactivity among racial and ethnic minorities, Crespo *et al*. (2000) established that ethnic differences still occur, accounting for variances in social classes. Dunn and Wang (2003) however found no significant differences of participation in PA amongst the various ethnic groups. The contradicting research results require further research to be done on students attending a tertiary institution.

Mwaba and Roman (2009) proved that irrespective of body weight and shape, black South African female students engaged in healthy dieting behaviours. In a similar study Peltzer and Pengpid (2013) confirmed a high level of obesity amongst black female students in South Africa. The question arises if ethnicity is still a predictor of participation in PA amid students in the transformed South African society.

2.7. Gender in Physical Activity and Lifestyle

Gender has been defined by Wikipedia (2016) as a range of characteristics differentiating between masculinity and femininity. Although PA have been effective in improving physical fitness and body composition in the college student population, most programs have not adequately addressed gender and long-term maintenance of increased PA (Desai *et al*. 2008). Keating *et al.* (2005) stated that there have been contradictory findings regarding gender differences in PA. A study done by Behrens and Dinger (2003) also stated that there were no gender differences in PA. According to Miller *et al.* (2005 females are more likely to participate in moderate PA than males, which contradicts the findings of Keating *et al.* (2005) and Behrens and Dinger (2003). Gender has however been identified as a possible factor which may lead to physical inactivity with the female gender considered to be more physically inactive than males (Bloemhoff, 2010). Research done on International Universities have found that PA

levels differ between male and female students (Shifrer *et al*. 2015; El Ansari, *et al.* 2014; Beville, *et al.* 2014; Guo and Ross, 2014; Haines, 2001).

Exercise levels and the motivation to exercise has been proven to be higher in women than men. The reason behind this could be due to exercise environments and cultural differences (Bloemhoff, 2010). Barriers on the other hand have been perceived to be very similar for women and men, mostly because the Universities academic context seems to affect all groups equally (Sousa *et al*. 2013).

2.8. Physical Activity levels of Female Students

In a Meta-analysis of PA behaviours in the USA, it was suggested that people engaging in PA associated with higher health benefits over the short and long term are declining more and more by the day (Schneider, *et al.* 2009). El Ansari *et al.* (2014) conducted a study in Saudi Arabia and found that one third of female university students were physically inactive. Only 43% of the students met the WHO (2013) Moderate Physical Activity (MPA) guidelines, with only 14% meeting the Vigorous Physical Activity (VPA) guidelines. Furthermore, 2.4% of the participants that met the minimum MPA recommendations of the American College of Sport Medicine and American Heart Association were female. Pinto *et al*. (1996) identified that women were significantly more likely than men to report participation in aerobics and moderate activities such as walking.

The intensity and duration of PA may be associated with how accessible the exercise facilities are to the students, suggesting the importance of access to exercise and recreational facilities on campus, as well as a competent group of staff members who are capable to support the students in starting and upholding a regular exercise program (Kuh *et al*. 2006).

2.9. Lifestyle Habits of Female Students

Healthy lifestyle behaviours are convinced behaviours that establish responsibility for one's own health. These can include learning how to manage stress, taking part in PA and having adequate nutritional intake. (Younis, 2014). Due to the rapid development and availability of high-caloric foods and increased dependence on

telecommunication at universities, significant lifestyle changes have been observed. In Qatar, these lifestyle changes amongst female students have proven to enhance/encourage sedentary lifestyles. According to Al-Nakeeb *et al*. (2015), this lifestyle transformation is suspected to be responsible for a significant growth in diseases such as: CVD, cancer and type 2 diabetes.

The WHO (2013) stated that most global deaths amongst males and females have been shown to be lifestyle related. A healthy lifestyle is of vital importance amongst female university students for a predictor of future health and life expectancy (Fahey *et al.* 2009). According to Takomana and Kalimbira (2012), lifestyle habits and behaviours that female students engage in during university and studying are likely to be sustained during adulthood. A few of these lifestyle habits include, alcohol use/misuse, tobacco use, physical inactivity as well as unhealthy dietary intake. (Keller *et al*. 2008)

Janse van Rensburg and Surujlal (2013) did research on the lifestyle habits of female students in South Africa. They found that female students reported a lower intake of alcohol during University compared to males. Furthermore, Janse van Rensburg and Surujlal (2013) suggested that stress is a high occurrence amongst female university students. The inability to handle stress can cause unhealthy lifestyle habits which include excessive eating, drinking and the misuse of tobacco. (Surujlal *et al.* 2012; Van Zyl *et al.* 2012).Gillen and Lefkowitz (2012) expressed that poor eating habits and limited amounts of PA levels caused vulnerability towards weight gain. Younis (2014) further suggested that stress, exercise and diet are a few factors that can be targeted during university years in the prevention of diseases/risk of diseases. These factors have been recognized as supreme in remaining healthy throughout later years of life.

According to Dalton (2013), a higher percentage of female students compared to male students reported binge eating due to excessive amounts of stress, peer pressure and availability of vending machines on campus. However, female students are more aware and conscious about their appearance than males which results in females exercising regularly to stay in shape (Janse van Rensburg and Surujlal, 2013). Evidence has revealed that female university students place themselves at risk for serious health conditions, primarily based on their poor lifestyle habits during their University years (Janse van Rensburg and Surujlal, 2013).

2.10. Body Composition of Female Students

According to the Centre for Disease Control and Prevention (CDC) (2009), the obesity rates have rapidly increased over the past few years and are near to extensive quantities (15% to 30% in adults, 5% to 18% in adolescents aged 12 to 19 years, 6% to 19% in children aged 6 to 11 years). Physical inactivity and overweight/obesity amongst female students have been proven to be the leading factors for a number of medical conditions namely: hypertension, stroke, cancer, coronary heart disease and diabete mellitus (Mirowsky, 2011). These factors are relevant/applicable to young females as well as at a later stage during adulthood. Table 3 is taken from the ACSM (2010) which has the predicted body fat percentage for the various age groups and the health risk that the individual may have based on their relative fat percentage and BMI.

Table 3 - Predicted Body Fat Percentage Based on Body Mass Index (BMI) for African American and White Female Adults

BMI ($kg.m^{-2}$)	Health Risk	20-39 yrs	40-59 yrs	60-79 yrs
<18.5	Elevated	<21%	<23%	<24%
18.6 – 24.9	Average	21% - 32%	23% - 33%	24% - 35%
25.0 – 29.9	Elevated	33% - 38%	34% - 39%	36% - 41%
>30	High Risk	≥39%	≥40%	≥42%

ACSM (2010) guidelines for exercise testing and prescription classification whether an adult is underweight, overweight, obese or at risk of developing metabolic diseases based on their BMI value, is presented in Table 4 below. A BMI of <18 is classified as underweight and a BMI of >25 is classified as overweight which increases various health risks (ACSM, 2010).

Table 4 -Classification of Disease Risk based on BMI and Waist Circumference

Category	BMI(kg.m$^{-2)}$	*Disease Risk Relative to Normal Weight and Waist Circumference*	
		Women ≤88cm	**Women >88cm**
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

The waist-to-hip norms for females are presented below in Table 5.
A Waist-to-hip ratio of >86 has been classified as an extremely high health risk in female adults (ACSM, 2010). According to Wells (2005), WHR has been proven to be the best index for determining risks for various diseases.

Table 5 - Risk Criteria for Waist Circumferences in Female Adults

Risk Category	Waist Circumference cm (in)
Very low	<70 cm (<28.5 in)
Low	70 – 89 cm (28.5 - 35 in)
High	90 - 110 cm (35.5 – 43.0 in)
Very high	>110 cm (>43.5 in)

According to the ACSM (2010) guidelines, by keeping your body fat percentage, BMI and waist-hip-ratio within the norms, the risk of health-related diseases will decrease and a healthy body weight can be maintained.

2.11. Chapter Summary

When young adults start attending university, many changes occur in their lifestyles that may contribute as obstacles to regular PA (Pengpid and Peltzer 2013). Independence has been proven to be a big instigator for the declination of PA (Sousa *et al*. 2013). According to the WHO (2013), most global deaths amongst males and females have been shown to be lifestyle related. According to a report by the WHO (2013) approximately 60% of the global population does not adhere to the minimum daily recommendation of 30 minutes of moderate intensity physical activity. The WHO (2013) suggests that 150 minutes per week of PA of moderate-to-vigorous intensity is necessary.

Satcher *et al.* (1999) further suggested that PA has been proven to be associated with a decreased risk of CVD as well as lower mortality rates for both older and younger adults. According to the AHA, obesity has been reclassified as a risk factor for coronary heart disease, however it has been proven modifiable (Eckel and Krause, 1998).

Kwan and Faulkner (2011) confirmed that, amongst students, external barriers triumph over the internal barriers. Among them we can highlight the lack of time, stress as well as the lack of social and environmental support (Gómez-lópez *et al*. 2010). These barriers to exercise are perceived to be stronger for students who do not exercise and for female students. Research has revealed that PA patterns can vary by race, ethnicity and socioeconomic status. By examining physical activity and inactivity among racial and ethnic minorities, Crespo *et al*. (2000) established that ethnic differences still occur, accounting for variances in social classes.

The most important factor regarding regular PA is that it provides greater health benefits and improves not only physiological well-being but psychological well-being as well (Desai *et al*. 2008).

Chapter 3 – Methodology

3.1. Introduction

3.2. Research Design

3.3. Study Participants

3.3.1. Study Population and Selection

- Inclusion and Exclusion Criteria

3.4. Measurement Instruments

3.4.1. International Physical Activity Questionnaire (IPAQ)

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- Triceps
- Subscapular
- Suprailliac
- Abdonimal/Para Umbilicus
- Anterior Mid-thigh
- Medial Calf

3.5. Methodological and Measurement Errors

3.6. Data Analysis

3.7. Ethics

3.8. Pilot Study

3.9. Distribution of Questionnaires and Conducting of Tests

3.10. Limitations

3.1. Introduction

The aim of the study was to determine the PA levels and lifestyle habits of the undergraduate female students attending the University of the Free State. Chapter 3 will henceforth provide theoretical perspectives on the research design and the methodology selected for achieving the aims of the study. 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 Research Design

The research intends to document and analyze the PA levels as well as the lifestyle habits of undergraduate female students at the University of the Free State. According to David and Sutton (2004) an appropriate research design is critical in any scientific research process and forms the "blueprint" of the study (Brink *et al.* 2012). Maholtra (2010) states that the research design is the plan followed to execute the research project. Zikmund *et al.* (2013) agreed by describing the research design as a "masterplan". This masterplan specifies the methods and procedures which must be followed to collect and analyzing the needed information. This study could be described as a one-time non-randomized cross-sectional study, based on an available population of undergraduate female students at the University of the Free State. The research process is illustrated in Figure 1.

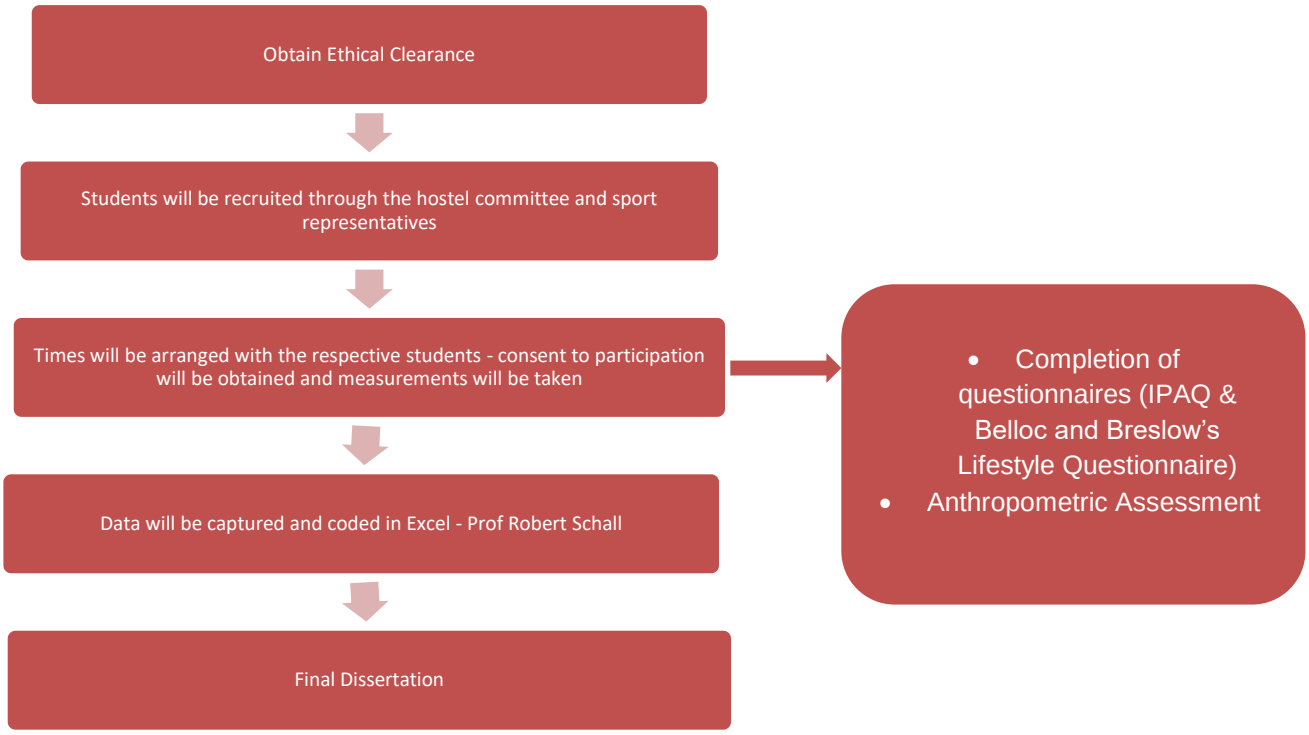


Figure 2: Graphic illustration of the study's approach

3.3. STUDY PARTICIPANTS

3.3.1. Study Population and Selection

According to Bowling (2014) sampling methods for research can be divided into two groups, namely sampling for quantitative research and sampling for qualitative research. Furthermore, sampling can either be random sampling or non-random sampling. Simple random sampling, unrestricted random sampling, cluster sampling, systematic sampling and stratified random sampling are all examples of random sampling (Bowling, 2014). Polit *et al.* (2001) described convenient sampling as a cohort of subjects that happen to be in the right place at the right time. A convenient sample of female undergraduate students at the University of the Free State was chosen. Subjects were recruited via the Hostel Committees. The sports representatives from each of the residence committees were contacted through Kovsie Sport and were involved in the recruitment process.

An information letter (Appendix E) which provided them with all the relevant information and procedures involved, was handed out to all the undergraduate female students during their weekly house meeting by the hostel sport representative. All the subjects that were willing to take part (including the sports representative) received a free body composition report directly after the completion of the anthropometrical assessments and questionnaires. The report included muscle mass, leanness, fatness and ideal body weight.

The inclusion criteria:

- Student must be a female,
- Registered as an undergraduate student at the University of the Free State

The exclusion criteria:

- Any female student who was a post graduate student (Honours, Masters or PHD).
- Not registered at the University of the Free State

3.4. Measurement Instruments

The researcher made use of two self-reported questionnaires, the International Physical Activity Questionnaire (Appendix A) and the Belloc and Breslow 7 Lifestyle Habits Questionnaire (Appendix B) to determine the PA levels and lifestyle habits of the participants. A measurement protocol, the Heath and Carter Anthropometric Assessment (Appendix C), was taken to determine the body composition of each participant.

3.4.1. The International Physical Activity Questionnaire (IPAQ)

Physical inactivity as stated by Pengpid and Peltzer (2013), is considered to be a major health concern globally. The IPAQ was developed as a standardized approach to measure an individual's PA levels (Sjöström *et al*. 2002). However, several different versions of the IPAQ were developed. These different versions included a long and short version that could be self-administered or administered by interview/telephone to young and middle-aged adults ranging from 15-69 years, to monitor their activity habits over the previous 7 days (Craig *et al*. 2003; IPAQ, 2005; Macfarlane *et al*. 2007). Standard methods were used to translate and adapt the questionnaires for use in different countries (Craig *et al*. 2003).

The IPAQ is a self-reported questionnaire which is suitable to facilitate cross-cultural comparisons of PA levels in populations across countries (Craig *et al*. 2003). Craig *et al.* (2003) further stated that the reliability of the IPAQ questionnaire was at an acceptable level, with 75% of the correlation coefficients observed to be 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). The acceptable reliability and validity of the IPAQ resulted in the World Health Organization (WHO) and the European Union (EU) using it on both a global and a regional scale (Guilbert, 2003).

Research conducted by Lambert and Kolbe-Alexander (2006) in South Africa using the IPAQ reports that the long IPAQ was found to be a comprehensive tool containing information about activities conducted on a weekly basis. These activities on a weekly basis included household activities, transport, leisure time PA, occupational activities and sedentary behavior. This report (Lambert and Kolbe-Alexander, 2006) on the

chronic lifestyle diseases in South Africa also stated that the IPAQ “has been validated for use in the South Africa population”. However, Hallal *et al.* (2012) raised concerns on the unreliability of self-reports, especially those pertaining to occupational PA. The scoring protocol states “asking more detailed questions regarding physical activity within domains is likely to produce higher prevalence estimates than the more generic IPAQ short form” (IPAQ, 2005). Pardo *et al*. (2014) also mentioned that some respondents in their study had difficulties distinguishing between vigorous and moderate activities. Fillipas *et al*. (2010) also warned about the use of the IPAQ, stating that it can be considered a useful screening tool, but it should not be utilized if a precise level of PA is required.

To conclude, the IPAQ questionnaires produced repeatable data (Spearman's rho clustered around 0.8), with comparable data from short and long forms. Criterion validity had a median rho of about 0.30, which was comparable to most other self-report validation studies (Craig *et al*. 2003).

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

Category 1: Low

This is the lowest PA. Individuals who do not meet the 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
- 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 (IPAQ, 2005).

3.4.2. Belloc and Breslow’s 7 Lifestyle Habits Questionnaire

According to Belloc and Breslow (1972) there is a strong relationship between the physical health status of an individual and the seven life-style practices for physical health. Belloc and Breslow (1972) designed this questionnaire using 7 key aspects which lead to a healthy lifestyle. The following are the 7 key aspects outlined by Belloc and Breslow:

- 3 meals a day with no eating between meals,
- Eating breakfast,
- Regular moderate PA (2-3 times per week),
- No smoking,
- Moderate or no alcohol use,
- 7 to 8 hours of regular sleep
- Maintaining a healthy weight

These seven health habits have been used to evaluate health practices, and to test the association between health practices and health status (Noguchi *et al.* 2015)

According to 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.

3.4.5. The Heath and Carter Anthropometric Assessment

It is well known that the analysis of body composition is an essential component for improvement in PA and in the performance of athletes (Marfell-Jones *et al*. 2006;

Sharkey and Gaskill, 2013; ACSM, 2014). The reliability of the anthropometric assessments comes down to the accuracy and capabilities of the measurer (Carter, 2002). In order to ensure the reliability of the measurements, investigators must report the test-retest reliability of the measurements (Carter, 2002). To ensure the reliability two measurements must be taken at each of the skinfold site. Should there be a significant difference between the two measurements then a third measurement must be taken and the mean value of the three measurements will then stand as the final measurement (Carter, 2002). The validity of the measurements will be determined by the accuracy of each measurement. To ensure validity the researcher (Level 1 Anthropometrist) had carefully and accurately identify each landmark for the skinfold sites that was used in determining the anthropometric profile of the student.

The six skinfold sites where the measurements were taken are the triceps, subscapular, suprailliac, umbilicus/abdominal, mid-thigh and medial calf. These measurements were carried out by the researcher (Level One Anthropometrist) following the guidelines of the International Standards for Anthropometric Assessment (ISAK) (Marfell-Jones *et al.* 2006). The completion of the questionnaires and the anthropometrical assessments did not exceed 30 minutes per subject.

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 Measurement

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.

Hip.

Subject position: The subject assumes a relaxed standing position with the arms folded across the thorax. The subject's feet should be placed 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-radialelandmark.

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).

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).

Mass and Height

Mass was measured using a calibrated electronic scale (Seca electronic scale, Delta Surgical South Africa (Pty) Ltd.) The female students wore only minimum or light clothing and were barefoot. The mass measurement was recorded to the nearest 0.1kg (Heyward, 2006). The standing height was measured by using a stadiometer. The scoring recorded the maximum distance between the vertex and the soles of the feet measured in centimetres (cm). Participants were requested to remove their shoes and socks before measurement commenced. Their arms were placed at their sides in a relaxed position. The back of the head, scapula, upper back, gluteus maximus, calves and calcaneus had to be in contact with the stadiometer. From the lateral view, the ear, acromiom, greater trochanter, back of patella and front of calcaneus needed to be aligned in vertical line. The Frankfort plane was then attained. As soon as the above alignments were achieved, the participants were instructed to look ahead and inhale. The stadiometer was placed on the highest point of the skull. The measurement was then recorded before the subject exhaled (Marfell-Jones *et al.* 2006).

Using the 6 skinfold measurements from the Anthropometric profiling, the body fat percentage was determined. The formulae used to calculate body fat percentage were

Women:

Body Density (BD) = 1.07878 – 0.00035(sum of 6 sf) + 0.00032(age)

% fat = (495/BD) – 450

Somatotype of the participants

Using the measurements from the anthropometric profiling the somatotype of the participant was determined (Duquet and Carter, 2001).

Endomorphic component

$= - 0.7182 + 0.1451(\sum SF\ x\ Z) - 0.00068(\sum SF\ x\ Z)^2 + 0.0000014(\sum SF\ x\ Z)^3$

Where:

$\sum SF$ = (triceps + subscapulare + supraspinale)

Z = 170.18 / stature (length)

Mesomorphic component

= 0.858 (HUM) + 0.601(FEM) +0.188 (CUAD) + 0.161(CCC) – 0.131(L) + 4.50

Where:

HUM = Humerus diameter

FEM = Femur diameter

CUAC = Corrected upper arm circumference

= upper arm circumference (tensed) – (triceps skinfold/10)

CCC = Corrected calf circumference

= calf circumference – (medial calf skinfold/10)

L = Body length

Ectomorphic component

If the HWR is larger or equal to 40.75, then Ectomorph = (0.732 x LMR) - 28.58

- If the HWR is smaller than 40.75 and larger than 38.28, then Ectomorph = (0.463 x LMR) -17.63
- If the HWR is smaller or equal to 38.25, then Ectomorph = 0.1

  Where: HWR = $\frac{height}{weight^{0.3333}}$ or $\frac{height}{\sqrt[3]{weight}}$

3.5. Methodological and Measurement errors

The primary researcher who is a qualified level 1 anthropometrist was responsible for taking all the measurements in order to reduce any errors for each of the readings. The primary researcher made use of general procedures of standardised testing based on the International Society for the Advancement of Kinanthropometry guidelines (Carter, 2002).

3.6. Data Analysis

The researcher captured all the data from the questionnaires electronically in a Microsoft Excel Spreadsheet. Any further analysis was done by a statistician using SAS procedure FREQ (SAS, 2016). Frequencies and percentages were calculated

for each section/category. The Shapiro-Wilk test (Villasenor Alva & Gonzalez Estrada, 2009) was used to investigate the normality of numerical data. For the numerical data which was evenly distributed, the mean and standard deviations were calculated. For the data that was skewed the medians and percentiles were calculated. In order to investigate the differences between year groups as well as ethnic groups the Chi-Square statistics (Thomas *et al.* 2015) will be used. The Kruskal-Wallis test (Thomas *et al.* 2011) will be used to investigate median differences between the year groups and ethnic groups. A significance level of ($p < 0.05$) will be used throughout the research study. Where no significant difference is achieved a level of ($p = > 0.05$) will be considered throughout the research study.

3.7. 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 were handed out and had to be signed by the participants (Appendix G). The form contained all the necessary information and basic elements as specified by Thomas *et al* (2015). All the information that was obtained in connection with this study that could be identified with the female participant has been treated confidential and was only disclosed with the permission of the participant or as required by law. Confidentiality was maintained by means of allocating numbers to female students. Information was kept with the primary researcher only and raw data held under lock and key. All processing of data was governed by a PC password protector. Only the findings will be used in the strictest confidentiality. Reports on the female students somatotyping was given direct after the test to the participant.

3.8. Pilot study

A pilot study was conducted a month prior to the primary survey. The researcher made use of two questionnaires and a measurement protocol to determine the PA levels, lifestyle habits and body composition of the students. The questionnaires were found effective in testing the proposed objectives. The somatotyping was also performed

without any difficulties. Additionally, the duration of testing per participant was determined and the progression of testing was evaluated in order to properly plan testing schedules for the study. To conclude, data sheets, equipment, and protocols were found to be effective in achieving the proposed objectives.

3.9. Distribution of questionnaires and conducting of tests

This study was lead and conducted by the primary researcher who did all the tests and handed out all the questionnaires personally. The questionnaires were handed out during university residence house meetings and when students came to the Exercise and Sports Science Centre for information after being informed at their residences. After students showed interest in participating in the research, it was agreed upon between the primary researcher and participants for a suitable time. Two hundred students who took part in the research and all tests were carried out at the universities residencies in a room that was provided by the hostel master for confidentiality or at the Exercise and Sports Science Centre in a private room.

3.10. Limitations

Some of the possible limitations that may have occurred are listed below:

- Questionnaires that are not answered truthfully.
- Sample population size too small.
- Sample population restricted to only undergraduate female students.
- Self reported data – You have to take what people say.
- Access -Depends on having access to students

Chapter 4 - Results

4.1. Introduction

The objectives of the study were: (1) To identify PA levels of the female undergraduate students at the University of the Free State campus using a validated self-reported measure instrument; and (2) To establish the lifestyle profile and body composition of undergraduate female students attending this Tertiary Institution and (3) to determine the impact of ethnicity on PA levels, lifestyle habits and body composition of undergraduate female students attending a tertiary institution. The respondents were required to complete two questionnaires (Belloc & Breslow and the IPAQ questionnaire) and provide further information regarding age, ethnicity, year of study, physical activity levels as well as their lifestyle habits. Furthermore, an anthropometric assessment (ISAK) was done on each student.

Two hundred questionnaires were handed out and collected for processing. The anthropometric assessment was also carried out on all 200 students, which constitutes to a 100% response rate.

This chapter presents the results obtained from the two questionnaires (Belloc & Breslow and the IPAQ questionnaire), an anthropometric assessment (ISAK) that was done, and the demographic information of this cohort of female students. Interpretation and discussion of the findings follow in Chapter 5.

4.2. Participants: Demographic Information

Demographic information/data was collected from all students (n = 200). This information included students' age, ethnicity and year of study and the data will be presented in various illustrations including bar graphs and tables.

The age of the total sample ranged from 18 – 25 years with a mean of 20 years. Based on the results summarized in Table 6, it is clear that the mean ages of the three ethnic groups were quite similar. White (n=112) students presented with a mean age of 20.2 years, African (n=63), 20.0 years and Coloured (n=25) 20.7 years respectively. The mean age of the year groups were as follows: 1st year students had a mean age of 19.3 years, 2nd year, 20.1 years and 3rd year 21.9 years respectively.

Table 6: Age according to Ethnicity and Year Groups.

Groups		Mean Age (Years)	STD	Min	Max
All Students	n=200	20.2	1.1	18	24
Ethnic Groups:	**White Students** *(n=112)*	20.2	1.0	19	23
	African Students *(n=62)*	20.0	1.0	18	24
	Coloured Students *(n=25)*	20.7	1.8	18	24
Year Groups:	**1st Year Students** *(n=69)*	19.3	0.9	19	24
	2nd Year Students *(n=68)*	20.1	0.9	18	24
	3rd Year Students *(n=63)*	21.2	0.7	19	24

4.2.1. Ethnic dispersion

Fifty six percent of White students were in the majority in this sample of students, followed by African (31.5%) and Coloured (12.5%) students.

4.2.2. Year of study

The year groups were of similar size, with 34.5% 1st year students, 2nd year students (34%) and 3rd year students (31.5%). First year registered female students consisted of 33% African, 13% Coloured and a majority of 54% White students. The second year registered female students consisted of 41% African, 6% Coloured and 53% of the students being White. A comparable tendency was noticed amongst the 3rd year registered students with 19% being African, 19% Coloured and majority of the group being 62% White female students.

4.3. Participation in physical activity

The main purpose of the IPAQ questionnaire was to identify the PA profiles of the undergraduate female students. Overall, the proportion of students who participated in any form of PA, including any sport or physical recreational activities at the University was 68%, while 32% stated that they did not participate in any sports or physical recreational activities.

Table 7 –indicates the PA participation of female students at university and intended participation after university. When stratified by ethnicity and year groups, 78.6% of White students participated in PA, 54.0% of African students, and 56.1% of Coloured students.. Amongst the 1st year students, 62.3% reported that they participated in PA, while 63.4% of 2nd year students reported PA, and the most active year group was the 3rd years with 79.4%.

4.3.1. Participation in PA after University

The results in table 7 show the intended PA participation after university by ethnicity and year group. Ninety eight percent (98.1%) of White (n=110) students, 92.1% of African (n=58) students' and 100% of Coloured (n=25) students stated that they intended to participate in PA after University. Amongst the 1st years, 97.1% claimed that they would like to participate in PA after University, 95.6% of 2nd year students and third years with 98.6%.

Table 8 - PA Participation of Female Students at University and after University: Ethnic and Year Group Comparison

Groups		Participation in PA	
		At University	**After University**
Ethnic Groups:	**White Students** *(n=112)*	88 *(78.6%)*	110 *(98.2%)*
	African Students *(n=63)*	34 *(54.0%)*	58 *(92.1%)*
	Coloured Students *(n=24)*	14 *(56.0%)*	25 *(100.0%)*
Year Groups:	**1st Year Students** *(n=69)*	43 *(62.3%)*	67 *(97.1%)*
	2nd Year Students *(n=68)*	43 *(63.2%)*	65 *(95.6%)*
	3rd Year Students *(n=63)*	50 *(79.4%)*	61 *(96.8%)*

4.3.2. MET Category

The data collected through the IPAQ questionnaire can be calculated as an ongoing measurement. Each type of PA is given a specific weight based on their energy requirements and is defined in METs to yield a score in MET minutes. According to Sjöström *et al.* (2002), one MET is the equivalent of a person's energy expenditure at rest (3.5 ml o^2 kg^{-1} min $^{-1}$). A MET minute is calculated by multiplying the minutes an activity was performed by the MET score of the activity in question. MET minute scores have been shown to be equal to the kilocalories spent by a person of 60 kg body weight. According to the IPAQ Research Committee (2005), in general kilocalories spent during PA can then be calculated from the MET minutes as follows: MET minutes x (weight in kilograms/60 kilograms)

The four IPAQ MET calculation scores can be determined as illustrated in Table 9

Table 9 - 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

Table 9 provides the mean and range values of the MET minute/week score, overall for all students (n=200), and by ethnic and year group. The average MET scores of all the students was 2183.3. White (n=112) students had the highest MET score of the three ethnic groups, namely 2432.6, while the African (n=63) and Coloured (n=25) students had a mean MET minute/week score of 1701.1 and 2113.8, respectively. The third year students had a mean score of 2288.2, and 1st year and 2nd year a mean score of 2030.2 and 2251.4 respectively.

Table 10 - MET/min/week of Female Students: Ethnic and Year Group Comparison

Groups		Mean	STD	Min	Max
All Students	n=200	2183.3	1109.2	292	4956
Ethnic Groups:	**White Students** *(n=112)*	2432.6	1121.8	578	4956
	African Students *(n=63)*	1701.1	891.3	292	4290
	Coloured Students *(n=25)*	2113.8	1182.5	396	4590
Year Groups:	**1st Year Students** *(n=69)*	2030.2	1058.6	358	4590
	2nd Year Students *(n=68)*	2251.4	1095.7	292	4590
	3rd Year Students *(n=63)*	2280.2	1181.7	396	4596

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.

*T*he categories of PA levels were computed as indicated in Table 10 and presented in Table 11.

Table 11 - 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.

The majority of the White students fell into the moderate category (52.7%), as was the majority of African students (57.1%), while the majority of Coloured students was classified in the in the high category (44.0%).

Table 12 - MET Categories of Female Students: Ethnic and Year Group Comparison

Groups		MET Category		
		Low	**Mod**	**High**
		n	n	n
		(%)	*(%)*	*(%)*
Ethnic	**White Students**	*7*	*59*	*46*
Groups:	*(n=112)*	*(6.3%)*	*(52.7%)*	*(41.1%)*
	African Students	*6*	*36*	*21*
	(n=63)	*(9.5%)*	*(57.1%)*	*(33.3%)*
	Coloured Students	*2*	*11*	*12*
	(n=25)	*(8.0%)*	*(44.0%)*	*(48.0%)*
Year	**1st Year Students**	*9*	*33*	*27*
Groups:	*(n=69)*	*(13.0%)*	*(47.8%)*	*(39.1%)*
	2nd Year Students	*2*	*40*	*26*
	(n=68)	*(2.9%)*	*(58.6%)*	*(38.2%)*
	3rd Year Students	*4*	*33*	*26*
	(n=63)	*(6.4%)*	*(52.4%)*	*(41.3%)*

4.3.3. Activity in Minutes Results

Table 12 shows the mean and range values of total activity minutes of all the students based on ethnicity and year groups per week. The maximum PA was 900 minutes and a mean of 450,8 minutes per week. The mean minutes of the ethnic groups were spread as follows: White (n=112) students had a mean activity of 501.9 minutes, African (n=63) 355.8 minutes and Coloured (n=25) 426.7 minutes. The mean minutes of the year groups were spread as follows: 1st year students had a mean of 432.3 minutes, 2nd year, 448.6 minutes and 3rd year 473.9 minutes.

Table 13 - Activity/min/week of Female Students: Ethnic and Year Group Comparison

Groups		**Mean Activity /min /week**	**STD**	**Min**	**Max**
All Students:	n=200	450.8	223.6	80	900
Ethnic Groups:	**White Students** *(n=112)*	501.9	226.0	145	900
	African Students *(n=63)*	355.8	188.3	80	870
	Coloured Students *(n=25)*	426.7	216.1	120	900
Year Groups:	**1st Year Students** *(n=69)*	432.2	243.1	100	900
	2nd Year Students *(n=68)*	448.6	218.9	80	900
	3rd Year Students *(n=63)*	473.9	219.1	120	900

4.3.4. Sports and Recreational Activities Results

Figure 3 illustrates the sports and recreational activities that the students participated in. The top three sporting codes and related percentages were hockey (39.5%), soccer (30.1%) and tennis (12.5%).

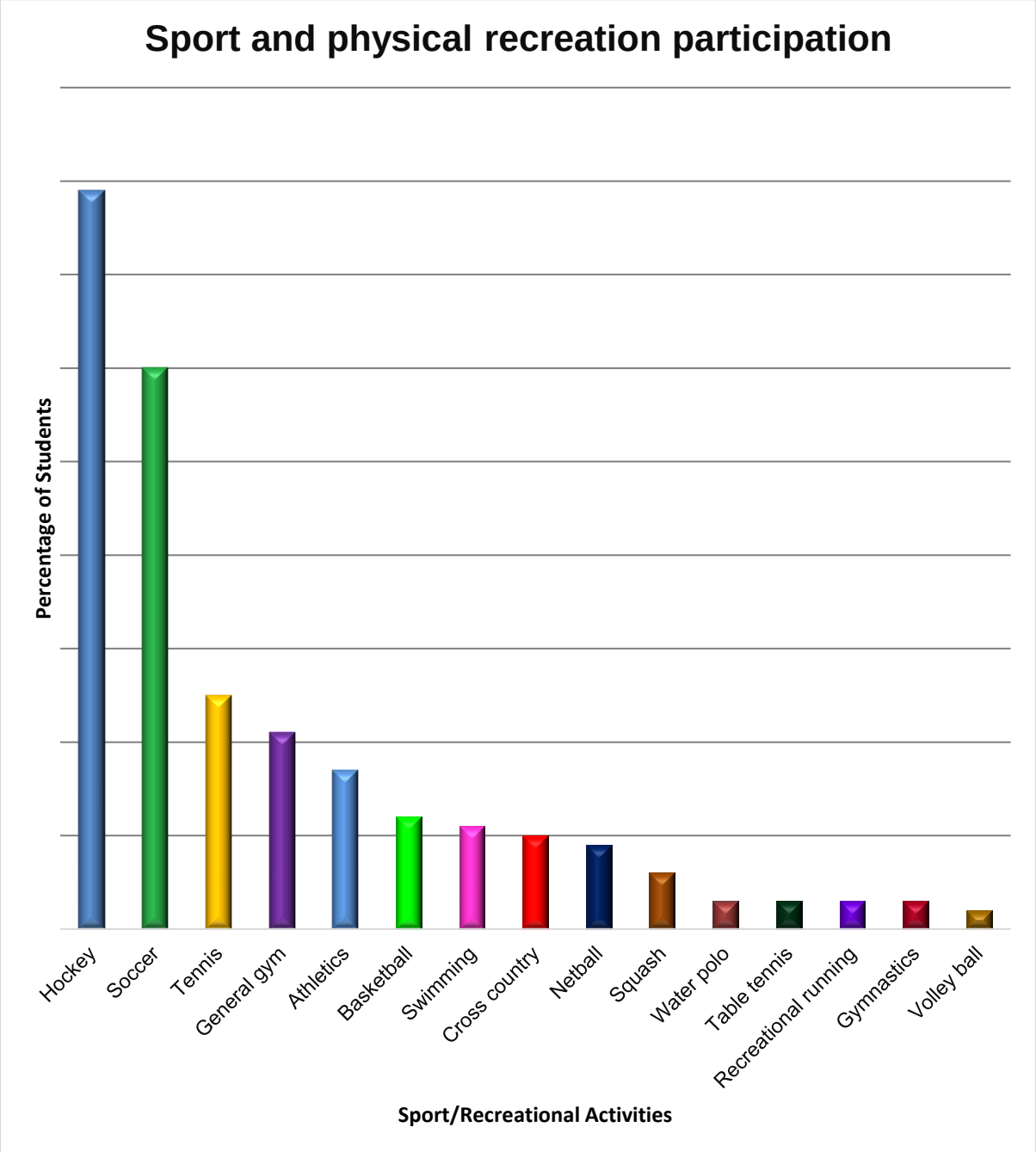


Figure 3 - Sports and physical recreation participation

4.4. Anthropometric Data

Anthropometric characteristics in Table 13 shows descriptive information for the anthropometric characteristics weight and height of the female undergraduate students. The mean, median, lower quartile and upper quartile values were determined. The results indicated that the average undergraduate female student is 168.5cm in length and weighing 67.4kg.

Table 14 - Stature and Body Weight

MEASUREMENT	MEAN	MEDIAN	LOWER QUARTILE	UPPER QUARTILE
Weight (kg)	67.4	65.7	47.4	101.0
Height (cm)	168.5	168.0	153.0	188.0

4.4.1. Skinfolds

Table 14 depicts the skinfold measurements of the female undergraduate students. The results report that the average skinfold measurements were as follows: triceps 13.9mm, subscapularis 12.0mm, supra-illiac 16.1mm, abdominal 17.2mm, frontal thigh 16.9mm and medial calf 12.1mm.

Table 15 - Skinfold Measurements

MEASUREMENT	MEAN	MEDIAN	LOWER QUARTILE	UPPER QUARTILE
Triceps (mm)	13.9	13.9	4.6	29.9
Subscapular (mm)	12.0	10.5	1.0	29.0
Supra-Iliac (mm)	16.1	16.7	5.4	32.0
Abdominal (mm)	17.2	16.1	1.7	38.0
Frontal Thigh (mm)	16.9	17.9	5.2	32.0
Medial Calf (mm)	12.1	12.1	3.2	23.0

4.4.2. Circumference

Table 15 indicates the mean, median and range of girth measurements amongst female undergraduate students. The results indicate that the average waist circumference measurement is 74.4cm, hip circumference 95.1cm, maximum calf circumference 35.8cm, arm relaxed circumference 29.2cm and the average arm flexed circumference measurement is 30.3cm.

Table 16 - Circumference Measurements

MEASUREMENT	MEAN	MEDIAN	LOWER QUARTILE	UPPER QUARTILE
Waist (cm)	74.4	76.4	5.0	97.0
Hip (cm)	95.1	99.2	5.0	122.0
Calf (Max) (cm)	35.8	35.5	5.0	42.3
Arm (Relaxed) (cm)	29.2	29.1	5.0	39.2
Arm (Flexed) (cm)	30.3	30.4	5.0	40.2

4.4.3. Bone Breadth

Table 16 provides the bone breadths of the students. The average humerus bone breadth amongst the students was 6.6cm, with the upper and lower quartiles being 4.9cm and 8.2cm respectively. The femur measurement represents with an average of 10.1cm, with the upper and lower quartiles being 10.1cm and 10.7cm respectively.

Table 17 - Bone Breadths

MEASUREMENT	MEAN	LOWER QUARTILE	MEDIAN	UPPER QUARTILE
Humerus (cm)	6.6	4.9	6.6	8.2
Femur (cm)	10.1	5.0	9.3	10.7

4.4.4. Body Composition Results

The mean, median, lower and upper quartile ranges of the students Fat Percentage, Lean Body Mass, Body Mass Index as well as the Waist-to-hip-ratio is presented in Table 17.

Table 18 – Body Composition Results

MEASUREMENT	MEAN	MEDIAN	LOWER QUARTILE	UPPER QUARTILE
Fat Percentage (%)	16.7	16.6	8.1	27.6
Lean Body Mass (LBM) (kg)	56.0	54.7	38.8	74.2
Body Mass Index (BMI)	23.6	23.5	18.4	34.6
Wasit-to-hip Ratio (W:H Ratio)	0.8	0.8	0.6	0.9

Fat Percentage

Table 18 provides the mean, minimum and maximum values of fat percentage for the students based on ethnicity and year groups. The mean fat percentage of the total 200 students was 16.7%.

The mean fat percentage of the ethnic groups were spread as follows: White students had a mean fat percentage of 17.1%, African students 16.8% and Coloured students with the lowest of 14.7%. The mean fat percentage of the year groups were distributed as follows: First (1st) year students had a mean fat percentage of 16.0%, 2nd year, 17.2% and 3rd year 16.9%.

Table 19 - Body Fat Percentage of Female Students: Ethnic and Year Group Comparison

Groups		Mean Body Fat *(%)*	STD	Min	Max
All Students:	n=200	16.7	4.7	8.1	27.6
Ethnic Groups:	**White Students** *(n=112)*	17.1	4.5	9.7	27.6
	African Students *(n=63)*	16.8	5.1	8.1	27.5
	Coloured Students *(n=25)*	14.7	4.3	8.1	21.1
Year Groups:	**1st Year Students** *(n=69)*	16.0	4.4	8.4	27.5
	2nd Year Students *(n=68)*	17.2	5.3	8.1	27.4
	3rd Year Students *(n=63)*	16.9	4.3	8.1	27.6

Lean Body Mass

Table 19 indicates the mean, minimum and maximum values of students' LBM based on year of study and ethnicity. The mean LBM of the total 200 students was 56kg. The mean LBM percentage of the 1st year students' was 55.3kg, 2nd year students was 54.7kg and 3rd year students displayed the highest percentage of 58.1kg.The mean LBM of the White students was 55.4kg with African and Coloured students displaying 56.9kg and 56.2kg respectively.

Table 20 - Lean Body Mass (LBM) of Female Students: Ethnic and Year Group Comparison

Groups		**Mean LBM** *(kg)*	**STD**	**Min**	**Max**
All Students:	n=200	56	8.6	39	74.2
Ethnic Groups:	**White Students** *(n=112)*	55.4	9.0	40	74.2
	African Students *(n=63)*	56.9	8.1	39	73
	Coloured Students *(n=25)*	56.2	8.2	44.7	72.5
Year Groups:	**1st Year Students** *(n=69)*	55.3	8.4	40.5	74.2
	2nd Year Students *(n=68)*	54.7	7.4	40	73.6
	3rd Year Students *(n=63)*	58.1	9.6	39	70.8

Body Mass Index

The mean, minimum and maximum values of the 200 students' BMI based on ethnicity and year group is presented in Table 20. The mean BMI of the total 200 students was 23.7 $kg.m^{-2.}$ As illustrated below, the mean score for BMI amongst White students was 23.5kg/m^{-2}, the African and Coloured mean scores were 24.4kg/m^{-2} and 22.8kg/m^{-2} respectively. The mean BMI score for 1st year students was 23.1$kg.m^{-2}$ with 2nd and 3rd year students demonstrating a mean BMI of 23.9$kg.m^{-2}$ and 24.1$kg.m^{-2}$ respectively.

Table 21 - Body Mass Index (BMI) of Female Students: Ethnic and Year Group Comparison

Groups		**Mean BMI** *(kg.m^{-2})*	**STD**	**Min**	**Max**
All Students	n=200	23.7	2.6	18.4	35
Ethnic Groups:	**White Students** *(n=112)*	23.5	2.7	18.4	35
	African Students *(n=63)*	24.4	2.6	19.8	30
	Coloured Students *(n=25)*	22.8	1.5	20.9	26.9
Year Groups:	**1st Year Students** *(n=69)*	23.1	2.2	19	28
	2nd Year Students *(n=68)*	23.9	3.0	18.4	35
	3rd Year Students *(n=63)*	24.0	2.5	19	29.2

4.5. One way and Multi-way ANOVA

Table 21 shows the ANOVA test done to determine the effect that the independent variables (Ethnicity, MET category, Belloc category, Year of Study and PA participation) have on the Dependent variables (BMI, Fat Percent and LBM).

There is a significant difference (p=0.0088) between the BMI of the different ethnic groups, with the African students demonstrating a mean BMI of 24.4 $kg.m^{-2}$, than the White students (23.5 $kg.m^{-2}$) and Coloured students (22.8 $kg.m^{-2}$) (p=0.0183). (consult Table 16).

Table 22 - One way and Multiway ANOVA

One-way and multi-way ANOVA of Female: BMI, Fat % 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	4.08	0.0183 *	4.86	0.0088**
	MET category	2	1.52	0.2217	1.28	0.2802
	Belloc category	2	0.11	0.8990	0.44	0.6448
	Year of study	2	2.49	0.0852	2.65	0.0733
	Participation in Sport					
	School	1	0.43	0.5151	0.11	0.7418
	University	1	0.69	0.4069	0.58	0.4491
	After University	1				
Fat Percent	Ethnicity	2	2.65	0.0735	2.12	0.1225
	MET category	2	1.41	0.2466	2.92	0.0562
	Belloc category	2	0.74	0.4775	1.40	0.2485
	Year of study	2	0.31	0.2734	2.13	0.1213
	Participation in Sport					
	School	1	3.47	0.0640	5.27	0.0229
	University	1	0.36	0.5466	0.45	0.5032
	After University	1				
Lean Body Mass (LBM)	Ethnicity	2	0.62	0.5397	1.37	0.2573
	MET category	2	1.89	0.1543	2.27	0.1057
	Belloc category	2	0.86	0.4255	2.21	0.1120
	Year of study	2	2.97	0.0534	3.66	0.0276
	Participation in Sport					
	School	1	1.35	0.2475	1.15	0.2848
	University	1	0.16	0.6907	0.36	0.5470
	After University	1				

* P <0.05
** P<0.01

4.6. Lifestyle Habits of Female Undergraduate Students

4.6.1. Belloc and Breslow Scores

Table 22 displays the mean, minimum and maximum values from the Belloc and Breslow Lifestyle Habits Questionnaire based on ethnicity and year of study. The mean score of the 200 students was 5.5. The mean score for the Belloc and Breslow questionnaire amongst 1st years was 5.3, with 2nd year students scoring 5.4 and 3rd year students with the highest score of 5.7. Amongst the ethnic groups the Coloured students had the highest mean score with 5.6 followed by White students (5.6) and African students reporting 5.1.

Table 23 - Belloc and Breslow Scores of Female Students: Ethnic and Year Group Comparison

Groups		Mean Score	STD	Min	Max
All Students	n=200	5.5	1.3	2	7
Ethnic Groups:	**White Students** *(n=112)*	5.6	1.1	2	7
	African Students *(n=63)*	5.1	1.5	3	7
	Coloured Students *(n=25)*	5.6	1.0	4	7
Year Groups:	**1st Year Students** *(n=69)*	5.3	1.4	2	7
	2nd Year Students *(n=68)*	5.4	1.2	2	7
	3rd Year Students *(n=63)*	5.7	1.1	2	7

Graphic illustrations of the Belloc and Breslow Questionnaire results are presented in Figures 4 and 5.

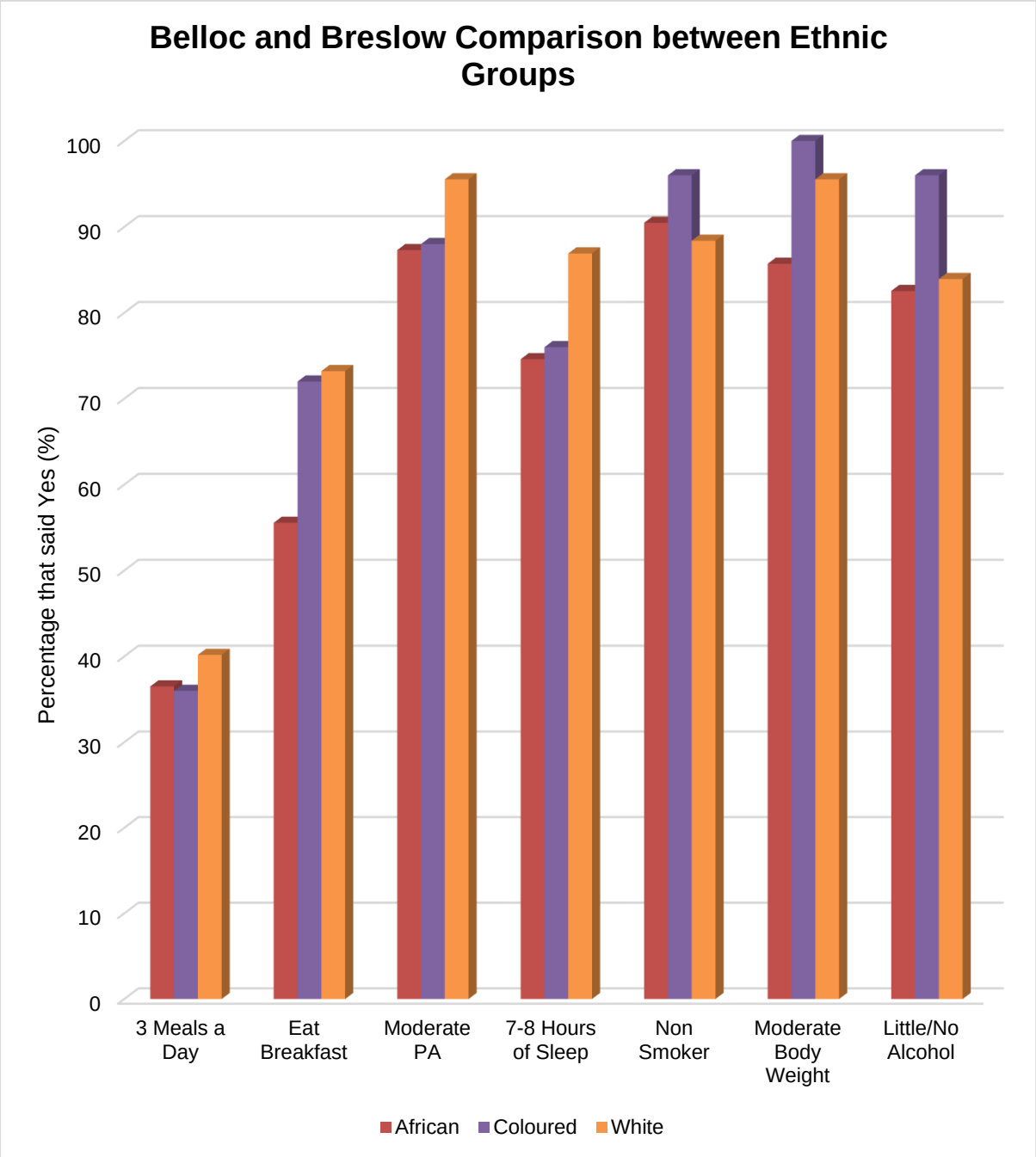
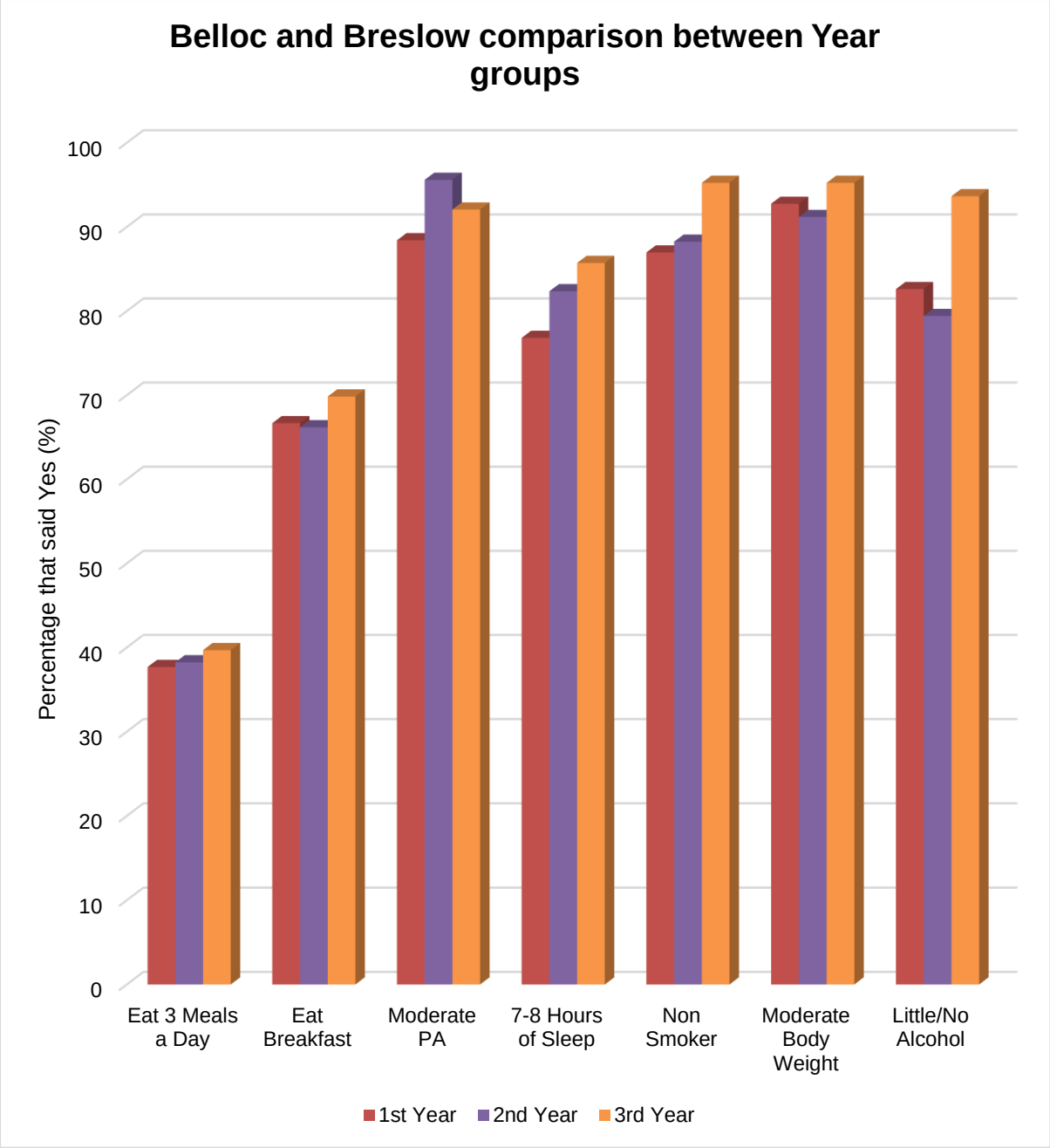


Figure 4 - Belloc and Breslow Comparison between Ethnic Groups



*F*igure 5 - Belloc and Breslow Comparison between Year Groups

4.6.2. Health Categories

According to Breslow (1972) lifestyle habits can be rated according to the amount of positive habits the individual adheres to:

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

Table 23 is a summary of the students' health categories based on the students ethnicity and year of study. The data was recorded and the results were categorized into three different groups namely poor, moderate and healthy. Sixty-two-point five percent of White students, 54% African and 60% Coloured students fall into the healthy category. Regarding year of study, 53.6% of 1st year, 55.9% 2nd year and 69.9 of 3rd year students fall into the healthy category.

Table 24 - Belloc and Breslow Health Categories of Female Students: Ethnic and Year Group Comparison

Groups		Belloc and Breslow Health Category		
		Poor	**Mod**	**Healthy**
Ethnic Groups:	**White Students** (n=112)	*5 (4.5%)*	*37 (33.0%)*	*70 (62.5%)*
	African Students (n=63)	*9 (14.3%)*	*20 (31.8%)*	*34 (54.0%)*
	Coloured Students *(n=25)*	*0 (0%)*	*10 (40.0%)*	*15 (60.0%)*
Year Groups:	**1st Year Students** *(n=69)*	*8 (11.5%)*	*24 (34.8%)*	*37 (53.6%)*
	2nd Year Students *(n=68)*	*4 (5.9%)*	*26 (38.2%)*	*38 (55.9%)*
	3rd Year Students *(n=63)*	*2 (3.2%)*	*17 (27.0%)*	*44 (69.9%)*

4.7. Barriers Faced by the Female Students

Forty percent of the students experienced barriers (Figure 6) that prevented or limited participation in PA. Study responsibilities was identified as the most common barrier with 41.3 % (n=33), followed by injuries 37.5% (n=30). The barrier that the students least experienced was lack of financial resources with a low 7.5% (n=6).

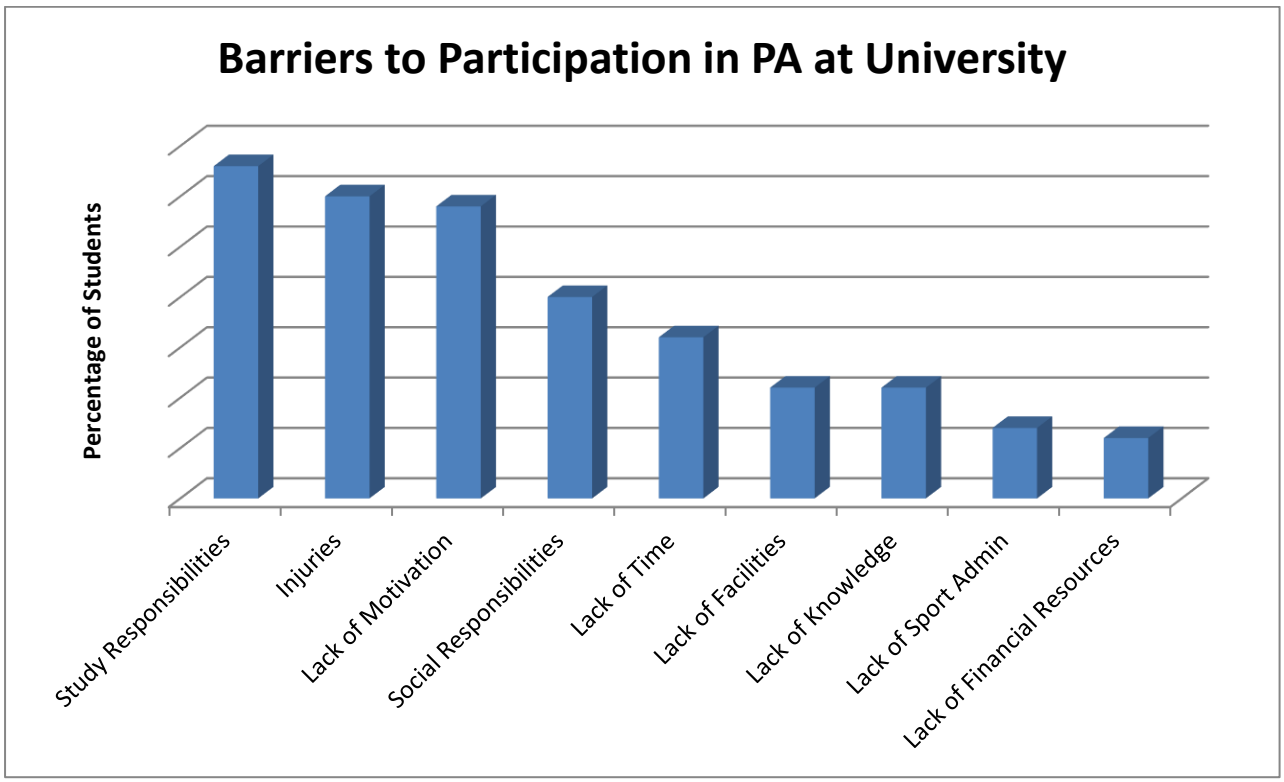


Figure 6 - Barriers to participation PA at University

4.8. Comparison of Female Ethnic and Year Groups

The results in Table 24 displays the comparison of the female ethnic groups and year groups with regard to MET category, Belloc and Breslow category and sport and PA participation at university and after university. There is a significant difference (p=0.0245) between the year groups and the healthy Belloc and Breslow category, with 54% of African students in the healthy category, which is lower than the White students with 62.5% and Coloured students with 60%. Participation in PA at University also shows a significant difference (p=0.0391) between the year groups, with 79.4% of the 3rd year students participating in PA in comparison to 2nd year students 63.2% and the 1st year students 62.3%. When analyzing the participation in PA at University there is a highly significant difference (p=0.0015) between the ethnic groups with 78.6% of the White students participating in PA, which is higher than the African students 54% and Coloured students (56%).

Table 25 - Comparison of Female Ethnic and Year Groups

Comparison of Female 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	0.7196	1	0.3963
	Belloc category	5.0561	1	0.0245
	Participation in Sport			
	School	0.0001	1	0.9941
	University	4.2586	1	0.0391
	After University	0.0099	1	0.9209
Ethnicity	MET category	1.8184	2	0.4029
	Belloc category	3.8812	2	0.1436
	Participation in Sport			
	School	11.1500	2	0.0038
	University	13.0414	2	0.0015
	After University	5.5249	2	0.0631

[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 a widespread body of empirical evidence which consists of physical and psychological health benefits of PA (Craike, Hibbins andCuskelly, 2010). When young adults start University, they gain control over their own lives and lifestyles, however they may not necessarily develop behaviours such as regular PA (Bray and Born, 2004).

The WHO (2013) reported that 60% of the world doesn't adhere to the minimum recommendation of 30 minutes of moderate intensity PA per day. When there is a lack of PA, it increases the risk of developing CVD, CHD, obesity, type-two diabetes mellitus, osteoporosis, depression and cerebral stroke (Eriksson 1986, Kohl *et al*. 1992, Kampert *et al*.1996, Wei *et al*. 1999). Following a sedentary lifestyle and being overweight or obese, I can have a major health, clinical and economical challenges in modern society. The main aim of the study was therefor to determine the physical activity levels and lifestyle habits of the undergraduate female students attending the University of the Free State.

The objectives of the study were:

(1) To identify physical activity levels of the female undergraduate students at the University of the Free State campus using a validated self-reported measure instrument; and

(2) To establish the lifestyle profile and body composition of undergraduate female students attending this tertiary institution and

(3) To determine the impact of ethnicity on PA levels, lifestyle habits and body composition of undergraduate female students attending this tertiary institution.

5.2. Demographic Information

The mean age of the students who participated in this study was 20 years of age. This coincides with a study done by Seo *et al*. (2011) who proved that the average female undergraduate student is 20.58 years of age. The range was between 18-25 years and the reason for this could be that majority students leave school at age 18 to start their studies and the oldest 25 could possibly be due to long courses such as medical degrees or extended courses.

5.3. Participation in physical activity

The main purpose of the IPAQ questionnaire was to identify and create the PA profiles of the undergraduate female students. The total number of students who participated in any form of PA, including any sport or recreational activities at the University was 68%, where 32% stated that they did not participate in any sports or physical recreational activities. In a study done by (Neicker, 2012), 40.7% of students indicated that they participated in some form of PA during 2012 and according to a study conducted by Blomehoff (2010) at the same institution, 67% of students were physically active irrespective of gender and ethnicity. The increase in participation in PA could be due to more accessible facilities and encouragement from the university authorities to remain fit and healthy. The University of the Free State provided outdoor gyms as well as the new KovsieFit Gymnasium to encourage and motivate students to participate in PA.

According to the results approximately 68% of the female students participated in some form of PA during their time at University. By dividing the data into the three different ethnic and year groups, a better understanding of the different levels of PA whilst at university is provided.

The results of this study succeeded in showing that there was a significant difference in PA ($p<0.05$) between the different ethnic groups (White, African and Coloured). African students with 54% and 56% of the Coloured students were physically active, with a significant larger percentage of White students (78.6%) considered to be physically active ($p=0.0015$). This data contradicts that of Losper (2012) whose study was conducted at the same tertiary institution. Her findings suggested that a non-

significant difference between the different ethnic groups (p=1.336). Reasons for this could be due to disadvantaged schools that have poor sport infrastructure and are not t upgraded which could possibly result in low PA at school level that is carried through to university and maybe adult life with long term consequences.

There was a similar trend among the different year groups at the university, with 62.3% of the first year students, 63.3% of the second year students and 79.4% of the third year students being physically active. This constitutes a significant difference (p=0.0391) in the PA levels between the year groups. This data provided supports that of Losper (2012), where it was found that there was a highly significant difference amongst the three year groups. Fountaine *et al*. (2009) remarked that the most important decision a first year student has to make is to somehow find a balance between studies and participation in PA, this could be part of the reason why the statistics prove that first year students have the lowest percentage of participation in PA. The positive escalation of PA participation from year one to three suggests that students find a balance in their lifestyle and studies as they get into routine. It would be recommended that institutions target first year students due to the escalation.

The reason for majority of female undergraduate students partaking in PA could be due to the amount of sporting activities available at the University, whether on a social or competitive level.

The reasons for not participating in PA could be due to existing barriers or perceived barriers. This study succeeded in showing that study responsibilities was identified as the most common barrier with 41.3%, followed by injuries 37.5%. A previous study done by Bloemhoff and Coetzee (2007) at the same institution supports this information showing that study responsibilities, time constraints and a lack of motivation were proven to be the biggest barriers. There is a similarity in barriers at institutions worldwide, in order to nullify barriers, lots of planning and encouragement is needed. Time management classes, outdoor gyms and sport encouragement is a necessity to assist students in finding a balance at university. Pinto *et al*. (1995) identified that women were significantly more likely than men to report participation in aerobics and moderate activities such as walking.

5.3.1. Participation in Physical Activity after University

The intention to participate in PA after the completion of studies was determined in this research. It was indicated that there was a non-significant difference (p=0.0631) between the different ethnic groups with 98.2% of the White students, 92.1%of the African students and 100% of the Coloured students stating that they would participate in PA following their graduation. Amongst the different year groups, there were no significant differences noted (p=0.9209) with 97.1% of the first year students, 95.6% of the second year students and 96.8% of the third year students stating that they were planning on participating in PA after university.

There is no real change in the percentage of students who said they would like to participate in PA when they leave University. The challenge will be to close the gap between intentions/planning to participate and what transpires in practice. Universities need to constantly promote the long-term benefits of PA and quality of life.

There was a high percentage (97.1%) of first year students who indicated that they would participate in PA post University, the increased freedom experienced during the first year at University may contribute to this high percentage compared to the slightly lower percentage of 2nd year students (95.6%), a possible reason for this slight decline in the number of students could be the course work and study load taking its toll on the students motivation and thus lead to a decreased number of students.

Possible reasons for females participating in PA after university could be due to females always striving to maintain a healthy body weight to improve self-image and self-confidence, to remain physically active and to stay fit and healthy.

5.3.2. MET Category

PA levels were branded into three categories namely low, moderate and high intensity. A study by Bloemhoff (2010) comparing PA levels of three different ethnic groups at the same institution proved that 36.7% of African students mostly participated in moderate intensity PA and 38.5% in low intensity PA. This contradicts the results found

in this study where 57.1% African female students participated in moderate intensity PA, 33.3% in high intensity PA with only 9.5% participating in low intensity PA. It appears that although a significant difference exists between the PA levels of ethnic groups, there is an escalation in more intensive PA activities by Black female students to the extent that no significant differences exist in the intensity levels of the different ethnic groups.

This study succeeded in showing that there was no significant difference (p=0.4029) between the different ethnic groups, 41.1% (n=46) of the White students, 33.3% (n=21) of the African students and 48% (n=12) of the Coloured students were classed in the high PA levels category. Coloured students reported the largest percentage of students participating in high intensity PA (48%).

Furthermore, research done by Bloemhoff (2010), identified that 25% of the African students and 23.7% of the White students fell into the low category. The results of this study shows a significant lower percentage of female students that fell into the low category, with 6.3% (n=7) of the White students, 9.5% (n=6) of African students and 8% (n=2) of the Coloured students.

The results reflect that there was no significant difference noticed amongst the different year groups. (p= 0.3963). The majority were classified in the moderate category with 47.8% being 1st years and 58.6% and 52.4% being 2nd and 3rd years respectively.

It is evident that there was an increase in the number of students participating in moderate PA through 1st year to third year and a decrease in the number of students in the low intensity category, this could be as a result of the students becoming more aware of and participating in more vigorous PA and the benefits there of, in order for them to lead a healthy lifestyle. It appears that although a significant difference exists between the PA levels of ethnic groups, there is an escalation in more intensive PA activities by Black female students to the extent that no significant differences exist in the intensity levels of the different ethnic groups.

5.3.3. Sports and Recreational Activities at University

During 2015, hockey with 39.5% was the most popular sport code amongst female undergraduate students, with soccer being 2nd with 30% and tennis 3rd with 12.5%. A previous study at the same institution done by (Losper, 2012) showed that soccer was the most popular sport with 39.3%, followed by netball with 28.6% and lastly hockey with 23.4%. Possible reasons for the rapid escalation in hockey participation could be due to the new Tartan hockey fields at the university which have encouraged students to participate in hockey. This reiterate the fact that a good sport infrastructure culminates in higher participation frequencies.

5.4. Anthropometric Data

The analysis of body composition is an essential component when it comes to PA. It provides reliable information for accurately evaluating the efficiency of lifestyle habits and PA levels. Despite the fact that PA is quite popular amongst students (68% participated in PA in the study), very little data is available on the anthropometric features of undergraduate university students.

5.4.1. Stature and Body Weight

With regards to the anthropometric profile established in this study, the results for mean mass (67.4 kg) and height (164.5 cm) were similar to the 61.3 kg and 164 cm reported by Murtaugh (2001), the 63.06 kg and 164.26 cm by Wassmer and Mookerjee (2002) and the 60.70 kg and 164 cm reported by Astorino *et al*. (2004) for mass and height respectively. Losper (2012) found that the average female undergraduate student weighs 57kg and is 163cm in length, which is lower as reported in this study. The above mentioned statistics could be an indication of the escalation of obesity. An increase in obesity is a word wide phenomenon and could be attributed to various factors which include low PA and eating disorders. This could be due to the availability of fast foods provided on campus versus organic and healthy foods which tend to be more expensive and more difficult to access.

5.4.2. Skinfolds

The results of this study reports that the average skinfold measurements were as follows: triceps (13.9mm), subscapularis (12.0mm), supra-illiac (16.1mm), abdominal (17.2mm), frontal thigh (16.9mm) and medial calf (12.1mm).

These results differ from Losper (2012) who reported skinfold measurements to be: triceps (19.80mm), subscapularis (18.60mm), supra-iliac (18.20mm), abdomen (25.40mm), frontal thigh (39.20mm) and medial calf (21.60mm). The skinfold measurements have decreased from 2012 to 2016, possible reasons for this could be due to an increase in the university's implementation and encouragement of PA levels as well as better lifestyles and eating habits on campus.

5.4.3. Circumference

The results indicate that the average waist circumference measurement is 74.4cm, hip circumference 95.1cm, maximum calf circumference 35.8cm and arm relaxed circumference of 29.2cm. By comparison, Losper (2012) had similar results with the waist circumference being 71.00cm, hip circumference 102.00, calf circumference 35.00cm and arm relaxed with 27.00cm. A decrease in the hip circumference from 2012 to 2016 is definitely beneficial to female students as it may indicate a lower risk of CVD.

5.4.4. Bone Breadth

Losper (2012) measured the bone breadths of her subjects, exactly the same as was done in this study. The results differed with Losper (2012) reporting the average humerus as 6.0cm and the average femur as 8.50cm. In this study, the average humerus bone breadth amongst the students was 6.6cm and the femur measurement represents with an average of 10.1cm.

5.4.5. Body Composition Results

The mean, median, lower and upper quartile ranges of the students Fat Percentage, LBM, BMI as well as the WHR was determined in this study.

Fat Percentage

In most clinical settings, body composition is routinely assessed to identify whether individuals are at risk due to excessive low or high levels of body fat. (Heyward, 2002). The total mean body fat percentage in this study was 16.7% which according to the ASCM (2018) guidelines falls in the excellent category, this is much lower than 25% reported by Losper (2012). This result is similar to the 16.9% reported in the USA (Sparling *et al*. 1998) but higher than the 15.7% reported for female students at a university in Italy (Calò *et al*. 2009).

Amongst the different ethnic groups, the average fat percentage was spread as follows: White students had a mean fat percentage of 17.05%, African students 16.8% and Coloured (n=25) students with the lowest of 14.7%. The data showed that there was no significant difference in fat percentage amongst the three ethnic groups (p=0.1225). Losper (2012) however revealed that there was a significant difference in the body fat percentage amongst the different ethnic groups (p=0.0143). The rapid decrease in the students body fat percentage means that students in this study are at lower risk, because the higher the body fat percentage, the higher the CVD risk.

The mean fat percentage of the year groups were spread as follows: First (1st) year students had a mean fat percentage of 16%, 2nd year, 17.2% and 3rd year 16.9%. The results reflect that there were no significant differences in the body fat percentage amongst the three different year groups (p=0.1213). The data is in line with that of Losper (2012) who also found no significant differences in the body fat percentage amongst the year groups (p=0.2780).

Lean Body Mass

The mean LBM of the total 200 students was reported as 56%, which is higher than Losper (2012) finding of 46%. The mean LBM percentage of the 1st year students was 55.3%, 2nd year students was 54.7% and 3rd year students displayed the highest percentage of 58.1% which again correlates with the findings that third year students are more active than first year students, which proves a positive outcome of increased PA. The data showed that there was a significant difference in the LBM amongst the different year groups (p=0.0276). In a previous study shown by (Losper, 2012), there was no significant difference in the LBM amongst the different year groups (p=0.0628).

The mean LBM percentage of the White students was 55.4kg with African and Coloured students displaying a percentage of 56.9% and 56.2% respectively. Despite the year groups having a significant difference in LBM, the LBM amongst the different ethnic groups recorded no significant difference (p=0.2573), this however opposes the research done by (Losper, 2012) where there was a significant difference proven amongst the different ethnic groups (p=0.0002). This correlates to the findings of the body fat percentage. The higher the lean body mass, the less fat percentage which again contributes to a lower risk of CVD.

Body Mass Index

BMI has been documented as a factor that could have an influence on an individuals' health status (US Department of Health and Human Services USDHHS, 2001). According to Sparling and Snow (2002), there is a positive influence on a students' lifestyle if PA levels and BMI values are maintained. A study done by Seo *et al*. (2011), found that the average female undergraduate student had a BMI of 21.46kg.m^{-2}.

The mean score for BMI amongst White students was 23.51kg/m^{-2}, the African and Coloured mean scores were 24.35kg/m^{-2} and 22.76kg/m^{-2} respectively. The findings showed that there was a highly significant difference in BMI amongst the different ethnic groups (p=0.0088). Losper (2012), however found no significant difference amongst the ethnic groups (p=0.1416). The mean BMI score for 1st year students was 23.13kg.m^{-2} with 2nd and 3rd year students having a mean BMI of 23.87kg.m^{-2} and 24.07kg.m^{-2}respectively.

As an entity the anthropometric profile of 1st, 2nd and 3rd year students in this study is not indicative of any CVD risk or mortality. These differences in physical characteristics likely reflect the rapid development of the physical demands and athleticism.

5.5. Belloc and Breslow Scores

- **Eating habits**

Belloc and Breslow (1972) suggested that eating three meals a day without any in-between snacking can be beneficial. Krishnan and Sharmila (2016) further amidst that breakfast is considered the most important meal of the day. However breakfast has also been proven as the most neglected meal of the day. Eating disorder is a serious problem and the pathology is less common in African female students compared to White female students (Szabo and Hollands,1997; Le Grange *et al.* 1998). Africans have been proven to score a “high” or in some instances “higher” than their White counterparts on measures of disordered eating (Marais *et al.* 2003).

A study by Le Grange *et al.* (2006) indicated that 11.9% of African respondents presented anorexia nervosa habits. These studies could possibly be supported by the results reported by Losper (2012) as only 10.1% African female students indicated that they consume three meals a day and 41.0% indicated that they consume breakfast. This is however lower than in this study where 36.5% of Africans indicated that they consume three meals a day with a high 55.6% of Africans consuming breakfast. This increase is incredibly positive and proves that students are becoming more health conscious and aware of their eating habits.

This study succeeded in showing that 36.5% of the Coloured students eat three meals a day and 55.6% eat breakfast. This is much higher than found by Losper (2012), who stated that no Coloured students ate three meals a day and only 38.1% ate breakfast. This study found that 73,2% of White students ate breakfast (which concur with the findings of Losper (2012) that indicated 72.6% of White female students consumed breakfast. It should be mentioned that even though the results of three meals a day for White students is higher than that of African students, it remains a risk for eating disorders.

These findings are similar to the first South African survey of eating habits among young adults done in 1998 by Le Grange *et al*. (1998). The incidence of similar eating disorders in the different ethnicity groups is thus obvious. The escalation of breakfast intake in the three ethnic groupings must be viewed as positive due to the importance of this meal.

- **Sleeping habits**

Lauderdale *et al.* (2006) remarked that African students reported lower sleep duration and lower sleep effectiveness than their White counterparts. During this study, 74.6% of the African female respondents indicated that they slept 8 hours a day which is higher than that reported by Losper (2012), where only 44.6% of black students reported they slept 8 hours. Sleeping habits has improved a lot over the two studies which is proving that students are well aware of the importance of sleep on their lifestyles.

Amongst the Coloured female students in this study, 76% of the students experienced adequate sleeping patterns of more than 8 hours per night. Szalontai (2006) contends that Coloured female students sleep an average of 9.47 hours per day in a 7-day week which coincides with this research. In a study carried out by Losper (2012) only 42.9% indicated that they sleep at least 8 hours a day during the week.

Hale and Phuong Do (2007) avers that 23.5% of White students who participated in their study slept 6 or less hours and 8.9% slept for 9 or more hours. These are extremely low sleep duration figures compared to the results reported in this study where 86.9% of the White female students indicated that they sleep at least 8 hours a day during the week.

The different year groups reported adequate amount of sleep with an average of 7- 8 hours per day. This study revealed that 76.8% of first years reported 7- 8 hours of sleep per day, with 2nd year and third years with 82.4% and 85.7% respectively.

It therefore seems that between 70% and 90% of the students, depending on the ethnic and year group, sleep on average of at least 8 hours per night. This is a massive improvement from Losper (2012) where only between 40% and 50% of students, depending on the ethnic and year group, reported that they sleep an average of 8 hours per night. This is a very positive development and may be attributed to an improvement in PA levels and resulting decrease in stress levels.

- **Smoking**

During recent studies, it was found that 17.6% of South Africans smoke tobacco (Ganz, 2016). Amongst women, cigarette smoking and death occurrence is currently

increasing (Pirie *et al*. 2013). In a study by Steyn *et al*. (1992), 10.3% of urban African females reported that they were smokers compared to the 4% reported by the rural African group. This study indicates that only 9.5% of the African female students reported that they were smokers. Amongst the Coloured female students, a small percentage of 4% were classed as smokers. This contradicts the findings of Steyn *et al.* (1992) who indicated that 28.6% of Coloured students did smoke. According to Losper (2012), 17.9% of White students reported that they were tobacco users, however in this study only 11.6% of White students stated that they smoked. This may be an indication of a decline in smoking at this specific institution.

Amongst the different year groups, the data succeeded in showing very similar results amongst the three different groups. In total, 13.0% of 1st year students indicated they participated in smoking activities, where 2nd and 3rd year students reported 11.76% and 4.8% were respectively smokers. Little data was found to back this research, but a possible reason for the high percentage of smoking during first year could be due to their first year of freedom as well as increased stress levels with university work.

It is also obvious that the occurrence of smoking is declining amid all the ethnic groups and year groups. This may be credited legislation and the anti-smoking campaigns which have been implemented around campus to prevent students from using smoke as a form of stress release.

- **Alcohol consumption**

Alcohol use is a complex behavior. No single measure will capture all the relevant aspects of alcohol use (Sutfin *et al*. 2009). Levitt *et al.* (1993) conveyed a survey where 82% of African females stated that they consumed little or no alcohol which correlates with the findings during this study where 82.5% of African students indicated little/no alcohol intake. Vorster *et al.* (1997) further reported that 73% of Coloured students did not make use of any form of alcohol. These results support those reported during this study which proved that 96% of Coloured female students indicated they didn't consume alcohol.

During this study, it showed that 83.9% of white students did not consume alcohol which supports the research of Losper (2012) with 84.5% of White students who reported that they didn't consume alcohol. An unexpected result indicates that 82.6% of 1st years, 79.4% of 2nd years and 93.7% of 3rd years indicated that they consumed little or no alcohol during university years. Again, 3rd year students demonstrate a

healthier lifestyle. This is an unexpected result, because it has been proven that University is a form of 'freedom' after school and students usually encounter binge drinking behaviours (Weld *et al*. 2013).

It is evident that the prevalence of alcohol consumption is declining amongst the ethnic and year groups. This may be attributed to legislation and anti-drinking campaigns. An anti-drinking campaign was implemented by the institution where the study was conducted which banned drinking on campus.

- **Ideal body weight**

According to Reddy *et al.* (2008) there is little ethnic difference in being overweight, however the highest obesity rates were reported for Africans. African women are also at increased risk for obesity-related health problems, such as CVD, stroke and diabetes (Reddy *et al.* 2008). The ideal body weight results of this study are based on the perception of the respondents. Eighty five point seven percent (85.7%) of African students indicated that they maintain a healthy body weight. It is interesting to note that 100% of the Coloured students indicated that they maintain a healthy body weight, with 95.5% of White students indicating that they maintain a healthy body weight as opposed to an unhealthy body weight.

Similar results were seen in the different year groups. Ninety two percent (92.8%) of 1st year students indicated that they maintained a healthy body weight, with 2nd years reporting with 91.2% and 3rd years with the highest of 95.2%. Once again third years excel with a healthy body weight.

The similarity of the frequency of perception regarding ideal body weight between the different ethnic and year groups is evident and requires further research. The results of this data could be because of the modern female student being aware and conscious about their body image and self-image and therefore take part in PA and follow healthy lifestyle habits in order to maintain a healthy body weight.

5.6. Health Categories

Students were categorized according to Belloc and Breslow (1972) three lifestyle habits categories namely poor, moderate and healthy. Sixty two point five percent (62.5%) of White (n=70) students, 54% African (n=34) and 60% Coloured (n=15) fall into the healthy category. Regarding year of study, 53.6% of 1st year, 55.9% 2nd year and 69.8% 3rd year female students fell within the healthy category. It is clear that 3rd year students are following a much healthier lifestyle an there is a positive increase from 1st year through to 3rd year.

The increased responsibilities when attending university and the decisions that need to be made regarding what to eat and whether to exercise can be a contributing factor as to why a mere 53,6% of first year female students were classed as being healthy. There was an increase in the percentage of students in the healthy category from 1st year students to 2nd year students, with a majority of 3rd year students considered to be healthy. A possible reason for this high number of 3rd year students could be the increased awareness on the effects of lifestyle habits and PA and a culmination of all the listed positive progression from 1st year till 3rd year.

5.7. Barriers Faced by the Female Students

Study responsibilities were identified as the most common barrier with 41.3 % followed by injuries 37.5%, lack of motivation 36.3% and time constraints of 20%. Bloemhoff and Coetzee (2007) supports this research with three major barriers towards PA, being study responsibilities, time constraints and a lack of motivation. Brown *et al.* (2006) confirm this tendency identifying a lack of motivation (36%) and time constraints (17%) as the main barriers. These findings imply that that female students' motivation may have an extremely important relationship with PA frequencies. Strategies to overcome these barriers and improve PA remain an important topic and challenge (Wagner *et al.* 2009).

The barrier that the students least experienced was lack of financial resources with a low 7.5%. A possible reason and explanation for this could be due to academic and sports bursaries and free access to most sport and recreational facilities on campus.

Chapter 6 – Conclusion and Recommendations

6.1. Conclusion

6.2. Recommendations

6.3. Future Research

6.1. Conclusion

The conclusions that were drawn from this research are presented in accordance with the aims and objectives set during Chapter 1.

The objectives of the study were: (1) To identify PA levels of the female undergraduate students at the University of the Free State campus using a validated self-reported measure instrument; and (2) To establish the lifestyle profile and body composition of undergraduate female students attending this Tertiary Institution and (3) to determine the impact of ethnicity on PA levels, lifestyle habits and body composition of undergraduate female students attending this Tertiary Institution.

Conclusions based on the objectives.

Objective one: To identify PA levels of the female undergraduate students at the University of the Free State campus using a validated self-reported measure instrument

The aim of this study was to determine the PA levels of female undergraduate students, the results were evident that 68% as a whole did take part in some form of PA whilst at university. There was an obvious increase in PA levels within the year groups, with 62.3% of first year students, 63.4% of the second year students and 79.4% of the third year students participating in PA. The increase is also evident in the MET-minutes/week. First year students reported 2251.4% MET-minutes/week, the second year students 2030,2% MET-minutes/week and the third year students 2288.2% MET minutes per week. The MET-minute/week of the students are considered to be above the recommended levels set out by the ACSM (2018) guidelines. A big positive finding of this study is the increase in willingness to participate in PA after University, with 97.1% of first year students, 95.6% of the second years and 96.83% of third year students expressing to participate in PA after university.

Objective two: To establish the lifestyle profile and body composition of undergraduate female students attending this tertiary institution

As reported throughout this study, majority of the students followed the 7 Belloc and Breslow lifestyle habits. On average amongst the students, 67% showed that they consume breakfast daily, with 87.5% of the respondents consuming little to no alcohol, 93.75% of the group maintaining a healthy body weight, 91.6% reported that they were nonsmokers, 79.17% expressed that they slept 7-8hours per day and a high 90.3% reported that they participate in PA at least 2-3times per week. An alarming finding of this study was that students eating patterns were not optimal with only 37.6% of the students stating that they consume three meals per day. A part of the objective of the study was to determine the body composition profile of students. Students had a mean weight of 67.4kg, a mean height of 168.5cm, a mean LBM of 56.0kg, a mean BMI of 23.6 $kg.m^{-2}$ and a mean body fat percentage of 16.7%. .

Amongst the different year groups, it was proven evident that lifestyle habits increase from 1st year until 3rd year. By the time the students progressed to the 3rd year, they started implementing a change to their lifestyle habits to a certain extent.

Objective three: To determine the impact of ethnicity on PA levels, lifestyle habits and body composition of undergraduate female students attending this tertiary institution.

The ethnic groups on the other hand don't show significant differences among their lifestyle habits, PA levels and body composition. Participation of PA was higher amongst White students with 78.6% compared to African students with 54.0% and Coloured students with 56.1%. What is evident is the White students had a higher mean MET-minutes/week (2432.6) than the African (1701.1) and Coloured (2113.8) students. It is clear that there was no statistically significant difference in body composition. However there was a lower mean fat percentage in Coloured students (14.7%) and a higher BMI of 24.4 $kg.m^{-2}$ in African students. A positive finding in this study shows that students have a strong intent in participating in PA after university with White (98.2%), African (92.1%) and Coloured (100%) students stating that they'll participate in PA after university.

6.2. Recommendations

The results of this study supplies a basic platform to the Universities sports administration department which provides them with information to reflect on and summarize the current PA levels and lifestyle habits of female undergraduate students at the institution. Understanding the students perceived constraints to participation in PA is a necessity and can assist the sports administration department in effectively developing PA activities and alternative programs. During this study, it was revealed that study responsibilities, injuries, lack of motivation and time constraints are the biggest barriers towards PA participation amongst female undergraduate students. A proposition is for the sport administrative department to use persuasive communication that affects students behaviour and boost their motivation to participate in PA and acceptable lifestyle habits. In addition, delegating students with tools to manage their constraints (for instance, providing assistance and guidance on time management) may be better than attempting to eliminate them. By promoting constant acceptable lifestyle habits and PA during studies could assist students to experiencing this as a long term benefit.

Students should be provided with all the relevant information regarding PA and lifestyle choices that are made during their time at University, by providing this information to the students it may motivate them to take part in some form of PA and recreational activities during their time at University. The implementation of the outside gym facilities on campus provide the students with a basic form of PA and exercise and will aid in promoting a healthy lifestyle and help maintain their levels of PA.

If students can implement an ethos of practicing a healthy lifestyle and being more physically active, the development of possible chronic disease risk will also be significantly decreased.

6.3. Future Research

The population sample consisted only of undergraduate female students attending the University of the Free State.

Research can also be done at other Universities to determine if there are any significant differences and/or similarities in the PA and lifestyle habits of students at various tertiary institutions.

Chapter 7 – Reflection

7.1 Introduction

Research is an extraordinary thing, it can be extremely frustrating, but incredibly interesting and fulfilling at the same time. Research offers the opportunity for ongoing learning and assists in gaining knowledge and excelling in your field of study. Continued education is important and by taking time for research can really help in progressing through your career.

PA and lifestyle habits personally is a big aspect in my life and I was intrigued to find out more about female undergraduate students and how to assist in encouraging females to follow a healthy lifestyle.

7.2 Reflecting on the research process

When I reflect on the research process, all that comes to mind is the word “challenging”. I started this research process with no experience on research and had to start from scratch. I am incredibly grateful for my study leader and supervisor, Prof. Bloemhoff and Prof. Coetzee for their outstanding knowledge and all the advice, support and assistance they offered me throughout. They were always willing to help, teaching me something new every day and encouraging me to be the best I can be. I also knew that I had to take the research step by step and be patient, which to be honest I don’t really have a lot of. I learnt that ongoing questions were important, always asking if I didn’t know, never being scared to ask for help and assistance. Choosing the correct research topic was also important. I thoroughly enjoyed this research, it was an interest of mine and I was curious on what the results and outcomes would be. Planning was also key throughout the research, setting out goals, working towards them and achieving them step by step. The biggest thing was just to write, to edit, write again etc. Once I got going, there was no stopping. Although it was a long process and very frustrating, I enjoyed every minute of it, learnt a lot and very grateful for the opportunity.

7.3 Personal remarks

To conclude, I personally grew a lot throughout this research journey. I learnt a lot and gained heaps of knowledge. I truly appreciate the time and effort that Prof. Bloemhoff and Prof. Coetzee put in for me and I appreciate the relationship I formed with these

two extraordinary men. I will forever be grateful for the opportunity and the experience even though it wasn’t the easiest of journeys.

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Appendices

Appendix A – International Physical Activity Questionnaire

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……___ 119
   - A moderate pace that makes you breath somewhat harder than normal……..…___
   - A slower pace where there is no change in your breathing…….……___

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 Breslows Lifestyle Habits 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.

For office use only

	YES	NO	
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 Form

HEATH & CARTER ANTHROPOMETRIC ASSESSMENT FOR FEMALES

For office use only

Date: ________________ (1 2)

Student no: ____________________ (3 - 12)

Ethnicity: ____________________ (13)

Year of study: ____________________ (14)

Weight: _______kg (15 - 17)

Height _______cm (18 - 20)

6 Skinfold measurements	mm	mm	mm	
Triceps				21 - 29
Subscapular				30 - 38
Suprailiac				39 - 47
Abdomen				48 - 56
Medial thigh				57 - 65
Medial calf				66 - 74

For office use only

Girths	mm	mm	mm	
Waist				75 - 86
Hip				87 - 98
Calf (maximum)				99 - 110
Arm (relaxed)				111 - 122
Arm (flexed & tensed)				123 - 134

Breadths	mm	mm	mm	
Biepicondylar Humerus				135 - 146
Femur				147 - 158

Summary of Calculations	%	
Fat Percentage		159 - 161
Lean Body Mass (LBM)		162 - 164
Body Mass Index (BMI)		165 - 167

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 Levels and Lifestyle Habits of Female Undergraduate Students at a Tertiary Institution

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 levels and lifestyle habits of the female undergraduate at a tertiary institution (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

_____ _____
Liné Malan Date
Biokineticist

Appendix E – Information Document

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

UFS·UV
HEALTH SCIENCES
GESONDHEIDSWETENSKAPPE

Information

Physical Activity Levels and Lifestyle Habits of Female Students at a Tertiary Institution

I, Liné Malan, am a master's student in Biokinetics at the University of the Free State. I am conducting a research project on the physical activity and lifestyle habits of the female undergraduate students at a tertiary institution (University of the Free Sate)

Participation in the study is completely voluntary and refusal or withdrawal from the study will involve in no penalty or loss of benefits to which participant is otherwise entitled. At no point during the study will any personal information be shared without the consent from the participant.

Participants will be asked to complete two questionnaires the International Physical Activity Questionnaire (IPAQ) and the Belloc and Breslow 7 Lifestyle habits questionnaire. The Belloc and Breslow questionnaire is to determine the lifestyle habits and the IPAQ is to determine what the physical activity profile is of the students. An anthropometric assessment (Body fat%) will also be done to determine the physiological profile of the participants. The complete assessment will take approximately 30 minutes, with the questionnaires taking 10 minutes to complete, and a further 20 minutes to complete the anthropometric assessment and body profile.

Thank you, should you require more information regarding the project please contact me: *linemalan12@gmail.com*

Kind regards

Liné Malan

Appendix F – Ethical Clearance Faculty of Humanities (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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Appendix G – Ethical Clearance Faculty of Humanities (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

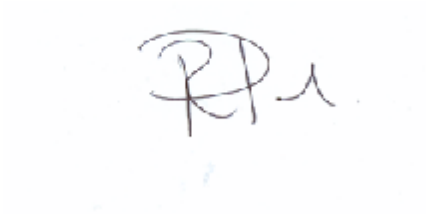
Application for extension for ethical clearance: Physical activity levels and life style habits of undergraduate students at a South African university (UFS-HUM-2014-63)

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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