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A COMPARATIVE STUDY OF THE ALPHA HEALTH RELATED FITNESS LEVELS OF 12 TO 13 YEAR OLD BOYS FROM DIFFERENT SCHOOLS IN JOHANNESBURG

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In Partial fulfilment for the MSc (Med) in Biokinetics.

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Declaration

I, Musawenkosi Johannes Xaba, declare that this thesis is my own work. It is being submitted for the degree of Master of Science in Medicine in the field of Biokinetics in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University.

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…… day of …… 2014

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List of Abbreviations

ALPHA – Assessing Levels of Physical Activity and Health in Adolescents
BMI – Body Mass Index
BF% - Body Fat Percentage
C-PAQ – Children's –Physical Activity Questionnaire
HIV – Human Immune Deficiency Virus
IOC – International Olympic Committee
ISASA – Independent Schools Association of South Africa
PE – Physical Education
SA - South Africa
SES – Socio-economic Status
WHO – World Health organisation
NCCDPP - National Centre for Chronic Disease Prevention and Health Promotion

Chapter One

1. Introduction:

Obesity as a well-known risk factor for non-communicable diseases, and has been identified as a global public health concern (Kruger et al., 2005). Furthermore, the lack of international epidemiological information means that for many countries the magnitude of the obesity epidemic in children and youth remains unknown, especially in developing countries (Janssen et al, 2005).

Furthermore, physical activity levels are found to be lower, and television viewing times are higher, in overweight compared to normal weight children (Janssen et al, 2005). There is a clear association between physical fitness and health in young people, and thus an ever increasing need to for regular screening of physical fitness levels to become a public health priority (Santos and Mota, 2011). As a result, in 2002, one of the main recommendations in Canada's child and youth physical activity guide was to increase physical activity in children. The guideline recommends that time currently being spent on physical activity (30 minutes per day) should progressively increase over 5 months to about 90 minutes per day (Janssen and LeBlanc, 2010).

South Africa (SA) has a complex cultural mix and studies have shown that South African children are also experiencing this rise in childhood obesity and other related co-morbid conditions (Kruger et al., 2006; Armstrong et al., 2006). Therefore, it has become essential to assess the fitness levels, as well as physical activity levels in South African children.

Aim of the study:

To assess the health and fitness levels of 12 to 13 year old boys from different ethnic, socio-economic and educational backgrounds.

Objectives of the study:

1. To assess and compare the fitness levels of 12 to 13 year old boys at St John's Preparatory School and Masibambane College using the ALPHA fitness test battery.

2. To assess and compare the physical activity levels in the 12 to 13 year old boys from Masibambane College and St John's College using the Physical Activity Questionnaire for children (C-PAQ).

Chapter Two

2. Review of Literature

2.1 Health risks

The World Health Organisation's (WHO) publication on global recommendations on physical activity for health identifies physical inactivity as the fourth leading risk factor for global mortality (Janssen et al., 2005; WHO: Geneva, 2010). Health related physical fitness refers to the components of fitness that are closely related to health such as cardiorespiratory fitness, musculoskeletal fitness, motor fitness and body composition (Ruiz et al., 2011). Ortega et al., (2008) suggests that physical fitness should be thought of as an integrated measure of most, if not all, of the body's systems responsible for carrying out our daily physical activities.

Physical activity is considered one of the most important health markers, and a predictor of morbidity and mortality, for cardiovascular disease (WHO: Geneva, 2010). Therefore, the promotion of physical activity plays an important role in minimising the development of chronic diseases of lifestyle (Min-Lee et al., 2012). In addition, it aids in injury prevention and contributes to quality of life and psychological health (Stafford, 1998).

2.1.1 Health risks in children

Micheli et al., (2011) reported that there is a growing body of scientific evidence indicating a decline in physical activity levels and fitness in young children and youth. These are reported to be associated with adverse impacts on their health, such as rising levels of childhood obesity, diabetes, heart disease, metabolic syndrome and an increased risk of coronary heart disease (Micheli et al., 2011).

Obesity and poor physical fitness levels constitute a global health problem affecting an increasing number of children and youth (Carrel et al., 2009). In fact, there has been such a rapid increase in childhood obesity, that cross national surveys from even the 1990's may now be outdated (Jannsen et al., 2005). The findings of many studies have broadened our knowledge of this increasing global epidemic (Carrel et

al., 2009; Allen et al., 2007; Ogden et al., 2006), but the magnitude remains unknown for many countries, especially in developing countries.

2.2 Obesity in children

According to the National Centre for Chronic Disease Prevention and Health Promotion (NCCDPP), cardiovascular disease is one of the major concerns amongst obese youth (www.cdc.gov). In a population based sample of 5 to 17-year olds, 70% of obese youth were reported to have at least one risk factor for cardiovascular disease. These children and adolescents find themselves at an increased risk of bone and joint problems, sleep apnea and psycho-social problems which eventually leads to a poor quality of life (www.cdc.gov).

The long term implications are that obese youth are more likely to become overweight or obese adults (McVeigh et al., 2004). Therefore, there is an increased risk for associated adult health related problems such as heart disease, type 2 diabetes, stroke, different types of cancer and osteoarthritis (www.cdc.gov).

It appears that physical activity levels may help to prevent or manage the obesity problem. For example, Janssen and colleagues (2005) conducted a cross sectional survey of 10 to 16 year old youths from 34 countries. Their findings reveal lower physical activity levels and higher television viewing times in overweight compared to normal weight youth (Jannsen et al., 2005). Although physical activity is an important modifiable risk factors, it is important to understand that obesity is a complex condition, mediated by various genetic, behavioural and environmental factors are the main mediators (www.cdc.gov).

2.2.1 Contributing factors

2.2.1.1 Behavioral factors

The factors that contribute to childhood obesity interact with each other, and as a result it is not possible to identify one causal factor. However, there are certain behaviours that can be identified as potential contributors to an energy imbalance. Evidence on the specific foods or dietary patterns that contribute to excessive energy intake in children and teens is limited. However, eating meals away from home,

snacking on energy dense foods, consuming beverages with added sugar, large portion sizes are often hypothesized as contributing factors to the negative energy imbalance (Feeley et al., 2012; www.cdc.gov). Consuming fast foods appears to be prevalent in South African youth. In a study of 655 urban black adolescents, 5 026 fast-food items were consumed in a 7 day period. The study concluded that visits to fast-food outlets were high in SA, even when compared to developed countries (Feeley et al., 2009).

Physical activity participation is also important in children and youth as it may contribute positively to body weight and bone strength. For example, in a South African study by Mcveigh et al., (2007), bone mass and bone area gain was found to be accentuated in pre- and early pubertal children with the highest levels of physical activity. It is also commonly accepted that physically active children are more likely to remain physically active into adulthood. Santos and Mota (2011) argue that cardiorespiratory fitness, muscular strength and body composition can be considered markers of health during childhood and adolescence, as well as indicators for future cardiovascular health.

Sedentary behaviour, especially television viewing and playing of computer games, has increased in recent years, and this has a number of negative impacts associated with it (Salmon et al., 2005). For example, it is generally well known that childhood sedentary behaviour is associated with obesity, as well as other metabolic diseases later in life (Rey-Lopez et al., 2008). In a review of longitudinal studies, increased physical activity and decreased sedentary behaviour are protective against weight gain in childhood (Must & Tybor, 2005). Sedentary behaviours may lead to less time which could be spent doing physical activity, increased energy consumption by snacking, exposure to unhealthy foods through advertisements and a lowered metabolic rate (Jordan, 2007).

2.2.1.2 Genetic factors

According to the NCCDPP there are certain genetic characteristics that leave some individuals more susceptible to excessive weight gain (www.cdc.gov). Furthermore, it is important to understand that the evidence strongly argues that a genetic susceptibility needs to exist in conjunction with a contributing environmental or behavioural factor to have a significant effect on weight gain (Haworth et al., 2012).

The extent to which the genetics affects BMI is varied in the literature. The estimates of its effect from twin studies range from as much as 50% to 90% (Maes et al., 1997). Genetic factors and environmental factors do affect BMI in both the clinical and normal range of BMI. Therefore obesity is the extreme response to the same genetic and environmental factors (Haworth et al., 2012). The rapid rise in the rate of overweight and obesity over the past decade cannot only be attributed solely to genetic factors. Human genetic makeup has not changed over the past three decades but there has been an alarming rise in the rate of obesity and overweight in school aged children (Reddy et al., 2012; McVeigh et al., 2004; Janssen et al., 2005; Haworth et al., 2012; www.cdc.gov). Thus, this suggests the importance of the behavioural and modifiable factors in the prevention and management of overweight and obesity.

2.2.1.3 Environmental factors

There are multiple environmental factors that can have an effect on a child's weight, rate of weight gain and amount of physical activity that they take part in (www.cdc.gov). These include the child's home, child care, the child's school and community environment. Vuković et al., (1998) found that physical activity was closely related to parental physical activity patterns in younger children and that the parent's physical activity was the predictor of intention for partaking in physical activity in future. Hence, children and youth are likely to develop the same habits as their parents with regards to both calorie intake and physical activity patterns (www.cdc.gov).

Child care also has a critical role to play, since most children of working mothers spend an enormous amount of time at child care centres. Healthy eating habits and physical activity during the developmental stages can have an influence on developing healthy future habits (Salmon et al., 2005). The home and child care environments are even more important now since there has been a worldwide increase in access to sedentary recreational opportunities such as televisions, computer and video games (Salmon et al., 2005; www.cdc.gov). Furthermore, the majority of young people aged 5 to 17 are enrolled in schools. The amount of time spent in school and on the community playgrounds can have a huge influence on whether children and youth adopt healthy or unhealthy habits (www.cdc.gov).

2.3 Physical activity

A recent systematic review by Janssen & LeBlanc (2010) highlights some of the major health benefits of physical activity. The experimental studies reviewed in the study examine the effect of exercise interventions on changes in blood lipids and lipoproteins. In the studies based on aerobic exercise alone, there were significant improvements in at least one lipid/lipoprotein variable. In contrast, resistance or circuit training studies reported small or insignificant changes. Only one dose of exercise was prescribed in these studies making the dose-response relationship in children and youth largely unclear (Janssen & LeBlanc, 2010).

Blood pressure is also an important component to consider. In the experimental studies reviewed by Janssen & LeBlanc (2010), the results reported significant reductions in systolic blood pressure in response to aerobic exercise training. Other studies have also reported significant reductions in diastolic blood pressure (Bell et al., 2007; Hagberg et al., 1983), suggesting that aerobic exercise is an effective tool for controlling blood pressure.

The relationship between overweight and obesity to physical activity has been extensively studied in the literature. Overweight and obesity are generally classified using age and gender specific body mass index (BMI) criteria. The majority of the observational studies reviewed by Janssen & LeBlanc (2010) utilised self/parent reported tools of documenting physical activity or sport participation. The studies that reported moderate to vigorous intensity activities were more consistently and strongly inversely related to obesity than the low intensity activities. Furthermore, studies using objective measurement tools have reported a significant and strong inverse relationship between physical activity and overweight/obesity (Dencker et al., 2006; Eisenmann et al., 2007; Ness et al., 2007; & Stevens et al., 2007).

Many intervention studies in this review that aimed to improve health measures (e.g. blood lipids, insulin resistance and bone density) reported significant changes in BMI, total fat, and/or abdominal fat in response to aerobic training (Janssen & LeBlanc, 2010). Other studies that employed resistance training, pilates, jumping exercises and circuit training also recorded significant improvements in BMI, total fat, and/or abdominal fat in response to the training modality (Janssen & LeBlanc, 2010).

Exercise has also been found to have a positive effect in reducing depressive symptoms for children and youth diagnosed with depression. Three studies found that 8 to 12 weeks of moderate aerobic exercise resulted in the reduction of at least one depressive symptom (Anessi et al., 2005; Norris et al., 1992 & Goldfield et al., 2007).

2.4 Measurement of physical activity in children

As far back as 1997, researchers realised that one of the major difficulties with epidemiological studies involving children is that the methods to measure physical activity are hampered by a number of difficulties that are not experienced in adult studies (Guillaume et al., 1997). Santos & Mota (2011) acknowledge that while objective measures of fitness are accurate and precise in the laboratory they are also more expensive. Sophisticated, time consuming equipment is required, and needs to be administered by qualified technicians. This makes their use in epidemiological studies or in school settings impractical and limited.

Field based fitness tests are easier to administer, require less equipment, cost less and can be administered to larger groups of participants at the same time. Therefore, in a school setting, field tests are more practical and feasible for researchers (Castro-Piñero et al., 2010).

Castro-Piñero et al., (2010) looked at the number of test batteries that are currently being used internationally to assess levels of fitness. The study clearly shows the need for more standardised methods of assessing the levels of fitness in children and youth. Standardisation will facilitate comparisons between countries, continents and even internationally. Thus, methodological differences between studies make comparisons difficult and hard to interpret. The HELENA study by Ortega et al., (2011) reported on sex- and age-specific physical fitness levels in European adolescents from a sample of 3428 boys and girls from 9 European countries. A number of fitness components were assessed and from this study normative values were established for European children and youth. The main strength of this study was the strict standardisation of the fieldwork among the countries involved. This in turn precludes much of the confounding bias which is due to inconsistent

measurement protocols and later interferes when comparing the results of isolated studies (Ortega et al., 2011).

Ruiz et al., (2010) assessed the reliability, feasibility and safety of a health related fitness test battery, the ALPHA test battery. Castro-Pińero et al., (2010) further systematically reviewed the predictive validity of health-related fitness, the criterion validity of field-based fitness tests, and the reliability of field-based tests in youth. The results of both these studies indicated that the ALPHA fitness test battery is valid, reliable, feasible and safe for the assessment of health–related physical fitness in children and adolescents and can be used for health monitoring purposes at population level.

2.5 Physical activity interventions and recommendations

Different international organisations such as the International Olympic Committee (IOC), National Health Departments, WHO and educational departments around the world have instituted programs to promote health in children and adolescents through sports and physical activity. In January 2011, the IOC assembled an expert group to discuss the role of physical activity and sport on the health and fitness of young people (Micheli et al., 2011).

Micheli et al., (2011) reported that there is a growing body of scientific evidence indicating the decline in the levels of physical activity and fitness in young children and youth. The recommendations for action included further education and training on all aspects of physical activity, especially for prescription from healthcare professionals, increased collaboration between healthcare, communities, school and sports sectors. The authors acknowledge that physical activity can be a powerful tool to improve and protect the health of youth (Micheli et al., 2011).

Canada has been at the forefront with regards to the development of physical activity guidelines for their youth. Their first set of guidelines for children youth was developed in 2002 (Ottawa, 2002). Many countries and organisations around the world have since developed physical activity recommendations for school aged children and adolescents (Janssen, 2007). The main recommendation in most countries is that children and youth should participate in at least 60 minutes of

moderate to vigorous intensity physical activity on a daily basis (Micheli et al., 2011; Ottawa, 2002; Janssen, 2007).

2.6 Trends in physical activity

The study by Janssen et al., (2005) recommended that increasing physical activity participation, and decreasing television viewing, should be the focus of strategies aimed at preventing and treating overweight and obesity in youth. Indeed, in most European countries, physical activity levels were lower and television viewing times were higher in overweight and obese children compared to normal weight children. Furthermore, McMurray et al., (2000) found that watching television on non-school days was related to being overweight and that increased hours of video game play enhanced the risk of being overweight for both genders. Regardless of ethnicity, participation in as little as one high intensity physical activity 3 to 5 times per week decreased the relative risk of being overweight in males.

Socioeconomic status (SES) and ethnicity may also play a role in physical activity participation. The Spanish AVENA study found that a high SES was associated with better fitness and fat percentage, however, these associations greatly depended on the fitness and socioeconomic parameters that were studied (Jiménez-Pavön et al., 2010). Furthermore, Falham et al., (2006) investigated ethnic and SES and their influence on fitness, activity levels and barriers to exercise in high school females. The findings showed significant differences between African Americans, Hispanics and Whites in BMI, percentage fat, mile run, perceived barriers to exercise and activity level. Furthermore, a study done by McVeigh et al., (2004), on a group of children from Johannesburg, indicated that SES correlates with a child's physical activity levels. They found that inactive behaviour was more prevalent among children from households with single mothers than children who came from households with married parents. The same study also revealed differences according to race. Over 90% of white males and females participated in physical education (PE) classes at school compared to only approximately 30% of their black peers. White children spent significantly greater time sleeping and playing sport than black children. Black children spent a greater amount of time watching TV and actively commuting to and from school.

The data from these studies suggests that childhood physical activity is of a multi-dimensional nature and that social and cultural factors have a definite influence on the patterns observed. These factors may influence the adoption of good physical activity patterns in youth if the aim is to establish life-long patterns of physical activity throughout childhood (McVeigh et al., 2004). With physical inactivity being regarded as the fourth leading risk factor for global mortality by the WHO it is important to identify current trends and establish guidelines to improve child health and well-being.

2.7 Trends in developing countries and SA

South Africa has seen a shift from an agriculturally-based economy to a cash based economy and this has resulted in a decreased need for physical labour but an increased demand for sedentary or less intensive physical work. In SA, much of the trend towards increased body size in adults has been attributed to the process of urbanization and the associated socio-economic change (McVeigh et al., 2004).

Improving socio-economic conditions, participation in global markets and exposure to other cultures and a number of other aspects of globalization can have many benefits for developing societies. Risk transition has seen a shift from being primarily infectious in nature, such as diarrhoea and pneumonia, to non-communicable diseases such as cardiovascular diseases, metabolic diseases and many types of cancers (Reddy et al., 2012).

Some other countries in the developing world seem to follow much of the same trend. For example, in Ghana, between 2003 and 2008, the prevalence of overweight increased from 8% to 10.3% in a sample of 15 to 19 year old girls (Reddy et al., 2012). In addition, a study of Algerian children between the ages of 6 to 10 years old had increases in the prevalence of overweight and obesity from 6.8% to 9.5% in just five years (Ziraba et al., 2009).

The burden of non-communicable diseases is growing in SA. There is a complex mix of over and under nutrition especially in schools located in low income communities, and increasing levels of physical inactivity in children (Draper et al., 2010). The South African National Youth Risk Behaviour Survey in 2002 and 2008 reveals

clearly that South African youth are not exempt from these global trends. The data from these surveys shows a substantial increase in rates of overweight and obesity among South African adolescents (Reddy et al., 2012), suggesting a looming chronic disease transition. Statistics from the survey suggest that as much a 17% of primary school children in SA are overweight or obese. Furthermore, the survey showed that as little as 40% of SA's children and youth are sufficiently active, with reported sedentary time being as high as 9 hours per day (http://www.mrc.ac.za). Therefore is has become increasingly important to measure anthropometric, health-related fitness and physical activities levels in SA children. The health status of SA's children will impact future generations, therefore such studies will help to guide interventions and provide useful data on the status of the health of our country's children.

Chapter Three

3. Methods

The protocol that is used in this study was developed by the Assessing Levels of Physical Activity (ALPHA) Project (The Alpha Project, www.thealphaproject.net). This project spent 2-3 years reviewing the evidence, developing tools, and consulting with international experts. It presents recommendations for assessing physical activity levels, the activity-related environment and health-related physical fitness at population level (The Alpha Project, www.thealphaproject.net). The reliability, validity, feasibility and safety of the field tests compiled by the ALPHA project are the reasons that the author has chosen this instrument to conduct this research in a school setting (Ruiz et al., 2010; Espana-Romero et al., 2010).

3.1 Study Design:

The study used a cross sectional observational study design. Physical fitness and strength was assessed at one time point using the ALPHA-FIT test battery, and physical activity levels was self-reported using the Children's Physical Activity Questionnaire (C-PAQ) (see Appendix I).

3.2 Study population

The population of this study consisted of 12 to 13 year old boys from two schools in the Johannesburg area. Although SES of each individual child was not assessed in this study, the two schools differ greatly in terms of ethnicity, the social and educational background, as discussed below. The schools that were selected for the study were Masibambane College and St John's Preparatory School. Permission was granted for the research to be conducted in the schools by the Headmasters of both schools (Appendix II and Appendix III).

3.2.1 Differences between the schools

The following section describes the social backgrounds of each school. The background of each school is discussed, and the differences in school fees, built environment and policies are described.

3.2.1.1 Background of each school

Orange farm is an impoverished informal settlement situated 50km south of Johannesburg. This area is rife with unemployment and each year a number of unskilled matriculants join the job queue. The situation is made worse because in order to access the Johannesburg job market people from this area have to embark on an unsafe train journey for an hour to reach the city. To add to the stress the family unit, after having suffered the effects of the apartheid regime, there is the added impact of the human immunodeficiency virus (HIV) epidemic which has had devastating effects in Sub Saharan Africa (www.stjohnsfoundation.co.za).

Masibambane College initially started off as a primary school whose construction was funded primarily by the City of Vienna. It is an Anglican Diocesan school initiated and supported by Education Africa and St John's College. Since then there have been other local and international donors who have contributed to the success of this school. It is for these reasons that Masibambane is not a public school but private school and a member of the Independent Schools Association of Southern Africa (ISASA) (www.educationafrica.com/masibambane). It started off with its first grade 1 class in 1997 with a mere 21 learners. With the help of domestic and international donors the school now caters for the educational needs of over 700 learners. The official opening of the Masibambane College high school was in 2010 with the first matric class in 2013. The construction of the high school was funded by the CEDAR Foundation from Canada (www.educationafrica.com/masibambane).

St John's College has a long history spanning over 115 years. It was founded on 1 August 1898 by an Irish priest. Johannesburg was then only 12 years old and the tiny school was situated on Plein Street and consisted of two desks and 7 learners. In 1902 the school reopened after the war in its current location with 180 boys. The school now caters for the needs of over 1200 learners in the different campuses. It consists of a Nursery School, Pre-Preparatory, Preparatory, College and a Sixth (VITH) Form program. It is situated in an affluent suburb in Johannesburg

(Houghton) and the majority of the learners at the school come from very wealthy families. St John's is also a private school and a member of ISASA (www.stjohnscollege.co.za).

3.2.1.2 School Fee Structure

There is a considerable difference in the fee structures of the schools in this study. The lowest tuition fee that parents can pay at Masibambane College is R3800.00 and the highest is R7500.00 per annum from grade 1 to 12 (http://www.isasa.org). The lowest tuition fee for grade 1 and 2 at St John's is ±R 61, 463.00, grade 3 to 7 is ±R 82, 714.00 and grade 8 to 12 is ±R 105,760.00 (http://www.stjohnscollege.co.za).

3.2.1.3 Built environment

A comparison of the built environment between the two schools is depicted in the table below.

Table 1: Comparing the built environment of each school.

Indoor Sports Facilities	
St John's College	**Masibambane College**
Indoor rowing gym	N/A
Indoor gym	N/A
Indoor squash courts	N/A
2 x Indoor hall	Indoor hall
Indoor cricket centre	N/A
Outdoor Sports Facilities	
7 full sized soccer fields used for various sports during the year	1 field which can be used for rugby, cricket and soccer
Olympic sized astro turf	N/A
1 unheated 25m swimming pool	N/A
1 heated waterpolo pool	N/A
Junior swimming pool	Community pool for recreational purposes
3 tennis courts	1 field used for both Tennis and basketball
2 basketball courts	
4 sets of Cricket nets (4 batting stations	Community Sports Centre

each)	
Climbing wall	N/A

3.2.1.4 Policies and programmes offered in each school

The learners at Masibambane College attend two 30 minute PE lessons per week. They also have 2-4 one hour afternoon sports practices per week. However, the learners do not play many interschool matches because of the area that they are situated in. The other schools in the nearby community are not able to compile teams for them to play against. The most commonly played sport in the community is soccer and basketball. During soccer season they are able to have fixtures against the other schools. The school is situated next to a Community Sports Centre which is used by the school for cricket, soccer and athletics, tennis and basketball. This centre is also used by the other schools in Orange Farm. Interschool matches, when played, take place on a Friday or Saturday at the school or at the Community Sports Centre.

The teachers who are responsible for the PE lessons at Masibambane College do not have any PE specific training. They are subject specialist teachers who did play sport at school and for some time after school. They have no background in Sports Science or PE. The learners at this school do not have access to Physiotherapy, Biokinetics or Occupational Therapy.

The St John's PE program consists of two 45 minutes lessons and one 30 minute lesson per week throughout the year. The focus of the lesson depends on the mainstream sport that is being played at that time. There is also an aspect of conditioning which focuses on different aspects of fitness e.g. speed, agility, core strength and endurance. The head of department of PE is a trained academic specialist teacher, has competed in sport at provincial and national level while at school and University. He is also a registered health professional (Biokineticist). His team consists of interns (students training to become teachers), other academic staff with coaching qualifications, and one very experienced PE trained teacher. The children at this school also have access to a school doctor, school nurse, and external consulting physiotherapists, occupational therapists, biokineticist and psychologist.

Over and above the PE lessons, the boys from St John's have a structured afternoon program comprising of two 1 hour practices and 1 to 2 interschool matches per week. The different sporting codes offered at St John's are swimming, waterpolo, cricket, soccer, rugby, basketball, tennis, squash, hockey, rock climbing, golf and rowing. Over and above this some of the boys do play club soccer, rugby, gymnastics and karate (the information above was collected through informal interview with teachers at each of the schools).

3.3 Sample selection and sample size:

Due to time constraints a convenience sample of two schools was chosen, namely St John's Preparatory School and Masibambane College. Every child born between 1 January 1999 and 31 December 2000 was given an opportunity to participate in the study. St John's Preparatory School has a population of 150 potential participants and Masibambane College has 50 potential participants. 54 (36%) boys from St John's Preparatory school and 23 (46%) boys from Masibambane College completed the study.

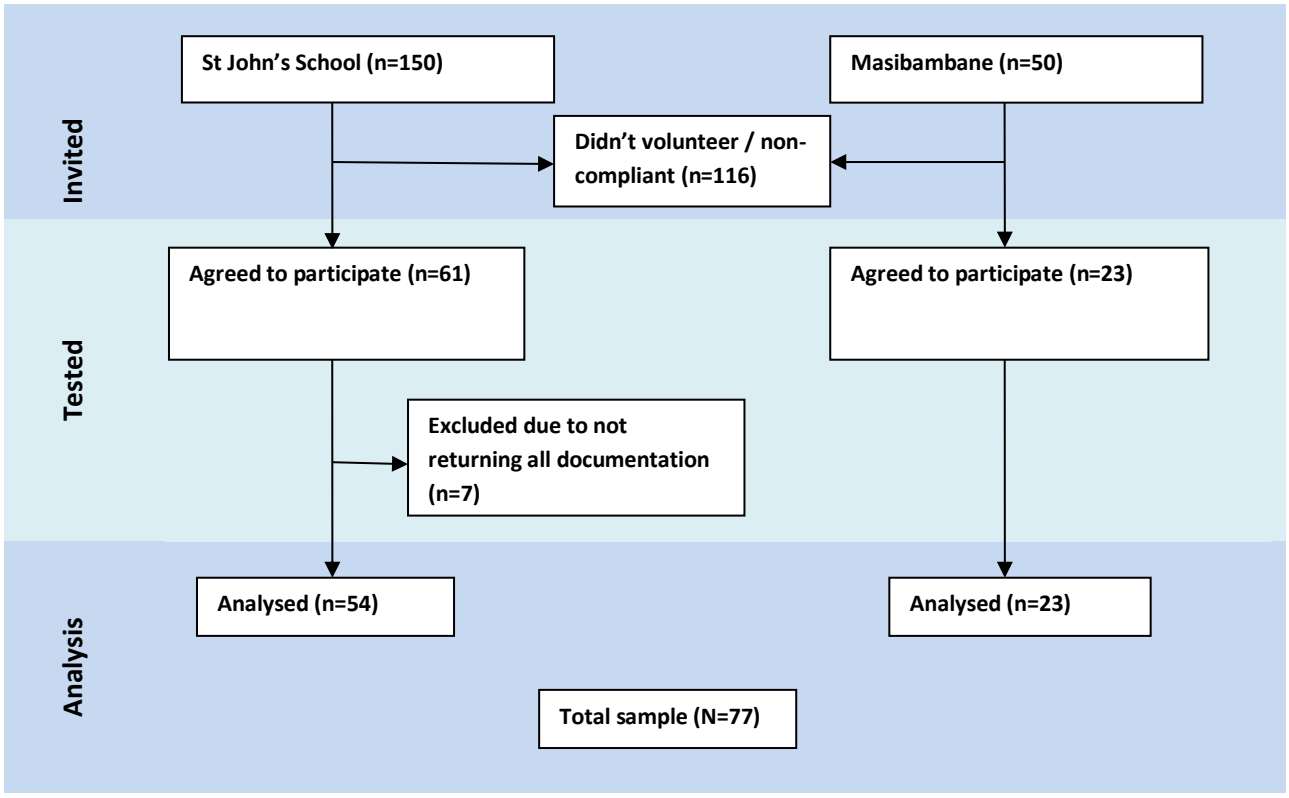


Figure 1 Sample selection and distribution

Figure 1 shows the total number of potential participants, the participants that were tested and the total number of participants that concluded the study. Out of the potential 50 participants from Masibambane College only 23 participants volunteered to take part in the study and all completed the study. Out of the 150 potential St John's participants only 61 agreed to participate in the study. 7 out of the 61 were excluded from the study because they did not return a completed the physical activity questionnaire.

From a population of 200 pupils, a sample size of N=132 was calculated as required based on a confidence interval of 95%. However, only 77 completed the study. There are a number of variables that could have led to this low participation number. The bulk of the testing was done after the academic school day. This means that the boys had to attend the testing in their own free time. Some of the children from Masibambane do not live very close to the school and depend on public transport to get home. Spending another 2 hours at school after an academic day can be discouraging. St John's has quite an intense extramural program. Some boys could not attend the afternoon testing sessions. When time was made during the academic day to conduct the testing the bulk of the learners preferred to use this time as free time and play games on the field while the testing was going on. In addition, there was no incentive for the boys to participate besides receiving their fitness results back. This was not really appealing for most of the learners. The above could have contributed to the low sample size in this study.

3.3.1 Inclusion Criteria:

- Participants must have attended either Masibambane College or St John's Preparatory School during the 2012 academic year, and at the time of study.
- Participant must be born between 1 January 1999 and 31 December 2000.
- Participant must be a full time learner at the school.
- Only male participants were included.

3.3.2 Exclusion Criteria:

- Participants were excluded if they were not a full time learner at either one of the schools.
- Born before 1 January 1999 and after 31 December 2000

- Participants were excluded if they had an injury or any medical condition that precludes them from taking part in moderate to strenuous physical activity, at the time of the study.
- Female scholars from Masibambane College were excluded.

3.4 Test protocol

The long version of the Children's Physical Activity Questionnaire (C-PAQ) was used to assess physical activity levels. This is a questionnaire which was developed by the Alpha Project to assess physical activity related environmental factors in the European population (Ruiz et al., 2010). The C-PAQ has been identified as an appropriate tool for assessing the physical activity levels of children and youth (Biddle et al., 2011 & The ALPHA Project, www.thealphaproject.net). The primary caregiver of each participant was asked to take part in the study by recording the physical activity patterns of the participant over a seven day period.

The ALPHA-FIT test battery was used to assess physical fitness and strength. It is a valid, reliable, feasible and safe test battery for the assessment of health-related physical fitness in young people which is used for health monitoring purposes at population level (The Alpha Project, www.thealphaproject.net). The test battery has been shown to be a reliable, valid and feasible test, the reliability values have been published elsewhere (Espana-Romer et al., 2010).

In the second part of the study a modified version of the ALPHA- FIT Test Battery for Children and Adolescents as detailed in the Test Manual (Appendix IV) was used. This modified version differs from the original version in three ways. Firstly, there was no assessment of the pubertal status of the participants. This was not done during this study because it is an invasive investigative method and it could have negatively affected participation. In addition, the researcher has not received any formal training in the use of this method of investigation.

Secondly, a modified version of the grip strength test was used in this study. The author did not have access to the same dynamometer that was utilised for the ALPHA test protocol. The ALPHA method for hand grip strength testing requires that the researcher measures the participant's hand on a piece of paper and then calculate the optimal grip strength based on the equations provided in the test manual. This would have been more time consuming and not appropriate for the

dynamometer used in the current study. A Jamar Dynamometer was used in this study because it was readily available for the researcher. This tool has been found to be a valid and reliable measuring instrument for assessing grip strength (España-Romero et al., 2010). There is conflicting evidence with regards to the elbow position when measuring grip strength (España-Romero et al., 2010). A number of studies have shown that grip strength is greater when measured with the elbow in full extension (Oxford, 2000; España-Romero et al., (2010); The Alpha Project, www.thealphaproject.net). A study by Su et al., (1994) when measuring grip strength found that the grip strength measured with the elbow in extension, regardless of shoulder position (0 degrees, 90 degrees, and 180 degrees of flexion), was significantly higher than when the elbow was flexed at 90 degrees with the shoulder positioned at 0 degrees of flexion. Therefore, for the purposes of this study, the grip strength was measured with the elbow in full extension. The starting position and end positions are detailed in the testing procedures section 3.4.3.

Thirdly, the original ALPHA-FIT test battery only measures triceps and sub-scapular skinfold measurements. In the current study extra skinfold measurements were taken namely: chest, abdominal and thigh skinfold measurements. Chest, abdominal and thigh skinfolds were done according to the ACSM's Guidelines for Exercise Testing and Prescription (Armstrong, 2006). This can be used with a number of equations to calculate body fat percentage. The testing procedures for these tests are detailed in section 3.4.3. This was added to the test battery in order to enable more comparisons to be made with regards to the body composition of the participants from these two schools.

The triceps and subscapular skinfold measurements were done according to the ALPHA-FIT test manual. Body fat percentage (BF%) was calculated using the Slaughter equation for white males and the Slaughter equation for black males (Slaughter et al., 1988; Dezenberg 1999). A recent study by Freedman et al., (2013) found that the Slaughter equations were highly correlated (r=0.90) with dual-energy X-ray in predicting body fat percentage. The Slaughter equation for white males was used for calculating BF% in all white St John's participants. The Slaughter equation for Black males was used for the Masibambane participants since the entire Masibambane sample is composed of black males. This was also used for the St John's black males.

Slaughter equation for white males = 1.21x (Ticeps skinfold + Subscap skinfold) - 0.008*(sum of the Triceps and sub scap skinfolds)²- 1.7

Slaughter equation for black males = 1.21x (Ticeps skinfold + Subscap skinfold) - 0.008*(sum of the Triceps and sub scap skinfolds)²- 3.2

To preclude much of the confounding bias a strict standardization of the fieldwork was employed. To ensure that comparisons can be made to the APHA-FIT test protocol the exact testing procedures were followed according to the test manual in the relevant tests. The same researchers conducted the same tests, i.e. the same person did weight, height, skinfolds, grip strength and waist circumference for all the participants. The same person did the standing long jump, motor fitness test and the shuttle run test.

The researcher was present to ensure that the correct procedures were followed at St John's and Masibambane. The research assistants were trained and familiarised with the testing procedures prior to conducting the tests and they could ask the researcher if they were uncertain. This was done to ensure that results can be compared with other studies conducted in the same way. The manual does not only include the description of the tests but also the most appropriate sequence, and the instructions for the tester and participants. This section is a summary of the instructions as detailed in the Alpha Test manual (www.thealphaproject.net).

3.4.1 Testing sequence

The sequence of testing was according to the APLHA recommendations, and went as follows:

1. Weight and height (BMI).
2. Waist circumference.
3. Skinfold thickness
4. Handgrip strength, standing long jump and 4x10m shuttle run test.
5. 20m shuttle run test.

3.4.2 Instructions for the participants

The participants were instructed to abstain from strenuous exercise in the 48 hours preceding the testing. They were also advised to wear comfortable sport clothes and

shoes because it was vital for the appropriate administration of the test battery. A notable and constant level of encouragement was used to guarantee the maximum performance from the participants throughout the tests.

3.4.3 Testing Procedures:

a. Body Mass Index (BMI):

Purpose: Measurement of body size.

Health relation: A higher BMI is associated with a worse cardiovascular profile.

Equipment: An electronic scale and measuring tape fixed on the wall to measure weight and height respectively. BMI was calculated using the formulae BMI = kg/m².

Body weight

The participant stood on the platform of the scale without support. He stood still over the centre of the platform with the body weight evenly distributed between both feet. Light underclothes were permitted, excluding shoes, long trousers and a sweater.

Practice and number of test trials: Two measurements of body weight were performed and the mean was retained.

Scoring: Weight was recorded in Kilograms (kg) e.g. 58.0 kg

Body height

Hair ornaments were not permitted and braids needed to be undone. The participant stood on the stadiometer with bare feet placed slightly apart and the back of the head, shoulder blades, buttocks, calves, and heels touching the wall behind them. Legs were kept straight and the feet flat on the ground. The tester positioned the participant's head so that a horizontal line was drawn from the ear canal to the lower edge of the eye socket running parallel to the floor (i.e., the Frankfort plane positions horizontally). The head board was pulled down to rest firmly on top of the head and compress the hair.

Practice and number of test trials: Two measurements of body height were performed and the mean was retained.

Scoring: Height was recorded in centimetres (cm) e.g. 157.3 cm

b. Waist circumference:

Purpose: A non-elastic tape was used to measure central body fat.

Health relation: A higher waist circumference is a risk factor for cardiovascular disease.

Performance: The participants were asked to remove their t-shirt so that the tape could be correctly positioned. They stood erect with the abdomen relaxed, the arms at the sides and the feet together. The tester faced the participant and placed an inelastic tape around him, in a horizontal plane, at the level of the natural waist, which is the narrowest part of the torso, as seen from the anterior aspect. The measurement was taken at the end of a normal expiration.
Practice and number of test trials: Two measurements were performed, not consecutively, and the mean was used in the analyses.
Scoring: It was recorded to the nearest 0.1 cm, e.g. 60.7 cm

Skinfold measurements

Purpose: To measure subcutaneous fat and to estimate percentage body fat.
Health relation: Higher adiposity is a risk factor for cardiovascular disease.
Equipment: Skinfold calliper and a pen.
Measurement: All skinfolds were measured on the participant's non-dominant side. This is normally done on the dominant side but according to the ALPHA-FIT test manual these should be measured on the non-dominant side. The measurement was never made over clothing.
Practice and number of test trials: For all skinfold measurements, two measurements were performed, not consecutively, and the mean was used in the analyses.
Scoring: It was recorded to the nearest 0.1 mm e.g. 21.2 mm

c. Triceps skinfold thickness:

Performance: The mid-upper-arm point is half the distance between the acromion process and the olecranon. The tester stood behind the participant and picked up the skinfold about 1 cm above the midpoint mark over the triceps muscle (at the back of the upper arm), with the fold running downward along the midline of the back upper arm. The caliper jaws were applied at right angles to the "neck" of the fold just below the finger and thumb over the midpoint mark. While maintaining a grip on the skinfold, the tester gently released the caliper handles and allowed the jaws to close on the fat fold for two seconds before taking the reading.

d. Subscapular skinfold thickness

Performance: The subscapular skinfold is picked up on a diagonal, inclined inferior-laterally approximately 45° to the horizontal plane in the natural cleavage lines of the skin. The site is just inferior to the lower angle of the scapula. The caliper jaws were applied 1 cm inferior-lateral to the thumb and finger raising the fold.

e. Chest skinfold thickness

Performance: The chest skinfold is a diagonal fold; one-half the distance between the anterior axillary line and the nipple. The participant stood comfortably erect, with the upper extremities relaxed at the sides of the body.

f. Abdominal skinfold

Performance: The abdominal skinfold is a vertical fold; 2cm to the right side of the umbilicus. The participant stood comfortably erect, with the upper extremities relaxed at the sides of the body.

g. Thigh skinfold measurement

Performance: The thigh skinfold is a vertical fold measured on the anterior midline of the thigh. This is marked midway between the proximal border of the patella and the inguinal crease (hip). The participant stood comfortably erect, with the upper extremities relaxed at the sides of the body.

Measurement: These skinfolds (chest, abdominal and thigh) were measured on the right side of the body according to the ACSM guidelines (Armstrong, 2006).

Musculoskeletal fitness

h. Handgrip strength

Purpose: To measure upper body isometric strength.

Health relation: Musculoskeletal fitness is inversely associated with established and emerging cardiovascular disease risk factors, back pain and with bone mineral content and density. Musculoskeletal improvements from childhood to adolescence are negatively associated with changes in overall adiposity.

Equipment: A hand dynamometer with adjustable grip (Sammons Preston, Jamar adjustable hand dynamometer).

Performance: The adjustable grip handle was adjusted to be in line with the 2nd, 3rd and 4th digit metacarpophalangeal joint for each participant. The child gradually and

continuously squeezed the dynamometer for 3 seconds, and performed the test twice (alternately with both hands) with the most comfortable grip span allowing short rest between measures. The elbow had to be in full extension and there was no contact between the hand holding the dynamometer and any other part of the body.
Instructions: Hold the dynamometer with one hand, flex the shoulder to 180 degrees (arm vertical). Squeeze the dynamometer as forcefully as you can while bringing the arm to 0 degrees of shoulder flexion (arm on the side of the body). The squeeze is gradual and continuous for the count of 3 seconds. It must take 3 seconds to reach the end position.
Practice and number of test trials: The tester demonstrated the correct performance. Thereafter, both hands were tested twice, and the best result (of each hand) was used as the value scored. The indicator was returned to zero after each attempt.
Scoring: The result was expressed in kilograms of force (kgf), e.g. 24.0 kgf

i. Standing long jump

Purpose: To measure lower body explosive strength.
Health relation: Musculoskeletal fitness is inversely associated with established and emerging cardiovascular disease risk factors, back pain and with bone mineral content and density. Musculoskeletal improvements from childhood to adolescence are negatively associated with changes in overall adiposity.
Equipment: Non-slippery hard surface, adhesive tape and a tape measure.
Performance: Jump forward for a distance from a standing start.
Instructions: The participants were instructed to stand with their feet shoulder-width apart, with their toes just behind the starting line. They were told to bend their knees and arms in front of them, parallel to the ground. As they swing both arms, they should push off vigorously and jump forward as far as possible. They were advised to try and land with the feet together and to stay upright.
Practice and number of test trials: The tester demonstrated the correct way to perform the movement. The test was done twice and the best attempt was recorded.
Measurement: A tape measure was laid out in the direction of the jump. The starting line was drawn perpendicular to the tape measure. Lines were drawn, from the start line, every 10cm starting at one metre. The distance jumped was measured from the

start line to the point where the back of the heel lands on the ground. A further attempt was allowed if the child fell backwards or touched the floor with another part of the body.

Scoring: The result was measured to the nearest cm, e.g. a jump of 1 m 56 cm scores 156cm.

Motor fitness

j. 4x10m shuttle run test

Purpose: To measure speed of movement, agility and coordination (motor fitness).

Health relation: Improvements in speed/agility seem to have a positive effect on skeletal health.

Equipment: This test was performed on grass for both schools since there is no appropriate indoor venue at Masibambane and in the majority of schools in SA. The tester required a stopwatch, adhesive tape, tape measure, three cones of different colours and four cones.

Performance: This is a running and turning (shuttle) test at maximum speed (4x10 m). Cones are placed at 10m intervals in a zig-zag formation (see Figure 2).

Instructions: To start off only one foot needs to be behind the line. When the start was given the participants were told to run as fast as they possibly could in the formation shown in Figure 2 and complete the task as fast as possible.

Graphic description.

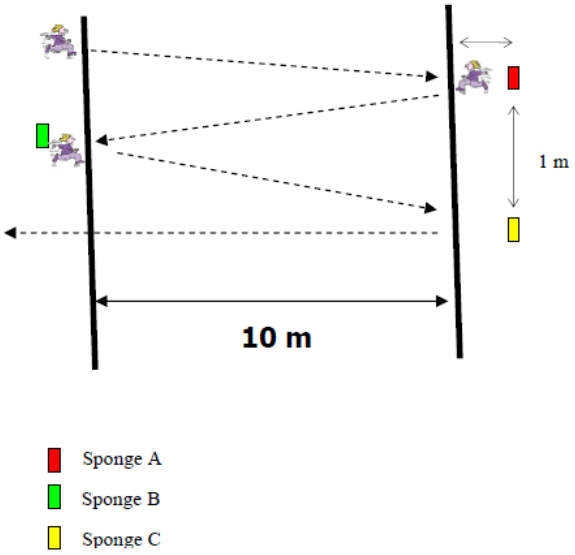


Figure 2A graphic representation of the 4 x 10m shuttle **(The Alpha Project, www.thealphaproject.net)**.

Practice and number of test trials: The tester demonstrated the correct execution of the task. Two trials were performed and the best time scored.
Measurement: Both feet had to cross the line each time, the participant remained in the required path and the turns were made as quickly as possible. The number of cycles were called out after each one was completed. The test was completed when the participant crossed the finishing line with one foot. If the participant slipped or slid during the test he was stopped and the test was repeated after 2 minutes.
Scoring: The time taken to complete the test was recorded and the result was scored in seconds with one decimal, e.g. 21.6 sec

Cardiorespiratory fitness

k. 20m shuttle run test

Purpose: To assess cardiorespiratory fitness.
Health relation: High cardiorespiratory fitness during childhood and adolescence is strongly associated with a healthier current and future cardiovascular health.
Equipment: Grass field large enough to mark out a 20m track, cones lined up using a tape measure, CD-player and a pre-recorded CD of the test protocol.

Performance: Participants were required to run between 2 lines (20m apart) in time with an audio signal. The initial speed of the signal is 8.5 km/h and is increased by

0.5 km/h per minute (1 minute is equal to 1 level). The test finished when the child failed to reach the end lines concurrent with the audio signals on 2 consecutive occasions. Otherwise, the test ended when the child stopped because of fatigue. This test was done once.

Instructions: The shuttle run test gives an indication of the individual's maximal aerobic capacity/endurance capacity. The participants ran there and back along a 20m track until they could no longer keep up. Speed was controlled by means of a tape that emitted bleeping sounds at regular intervals. They were instructed to pace themselves so that they were on one end of the 20m track when they heard the bleeping sound. Accuracy to within one or two metres was enough. They were required to touch the line at the end of the track with one foot, turn sharply and run in the opposite direction. At first, the speed was low but it increased slowly and steadily every minute. Individuals were aiming to follow the set rhythm for as long as they could. They were advised to stop when they could no longer keep up with the set rhythm or felt unable to complete the one minute period. They were told to remember the number announced by the recording when they came to a stop as this was their score.

Practice and number of test trials: Only one trial was performed.

Measurement: A space of at least one metre at either end of the track was allocated for the participants to turn comfortably. The two ends of the 20m track were clearly marked.

Scoring: After the participant had stopped, the last completed score was retained. *Example:* a score of stage 6.5 means that the individual could only keep up with the bleep for 6.5 stages.

3.5 Ethics

Ethical clearance was granted (M120719) by Human Research Ethics Committee (HREC) of the University of the Witwatersrand before the commencement of the research (Appendix V).

Eligible participants were invited to participate in the study. This was on a voluntary basis and the participants were informed of their right to withdraw from the study at any point without prejudice. Appendix VI is a child information sheet that was handed out to the minors after the presentation. The potential participants were also given a

parent information sheet which explained to the parents what the research was about (Appendix VII).

Since this study was dealing with minors, consent forms (Appendix VIII) were signed by parents/guardians. The participants were asked to sign an assent form (Appendix IX) before they could take part in the study. The headmasters of both schools gave permission for the research to be conducted in their institutions (Appendix II and III).

The information obtained via this study was kept confidential and in a safe place. Personal details may be collected for a follow up, however, only the researcher and supervisor will have access to any of this information. Should the need arise for this information or the results of the study to be published, the identity of the participants will not be released.

3.6. Data Analysis

Descriptive statistics was used to interpret the descriptive data and represented in terms of the mean as well as the standard deviation (SD) and the minimum and maximum values**.** Microsoft office excel 2010 was used to summarise the physical activity data and compute the figures. An independent t-test was used to statistically compare the two schools using STATISTICA version 10.1. Statistical significance was set at $p<0.05$ for all the tests.

Chapter Four

4. Results

Seventy Five grade 6 boys and seventy five grade 7 boys from St John's were invited to participate in the study and only twenty six grade 6 (n=26; age=12) and twenty eight grade 7 (n=28; age=13) completed the study. Twenty six grade 6 boys and twenty four grade 7 boys from Masibambane were invited to participate in the study and only eleven (n=11; age=12) and twelve (n=12; age=13) completed the study. In this study only 7% of the participants from St John's College were black and all the Masibambane participants were black. Therefore, the St John's results are more representative of a white population.

4.1. Anthropometric data

4.1.1. Grade 6 anthropometric data

The average anthropometric data for St John's grade 6 boys is shown in Table 2 below. Twenty six boys were tested, and the mean, minimum and maximum value, as well as standard deviation (SD) is depicted below.

Table 2 St John's Anthropometric Data (n=26; age 12)

Variable	Mean (±SD)	Minimum	Maximum
Weight (kg)	43.6 (±7.4)	34.2	66.1
Height (cm)	153.1(±7.2)	142.1	168.1
BMI (kg/m²)	18.5 (±2.2)	15.5	24.7
Waist (cm)	65 (±5)	58.0	79.3
Triceps (mm)	12 (±5)	4.4	27.5
Sub scapular (mm)	6.2 (±23)	3.0	16.1

Sum (Triceps & subscapular)(mm)	18.3 (±7.3)	9.2	41.2
Chest (mm)	7 (±4.2)	2.3	20.0
Abdominal (mm)	11.7 (±7.3)	2.8	35.3
Thigh (mm)	16.8 (±6.9)	7.4	37.0
Body Fat (%)	17.3 (±6.1)	8.8	34.5

BMI= Body Mass Index

The average anthropometric data for the Masibambane grade 6 boys are shown in Table 3 below. Eleven boys, aged 12 years old were tested and the mean, SD and range are shown in the table below.

Table 3 Masibambane Anthropometric Data (n=11; age 12)

Variable	Mean (±SD)	Minimum	Maximum
Weight (kg)	41.5 (±13.4)	29.8	77.1
Height (cm)	149 (±9)	137.5	164.0
BMI (kg/m²)	18.4 (±4)	15.3	28.7
Waist (cm)	62.7 (±8.5)	54.5	84.2
Triceps (mm)	12.6 (±7.1)	6.0	29.5
Sub scapular (mm)	9.3 (±7.9)	5.0	32.4
Sum (Triceps & subscapular)(mm)	21.9 (±14.6)	11.4	61.9
Chest (mm)	7.7 (±6.9)	3.5	26.0
Abdominal (mm)	13.1 (±9.6)	5.8	34.8
Thigh (mm)	18.3 (±9.7)	8.1	40.5
Body Fat (%) (for white males equation)	19.4 (±9.3)	11.1	42.5
Body Fat (%)(for black males equation)	18.6 (±9.3)	10.3	41.7

BMI= Body Mass Index

4.1.2. Grade 7 anthropometric data

Table 4 below shows the mean, minimum and maximum values as well as the standard deviation for the anthropometric data of the St John's grade 7 boys.

Table 4 St John's Anthropometric Data (n=28; age = 13)

Variable	Mean (±SD)	Minimum	Maximum
Weight (kg)	51.6 (±8.5)	36.6	65.3
Height (cm)	160.9 (±10.3)	137.0	181.1
BMI (kg/m²)	19.9 (±2.2)	16.3	24.2
Waist (cm)	69.3 (±5)	60.3	79.8
Triceps (mm)	10.8 (±4.8)	4.8	26.0
Sub scapular (mm)	6.7 (±3.4)	3.8	22.2
Sum (Triceps & subscapular)(mm)	17.6 (±7.8)	8.6	48.2
Chest (mm)	6.7 (±4.4)	3.2	22.2
Abdominal (mm)	11.9 (±8.1)	4.2	36.0
Thigh (mm)	14.6 (±7.7)	4.1	37.0
Body Fat (%)	16.5 (±6.3)	8.1	38.0

BMI= Body Mass Index

The anthropometric data for the Masibambane grade 7 boys are shown in Table 5 below.

Table 5 Masibambane Anthropometric Data (n=12; age =13)

Variable	Mean (±SD)	Minimum	Maximum
Weight (kg)	42.5 (±5.1)	33.0	52.4
Height (cm)	154.7 (±4.5)	147.6	163.0
BMI (kg/m²)	17.7 (±1.7)	14.9	20.6
Waist (cm)	42.5 (±5.1)	33.0	52.4
Triceps (mm)	8.6 (±3.4)	5.2	16.3
Sub scapular (mm)	6.4 (±1.7)	4.6	9.8
Sum (Triceps & subscapular)(mm)	15.1(±4.5)	10.0	24.7
Chest (mm)	5.3 (±2.2)	3.7	11.9
Abdominal (mm)	8.3 (±4.9)	4.7	22.7

Thigh (mm)	13.2 (±4.8)	7.6	23.3
Body Fat (%) (for white males equation)	14.6 (±4.3)	9.5	23.3
Body Fat (%)(for black males equation)	13.8 (±4.3)	8.7	22.5

BMI= Body Mass Index

4.1.3. All anthropometric data

The two tables below (Table 6 and 7) show the mean data for the combined age groups, for St John's and Masibambane, respectively. For both age groups, St John's boys were heavier (47.8±8.9) than their Masibambane counterparts (42.1±9.7). They were also taller (157.1±9.7) than the Masibambane boys (151.9±7.4). The St John's boys had an average BMI of 19.2 (±2.3) and a BF% of 16.9 (±6.2). On the other hand, the Masibambane boys had an average BMI of 18.1(±3.0) and a BF% of 16.9(±7.4).

Table 6 All St John's Anthropometric Data (n=54)

Variable	Mean (±SD)	Minimum	Maximum
Weight (kg)	47.8 (±8.9)	34.2	66.1
Height (cm)	157.1(±9.7)	137.0	181.1
BMI (kg/m²)	19.2 (±2.3)	15.5	24.7
Waist (cm)	67.2 (±5.4)	58.0	79.8
Triceps (mm)	11.4 (±4.9)	4.4	27.5
Sub scapular (mm)	6.5 (±3.2)	3.0	22.2
Sum (Triceps & subscapular)(mm)	17.9 (±7.5)	8.6	48.2
Chest (mm)	6.8 (±4.2)	2.5	22.2
Abdominal (mm)	11.8 (±7.7)	2.8	36.0
Thigh (mm)	15.7 (±7.4)	4.1	37.0
Body Fat (%)	16.9 (±6.2)	8.1	38.0

BMI= Body Mass Index

Table 7 All Masibambane anthropometric data (n=23)

Variable	Mean (±SD)	Minimum	Maximum
Weight (kg)	42.1 (±9.7)	29.8	77.1
Height (cm)	151.9 (±7.4)	137.5	164.0
BMI (kg/m²)	18.1 (±3.0)	14.9	28.7
Waist (cm)	52.2 (±6.56)	54.5	84.2
Triceps (mm)	10.5 (±5.7)	5.2	29.5
Sub scapular (mm)	7.8 (±5.6)	4.6	32.4
Sum (Triceps & subscapular)(mm)	18.3 (±10.9)	10.0	61.9
Chest (mm)	6.5 (±5.1)	3.5	26.0
Abdominal (mm)	10.6 (±7.7)	4.7	34.8
Thigh (mm)	15.6 (±7.8)	7.6	40.5
Body Fat (%) (for black males equation)	16.9 (±7.4)	9.5	42.5

BMI= Body Mass Index

The mean waist circumference of the St John's boys (67.2±5.4) falls within the 'average' range. The Masibambane mean waist circumference 52.2 (±12.3), however, falls within the 'very low' range of waist circumference. The mean BF% of the St John's boys (16.9±6.2) and Masibambane boys (16.9±7.4), both fall within the 'average' range of the alpha reference values (Appendix IV).

The mean BMI of the St John's boys, 19.2 (±6.2) and Masibambane boys 18.0 (±3.0) fall in the 'average' and 'low' ranges of BMI respectively, according to the Alpha reference values (Appendix IV). Figure 2 shows the distribution of BMI scores for all

the St John's boys and all the Masibambane boys according to the ALPHA normative values for BMI of boys that are 13 years old and younger.

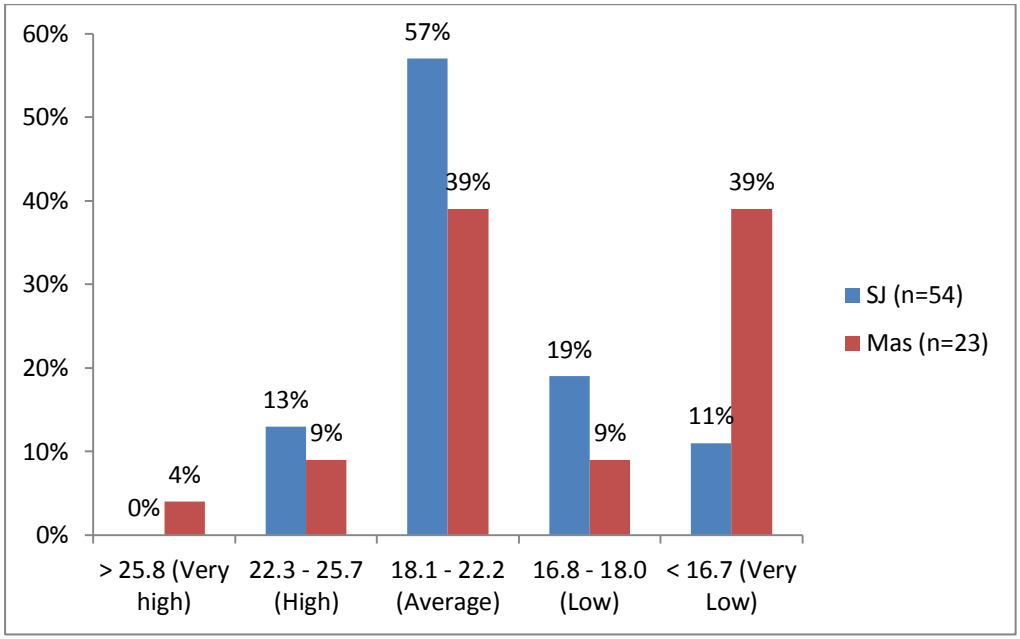


Figure 3 BMI classification of both schools based on the ALPHA Normative Data

Four percent (n=1) of the Masibambane boys fall within the 'very high' BMI range. The bulk of the boys in each school, 57% of St John's and 39% of Masibambane boys, fall within the 'average' BMI range. A higher number of Masibambane boys (39%) fell within the 'very low'BMI range, when compared to their St John's counterparts (11%).

4.2. Strength and fitness data

4.2.1. Grade 6 strength and fitness data

Handgrip strength, standing long jump (LJ), motor fitness (shuttle run) and cardiorespiratory fitness (bleep test) values are shown in the two tables below (Table 8 and 9), for the St John's and Masibambane grade 6 boys, respectively.

Table 8 St John's Strength and Fitness Data (n=26; age = 12)

Variable	Mean (±SD)	Minimum	Maximum
Hand grip (right side) (Kgf)	25.5 (±5.5)	13.0	35.5
Hand grip (left side) (Kgf)	23.3 (±5.8)	10.0	33.0
Standing LJ (cm)	169.0 (±20.6)	139.0	211.0
Motor fitness (sec)	11.8 (±0.8)	10.2	13.6
Cardiorespiratory fitness (stage)	6.7 (±1.3)	5.2	10.6

LJ=Long Jump; Motor fitness = 4x10m shuttle; Cardiorespiratory fitness = 20m shuttle run

Table 9 Masibambane Strength and Fitness Data (n=11; age = 12)

Variable	Mean (±SD)	Minimum	Maximum
Hand grip (right side) (Kgf)	23.2 (±5.1)	16.0	32.0
Hand grip (left side) (Kgf)	22.3 (±6.1)	14.0	33.0
Standing LJ (cm)	157.2 (±16.9)	131.0	188.0
Motor fitness (sec)	12.4 (± 0.6)	11.4	13.3
Cardiorespiratory fitness (stage)	4.1 (±2.2)	2.2	9.8

LJ=Long Jump; Motor fitness = 4x10m shuttle; Cardiorespiratory fitness = 20m shuttle run

4.2.2. Grade 7 strength and fitness data

The strength and fitness data for St John's and Masibambane grade 7 boys are shown in Table 10 and 11 below.

Table 10 St John's Strength and Fitness Data (n=28; age = 13)

Variable	Mean (±SD)	Minimum	Maximum
Hand grip (right side) (Kgf)	33.2 (±7.5)	16.0	47.0
Hand grip (left side) (Kgf)	32.0 (±7.1)	16.5	44.0
Standing LJ (cm)	184.5 (±24.2)	140.0	238.0
Motor fitness (sec)	11.3 (±0.8)	10.3	13.0
Cardiorespiratory fitness (stage)	8.1 (±1.4)	5.1	10.5

LJ=Long Jump; Motor fitness = 4x10m shuttle; Cardiorespiratory fitness = 20m shuttle run

Table 11 Masibambane Strength and Fitness Data (n=12; age = 13)

Variable	Mean (±SD)	Minimum	Maximum
Hand grip (right side) (Kgf)	26.5 (±4.4)	19.0	36.0
Hand grip (left side) (Kgf)	26.8 (±4.8)	19.0	38.0
Standing LJ (cm)	170.3 (±14.4)	145.5	192.0
Motor fitness (sec)	11.6 (±0.7)	10.6	12.7
Cardiorespiratory fitness (stage)	6.6 (±2.0)	3.4	9.8

LJ=Long Jump; Motor fitness = 4x10m shuttle; Cardiorespiratory fitness = 20m shuttle run

4.2.3. All strength and fitness data

The combined strength and fitness data for both age groups are shown in the tables below, for St John's and Masibambane, respectively.

Table 12 Combined grade 6 & 7 St John's Strength and Fitness Data (n=54)

Variable	Mean (±SD)	Minimum	Maximum
Hand grip (right side) (Kgf)	29.5 (±7.6)	13.0	47.0
Hand grip (left side) (Kgf)	27.8 (±7.8)	10.0	44.0
Standing LJ (cm)	177.0 (±23.7)	139.0	238.0
Motor fitness (sec)	11.6 (±0.8)	10.2	13.7
Cardiorespiratory fitness (stage)	7.4 (±1.5)	5.1	10.6

LJ=Long Jump; Motor fitness = 4x10m shuttle; Cardiorespiratory fitness = 20m shuttle run

Table 13 Combined grade 6 & 7 Masibambane Strength and Fitness Data (n=23)

Variable	Mean (±SD)	Minimum	Maximum
Hand grip (right side) (Kgf)	24.9 (±5.0)	16.0	36.0
Hand grip (left side) (Kgf)	24.6 (±5.8)	14.0	38.0
Standing LJ (cm)	164.1 (±16.7)	131.0	192.0
Motor fitness (sec)	12.0 (±0.76)	10.6	13.3
Cardiorespiratory fitness (stage)	5.4 (±2.4)	2.2	9.8

LJ=Long Jump; Motor fitness = 4x10m shuttle; Cardiorespiratory fitness = 20m shuttle run

4.3. Comparison of the two schools

4.3.1. A comparison of the anthropometric data

Table 14 below shows a comparison of the anthropometric data expressed as a mean and SD for the grade 6 boys from both schools. The St John's boys recorded a higher average weight, height, BMI and waist circumference scores compared to their Masibambane counterparts. Furthermore, the body fat percentage (BF %) of the Masibambane group was higher than the St John's boys for both equations (when calculated with both the black and white equations). There was, however, no statistical difference (at $p<0.05$) between the grade 6 boys' anthropometric data.

Table 14 A Comparison of Anthropometric Data between St John's and Masibambane College for age 12

Variable	St John's (n = 26) Mean (±SD)	Masibambane (n = 11) Mean (±SD)	p-value
Weight (kg)	43.6 (±7.42)	41.6 (±13.9)	P=0.546
Height (cm)	153.1 (±7.2)	149.0 (±9.0)	P=0.145
BMI (kg/m²)	18.5 (±2.3)	18.4 (±4.0)	P=0.913
Waist (cm)	65.0 (±5.1)	62.7 (±8.4)	P=0.316
Body Fat (%) (white males equation)	17.3 (±6.1)	19.4 (±9.3)	P=0.425
Body Fat (%) (black males equation)	N/A	18.6 (±9.3)	P=0.623

*indicates statistical significance ($p<0.05$); BMI = Body Mass Index

Table 15 below is a comparison of the anthropometric data expressed as a mean and SD for the grade 7 boys from both schools. The St John's grade 7 boys were statistically significantly heavier, with significantly greater BMI and waist circumference compared to their Masibambane counterparts (at $p<0.05$). Height and BF % were also higher for the St John's boys even though this was not statistically significant.

Table 15 A Comparison of Anthropometric Data between St John's and Masibambane College for age 13

Variable	St John's (n = 28) Mean (±SD)	Masibambane (n = 12) Mean (±SD)	p-value
Weight (kg)	51.6 (±8.5)*	42.5 (±5.1)	P=0.001
Height (cm)	160.9 (±10.3)	154.7 (±4.5)	P=0.05
BMI (kg/m²)	19.9 (±2.2)*	17.7 (±1.7)	P=0.004
Waist (cm)	69.3 (±5.0)*	42.5 (±5.1)	P=0.000
Body Fat (%) (white males equation)	16.5 (±6.3)	14.6 (±4.3)	P=0.166
Body Fat (%) (black males equation)	N/A	13.8 (±4.3)	P=0.335

*indicates statistical significance (p<0.05); BMI = Body Mass Index

Table 16 below is a comparison of the combined grade 6 & 7 anthropometric data from both schools expressed as a mean and SD. When comparing the combined age groups, St John's boys were heavier and taller, but this was not statistically significant. However, the St John's boys had a statistically significantly greater waist circumference compared to the Masibambane boys at p<0.05.

Table 16 A Comparison of Anthropometric Data between both Schools for both age groups

Variable	St John's (n = 54) Mean (±SD)	Masibambane (n = 23) Mean (±SD)	P value
Weight (kg)	47.8 (±8.9)	42.1 (±9.7)	P=0.01
Height (cm)	157.1 (±9.7)	151.9 (+7.4)	P=0.02
BMI (kg/m²)	19.2 (±2.3)	18.0 (+3.0)	P=0.07
Waist (cm)	67.2 (± 5.4)*	62.6 (±12.3)	P=0.002
Body Fat (%) (white males equation)	16.9 (±6.2)	16.9 (±7.4)	P=0.99
Body Fat (%) (black males equation)	N/A	16.1 (±7.4)	P=0.62

*Indicates statistical significance (p<0.05); BMI = Body Mass Index

4.3.2. A comparison of the strength and fitness data

Table 17 below is a comparison of the strength and fitness data expressed as a mean and SD for the grade 6 boys. There was a statistically significantly greater

cardiorespiratory fitness observed in the St John's group compared to the Masibambane group.

Table 17 A Comparison of Strength and Fitness Data between St John's and Masibambane College for the grade 6 boys.

Variable	St John's (n = 26) Mean (±SD)	Masibambane (n = 11) Mean (±SD)	P value
Hand grip (right side) (Kgf)	25.5 (±5.5)	23.2 (±5.1)	P=0.24
Hand grip (left side) (Kgf)	23.3 (±5.8)	22.3 (±6.1)	P=0.64
Standing LJ (cm)	169.0 (±20.7)	157.2 (±16.9)	P=0.10
Motor fitness (sec)	11.8 (±0.9)	12.4 (±0.6)	P=0.05
Cardiorespiratory fitness (stage)	6.7 (±1.4)*	4.1 (±2.2)	P=0.001

*indicates statistical significance (p<0.05); LJ=Long Jump; Motor fitness = 4x10m shuttle; Cardiorespiratory fitness = 20m shuttle run

Table 18 below is a comparison of the strength and fitness data expressed as a mean and SD for the grade 7 boys. The St John's group proved to be statistically significantly stronger with regards to hand grip strength and a statistically significantly greater cardiorespiratory fitness compared to their Masibambane counterparts at p<0.05.

Table 18 A Comparison of Strength and Fitness Data between St John's and Masibambane College for the grade 7 boys.

Variable	St John's (n = 28) Mean (±SD)	Mabibambane (n = 12) Mean (±SD)	P value
Hand grip (right side) (Kgf)	33.2 (±7.5)*	26.5 (± 4.4)	P=0.006
Hand grip (left side) (Kgf)	32.0 (±7.1)*	26.8 (±4.8)	P=0.02
Standing LJ (cm)	184.5 (±24.2)	170.3 (±14.4)	P=0.06
Motor fitness (sec)	11.3 (± 0.8)	11.6 (±0.7)	P=0.24
Cardiorespiratory fitness (stage)	8.1 (±1.4)*	6.6 (±2.0)	P=0.01

*indicates statistical significance (p<0.05); LJ=Long Jump; Motor fitness = 4x10m shuttle; Cardiorespiratory fitness = 20m shuttle run

Table 19 below is a comparison of all the boys from each school, it shows their strength and fitness data expressed as a mean and SD. The St John's group scored statistically significantly greater in the right arm hand grip strength, standing long jump, motor fitness and had a greater cardiorespiratory fitness compared to their Masibambane counterparts at p<0.05.

Table 19 A comparison of the Strength and Fitness Data between both schools for both age groups

Variable	St John's (n = 54) Mean (±SD)	Masibambane (n = 23) Mean (±SD)	P value
Hand grip (right side) (Kgf)	29.5 (±7.6)*	24.9 (±5.0)	P=0.01
Hand grip (left side) (Kgf)	27.8 (±7.8)	24.6 (±5.8)	P=0.08
Standing LJ (cm)	177.0 (±23.7)*	164.1 (±16.7)	P=0.02
Motor fitness (sec)	11.6 (±0.8)*	12.0 (±0.7)	P=0.03
Cardiorespiratory fitness (stage)	7.4 (±1.5)*	5.4 (±2.4)	P=0.001

*Indicates statistical significance ($p<0.05$); LJ=Long Jump; Motor fitness = 4x10m shuttle;

Cardiorespiratory fitness =20m shuttle run

4.4. Physical Activity Levels

The primary care giver of the each participant was also required to complete the Physical Activity Questionnaire for children (C-PAQ) – (Appendix I). These were recorded as the total number of minutes that the participants spent doing sporting activities, leisure time activities, school activities and sedentary activities at home. In this section the data from the two grades were combined for analysis.

It is important to note that the two schools had different sporting codes going on at the time the testing was done. Therefore, the focus should be on the amount of time spent doing physical activity rather than the type of activity being done.

Table 20 below indicates the average amount of time that the participants from each school spent in the different physical activity domains per day. The Masibambane boys spent more time doing sporting, leisure time and school activities than the St John's boys. The St John's boys spent more time doing sedentary activities compared to the Masibambane boys.

Table 20 Time spent in various physical activity domians for both schools

Activity	St John's (N=54)	Masibambane (N=23)
	Average Minutes per day	Average Minutes per day
Sports Activities	60.5	73.7
Leisure time activities	89.7	144.1
Activities at school	17.3	20.5
Sedentary activities	242.6	147.3

Table 21 below shows that 80% of St John's boys were meeting the recommended daily physical activity guideline of 60 minutes per day (Micheli et al., 2011; Ottawa, 2002; Janssen, 2007). All the Masibambane boys met the recommended daily physical activity guidelines of 60 minutes per day.

Table 21 Amount of children meeting the recommended daily physical activity guidelines

	St John's (N=54) n (%)	Masibambane (N=23) n (%)
Active	43 (80%)	23 (100%)
Inactive	11 (20%)	0 (0%)

4.5.1 Sporting activities

Figure 4 shows the average amount of time that the participants from each school spent doing sporting activities over a period of 7 days. The Masibambane boys spent significantly more time running (p=0.02), playing soccer (p=0.003), rugby (p=0.002) and dancing (p=0.001). St John's boys spent significantly more time swimming (p=0.01) when compared to the Masibambane group.

The average amount of time that the boys from each school spend doing each sport seems to follow the same trend regardless of age group. The amount of time spent running, playing rugby, basketball, racquet sports, soccer and dancing by the Masibambane boys is greater than the St John's boys. The St John's boys reported

spending more time swimming, playing cricket and waterpolo. None of the St John's boys reported doing any running over and above what they are required to do for PE every Friday. None of them reported doing any form of formal dancing.

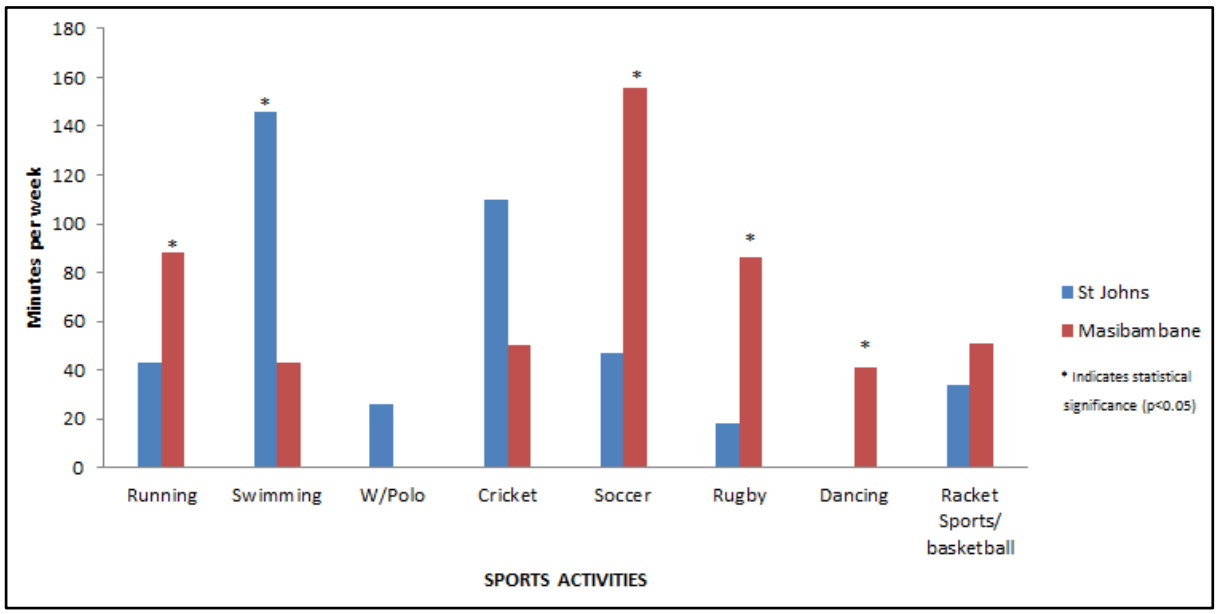


Figure 4 A comparison of the amount of time spent doing sporting activities between the two schools

4.5.2 Leisure Time Activities

Figure 5 shows the average amount of time that the participants from each school spent doinglLeisure type activities over a period of 7 days. The Masibambane groups spent statistically significantly more time riding their bikes (p=0.001), playing in the playground (p=0.001), doing house chores (p=0.001) and exercising by walking (p=0.001).

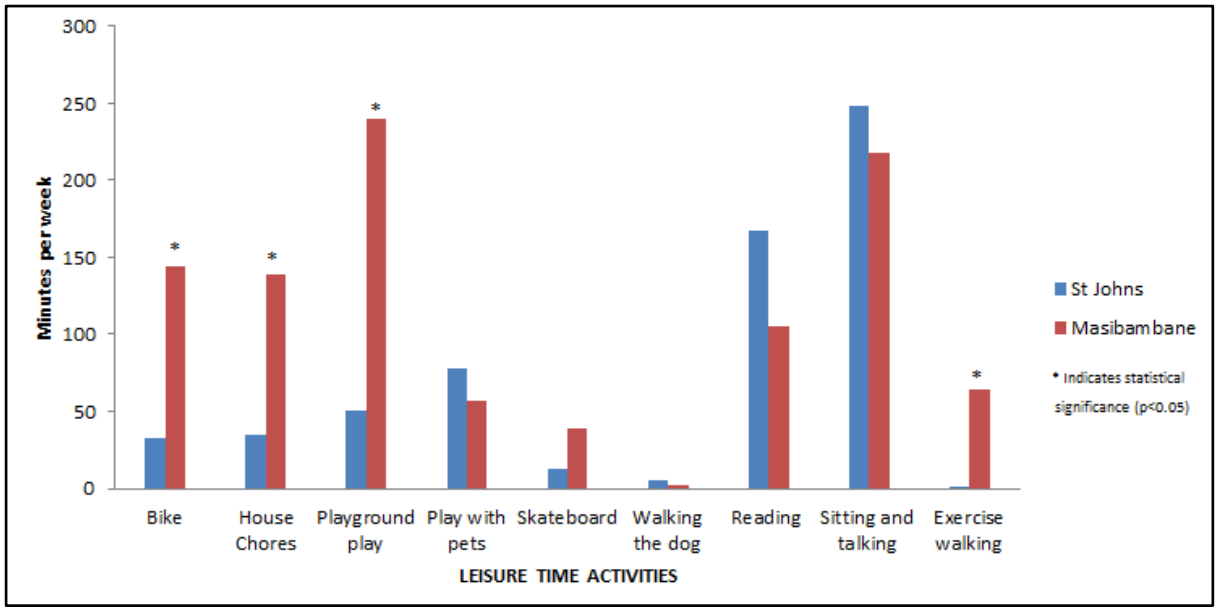


Figure 5 A comparison of leisure time activities between the two schools

4.5.3 School Activities

Figure 6 shows the average amount of time that the participants from each school spend doing PE (PE), walking to school or cycling to school over a period of seven days. The Masibambane group spent statistically significantly more time walking or cycling to school than their St John's Counterparts.

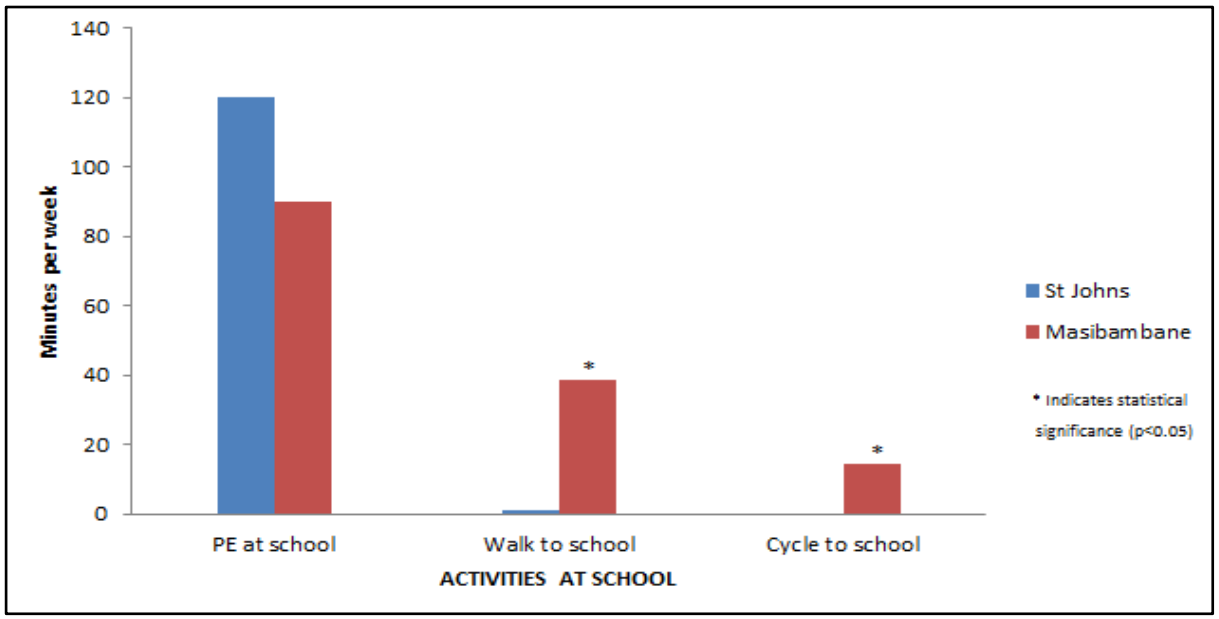


Figure 6 A comparison of school-related activities between the two schools

4.5.4 Sedentary Home Activities

Figure 7 shows the average amount of time that the participants in each group spent doing sedentary type activities at home over a period of 7days. The St John's group spent statistically significantly more time doing homework (p=0.001), playing computer games (p=0.01), spending time on the internet (p=0.001) and travelling to school by car (p=0.003).

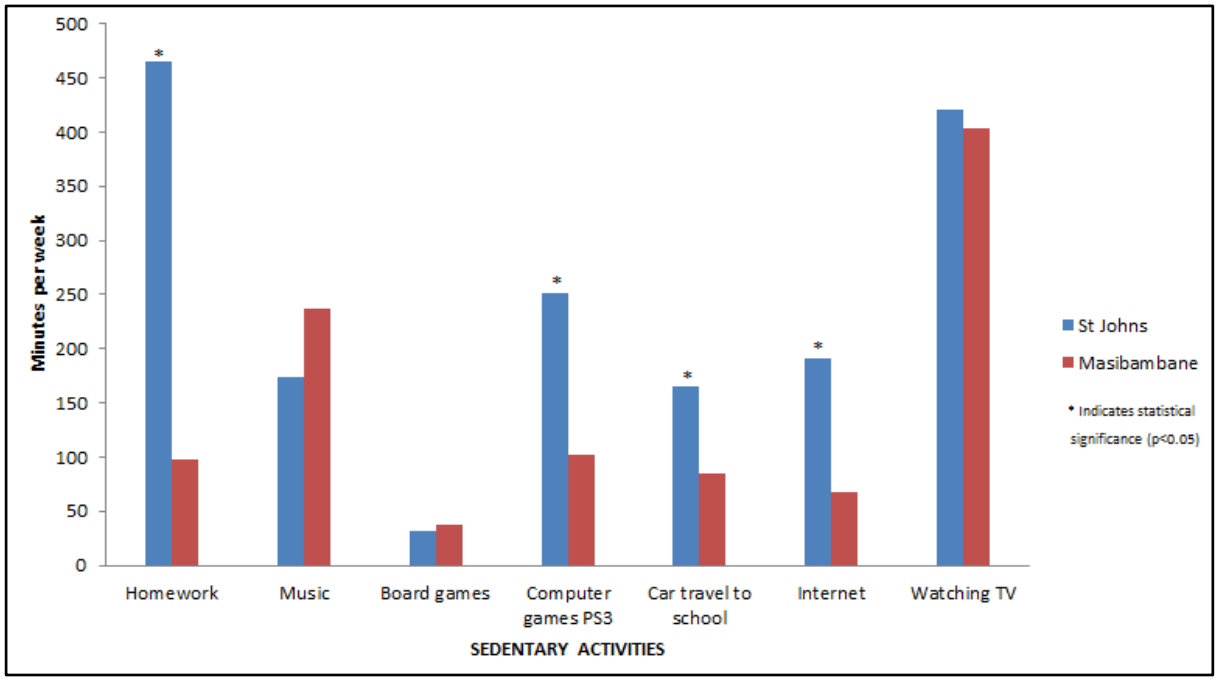


Figure 7 A comparison of sedentary activities between the two schools

Chapter Five

5. Discussion

5.1 Anthropometric

There is a rapid increase in the prevalence of chronic non-communicable diseases in developing countries (Kelishadi, 2007). Obesity, as a risk factor for non-communicable disease, continues to be a global public health concern (Kruger et al., 2005). As far back as 1994, researchers had already identified that countries then in economic transition, such as China, SA and Brazil, were particularly affected and were experiencing an increased rate of obesity across all economic levels and age groups (Popkin, 1994). Armstrong et al., (2006) found that South African children were showing trends of obesity and overweight that are similar to what developed countries were experiencing 10 years before their study.

The anthropometric results of this study showed that, for both schools, boys were shorter and weighed less than the values reported by Espana-Romero et al., (2010) using the ALPHA test protocol. The current study's participants were 10-15kg lighter and approximately 10cm shorter than the 'APLHA Study', however, this was expected, as the 'ALPHA Study' authors' results spanned boys from 12 to 18 year olds. In a similar study by Ortega et al., (2011) normative values were reported for children ages 12-18 years based on 3428 participants. The mean age for that study was 14.9, and expectedly the results showed the Eurpoeans to be heavier (59.8±12.7) and taller (166.4±9.1) compared to the current study's younger population.

After narrowing the comparison to the specific age groups, both groups were below the 50th weight-for-age percentiles (Gallahue & Ozman, 1995) for all ages. For height, St John's boys fell within the 50th percentile, whilst the Masibambane boys fell just below the 50th percentile (Gallahue & Ozman, 1995), for both age groups. St John's boys had similar results to their 13 year old developed-country counterparts (Sunnegardh & Bratteby, 1987). Important to note is that at age 12, the differences between the St John's and Masibambane boys were small and statistically insignificant; however, there was a trend for the differences between the two groups

to get larger, with older age. It appears that with the onset of adolescence, the Masibambane boys tended to fall behind their St John's and overseas counterparts.

Body mass index is often used to determine overweight and obesity, as it is easy to measure, and there is a large amount of research with which to compare these measures to (Moreno et al., 2005). It cannot be considered in isolation for diagnostic purposes but for health screening purposes it is useful to combine BMI and other anthropometric measurements to determine risk factors for cardiovascular disease and other hypokinetic diseases (http://www.cdc.gov). The current study found that only 4% of the Masibambane boys fell into the very high BMI range and 9% were in the high range, whereas 13% of the St John's boys fell into the high BMI range. These findings are similar to that of the South African national food consumption survey (Labadarios, 2001) and the Thusa Bana study (Mukuddem-Petersen & Kruger, 2004) which found that 8% and 5.6% of the children, in the respective studies, recorded high BMI values. Similarly, a study by Monyeki et al., (2012) found an 8% overweight prevalence in 14 year old boys. In the same study, 44% of the boys were categorised as underweight. The current study found a similar trend, and interestingly, more boys from Masibambane (31%) fell into the low range, when compared to their St John's counterparts (11%).

Research suggests that BMI differs across various ethnic groups. For example, Mukuddem-Petersen & Kruger (2004) reported BMI values based on the ethnicity of the participants. They reported that 14.2% of white children and 7.1% of black children had a high prevalence of overweight and obesity. Similarly, in the current study, 13% of the white children and 9% of the black children had a high prevalence of overweight.

When comparing the two schools, this study found no significant differences between the grade 6 boys in the two schools. The St John's group did record higher weight, height, BMI and waist circumference values. These findings are similar to the findings of McVeigh et al., (2007), on a sample of black and white pre-pubertal, South African children in the Western Cape. These authors also found that white children were generally heavier (35.12±4.88) and taller (142.71±6.82) compared to their black counterparts (32.82±6.44 and 137.62±6.08 respectively).

In the current study, the older St John's group had statistically significantly higher weight, BMI and waist circumference scores when compared to the Masibambane group. Height and weight were also higher but with no statistical significance. These findings are similar to McVeigh et al., (2007), with regards to the white children (St John's) recording higher values. However, the findings of this study differ with regards to the significant findings, only height was significantly higher in the above mentioned study compared to weight in the current study. The other variables were not assessed in the other study since its primary focus was on bone mass accretion.

5.2 Physical fitness

Low physical fitness levels in children have been shown to be associated with adiposity, cardiovascular disease and future disease risk (Ortega et al., 2008). Conversely, improvements in physical fitness are encouraged to improve health, wellness and bone strength (Ortega et al., 2008). Based on the results of The HELENA Study (Ortega et al., 2011), compared to European children of the same age, the mean performances of the Masibambane boys fall within the 50th percentile for the grip strength test, whilst the St John's boys fell within the 70th percentile. A similar trend was found when comparing the current study to Australian normative data. St John's boys, aged 12 and 13, fell into the 60th and 90th percentile for their age group for grip strength respectively, whilst the Masibambane boy's fell within the 50th percentile for both age groups (Catley & Tomkinson, 2011).

St John's boys continued to perform well against their European counterparts in the standing long jump test (72nd percentile), and their Australian counterparts (70th and 80th percentile for 12 and 13 year olds respectively) (Catley & Tomkinson, 2011; Ortega et al., 2011).

Masibambane boys fell between the 60th and 70th European percentile in the standing long jump test, and in the 50th and 60th percentile for Australian 12 and 13 year olds respectively. Similar to the rest of the strength and fitness tests, the St John's boys outperformed their European counterparts (coming in the 72nd percentile) and the 12 and 13 year old Australian counterparts (coming in the 70th and 80th percentile for the respective age groups (Catley & Tomkinson, 2011; Ortega et al., 2011).

The Masibambane boys fell within the 60th percentile, whilst the St John's boys fell within the 75th percentile in the 4 x 10m shuttle run, when compared to their European boys of the same age (Ortega et al., 2011).

For cardiorespiratory fitness, the Masibambane boys fell within the 60th percentile compared to their European counterparts (Ortega et al., 2011) and 50th percentile and 70th percentile, for 12 and 13 year old respectively, when compared to their Australian counterparts (Catley & Tomkinson, 2011). Whilst the St John's boy's cardiorespiratory fitness was within the 75th European percentile, and between the 80th and 90th Australian percentile (Catley & Tomkinson, 2011; Ortega et al., 2011).

Therefore, it can be clearly seen that the St John's children were in the better performing range when compared to both the Masibambane and overseas children of the same age. Although the 12 year old St John's boys performed better on all strength and fitness tests compared to their Masibambane counterparts, only the cardio respiratory fitness was statistically significantly higher. However, the older St John's boys (13 year olds) performed significantly better on both bilateral hand grip and cardiorespiratory fitness tests. This data suggests that although strength and fitness differences exist between the two schools, these become more pronounced with age. Encouragingly, the average strength and fitness scores for the Masibambane boys were never below the 50th percentile when compared to their developed country peers.

SES may play a role in the performance disparity between the children in the current study. For example, findings were observed in a study from Northern Ireland where adolescents from a higher SES performed better in cardiorespiratory fitness than those with a lower SES (Mutunga et al., 2006). However, the research on the effect of SES on physical fitness remains controversial. In contrast, Jamenez-Pavon et al., (2010) showed boys from a low SES performed better for muscular strength and aerobic endurance, using the Eurofit Test Battery.

There could be a number of reasons why the St John's group scored higher in these tests. Based on the bigger body size the St John's boys are expected to perform better than the Masibambane boys in the grip strength test. They spend more time

doing supervised and structured fitness training. They also compete in different sports on a weekly basis during the course of the year. The Masibambane boys do not have enough numbers at the school and also come from a sector of society where interschool weekly sports competitions are not the norm. Their sports involvement is predominantly recreational and participation driven as part of their PE (PE) structure at the school. The PE program at St John's is structured to address skill improvement, strength, agility and endurance development in multiple sporting codes. The St John's boys have more time allocated to PE at school compared to the Masibambane boys. Thus, the structure and amount of sport and PE in school may explain why the St John's boys outperformed not only their Masibambane counterparts, but also their peers in developed countries.

5.2 Physical activity Levels

There are numerous benefits for the participation in regular physical activity, especially during the primary school years. For example, physical activity has been shown to reduce cardiovascular disease risk factors, improve bone health and prevent obesity (Biddle et al., 2004). In fact, children are encouraged to accumulate at least 60 minutes of moderate physical activity per day (Janssen & Le Blanc, 2010). There are many factors that influence physical activity participation. Environmental factors and SES appear to be an influential factor on the amount of time spent doing certain activities (Lopez et al., 2010; Salmon et al., 2005; Faulker et al., 2008; Meyers et al., 1996; McVeigh et al., 2004; Fahlman et al., 2006).

Previous literature has suggested that high family income and high parental education is associated with increased physical activity levels (Kantomaa et al., 2007). Although these two variables were not quantified in this study, the current study found an opposite trend. In the lower SES school, Masibambane, all the pupils met the recommended guidelines for physical activity, whilst only 80% of the St John's pupils were sufficiently active.

Although the time spent in PE classes was less in the Masibambane group than the St John's group, all of the students attended PE during the week, which is similar to the findings of Vukovic (1998) showing a high level of sport and physical activity involvement during PE and after PE in school.

The sedentary behaviour of children and youth appears to follow the same trends in developed and developing countries. This study sample appears to exhibit similar patterns to the rest of the world. They also spend a lot of time watching television, playing computer games and being less physically active. Vicente-Rodríguez et al., (2008) argues that sedentary lifestyle patterns in children and adolescents have been associated with obesity and that this is also becoming an increasing concern in European countries. There has also been a gradual increase in terms of access to sedentary recreational opportunities. Furthermore, it is suggested that the increasing use of information and communication technology, particularly watching television, playing video games and the use of computers are critical sedentary factors affecting obesity prevalence (Salmon et al., 2005 and Vicente-Rodríguez et al., 2008).

In the current study, the boys from St John's school spent an average of 4 hours a day (outside of the normal school day) in sedentary behaviours, whilst the Masibambane boys spent an average of 2.5 hours a day in sedentary pursuits. For the St John's boys, a large portion of this time was spent playing computer games, which is similar to other studies which found a high usage of video game consoles (Salmon et al., 2005).

There is also a significant difference between the two schools with regards to the amount of time that the St John's boys spend playing computer games and doing homework. The main reasons for these are that it may be more difficult for the Masibambane boys to easily afford expensive video games and internet at home. The Masibambane boys come from less financially resourced families, whereas the St John's boys come from wealthier families and can easily afford such games. At St John's school the academic standards and expectations from the boys are very high, which may explain the amount of time that they spend doing homework, whereas, the Masibambane boys spent more time listening to music and watching television.

Although the evidence is conflicting, several cross-sectional studies carried out on children and adults suggested a strong relationship between high amounts of hours of television viewing and increased obesity (Kautiainen et al., 2005 & Anderson et al., 1998). Recent findings from a birth cohort (Hancox 2006) reinforce the fact that watching television in childhood is associated with an increased BMI, adding

evidence for an association of cause and effect between television viewing and overweight.

This is of particular concern as the current study found both groups to spend a large majority of time watching TV. Both groups spend less than 8 hours per week watching television. This is less than the average of 17.28 hours reported by McVeigh et al., (2004) on a group of 9 year old South African Children. In addition, a study by Lopez et al., (2010), found that Spanish 12 -18.5 years old watched more than 3 hours per day of television. This study showed similar patterns observed by Andersen et al., (1998) where 42% of Non-Hispanic black boys watched 4 hours daily of TV compared to 24.3% on Non-Hispanic white boys. According to the recommendations by the Canadian Society for Exercise Physiology both groups are safe because they spend less than the recommended screen time of 2 hours per day (Tremblay et al., 2011).

Domains of physical activity

There are numerous factors that may affect which activities children participate in. Intrapersonal, social and environmental factors influence the amount and type of physical activity performed (Allender et al., 2006). The types of physical activity chosen has been shown to vary according to family income (Kantomaa et al., 2007) as well as factors such as the built environment and resources (Sallis & Owen, 1999). The type of physical activity varied greatly between the two schools in the current study. The Masibambane boys spent significantly more time running, dancing and playing soccer and rugby, whilst the St John's boys spent more time swimming, and playing waterpolo and cricket. A suggested reason for the difference may be the season of the testing. For example, at the time of testing, St John's boys were required to do swimming, cricket and waterpolo. Some of them do play club rugby and soccer during this period but it is over and above the water sports mentioned. It is presumed that had this been a soccer or rugby season, these specific results may have been different.

Furthermore, the built environment and available facilities will also determine the choice of physical activity (Sallis & Owen, 1999). The Masibambane boys have very limited access to a swimming pool and waterpolo as a sport because of their demographic location and less resourceful/ poorer SES of the school. Thus, the built

environement would explain the lack of the water sport or activity in the Masibambane boys. Within a South African context soccer has traditionally been the sport that most black boys, living in semi-urban or rural areas, would play. Swimming and waterpolo, on the other end, have traditionally been and still remain a predominantly white dominated sport. It is encouraging to see the diversity in terms of exposure to the different sporting disciplines in the two schools. Masibambane College is better resourced compared to other schools in the same demographic area and a larger sample study involving multiple schools could reveal different trends.

The St John's boys recorded no time spent doing exercise in the form of walking while both samples recorded a very small amount of time walking their dogs. The major differences with regards to leisure time activities was recorded in the following; the Masibambane boys spend a large amount of time riding their bikes, playing on the playground and doing household chores. Since they come from financially poorer backgrounds it is understandable that they may be required to do more chores at home. Children may also spend more time outside on the streets or playgrounds in the semi-urban areas compared to children who live in the city or suburbs. The St John's children may live in secure homes and suburbs and it is generally not seen as safe for them to be on the street and playgrounds alone. .

In addition, almost none of the St John's boys walk or cycle to school. However, most of the Masibambane boys may live within walking distance to the school and walking is was found to be common in these boys. It is clear that the predominant method of getting to school by the St John's boys is travelling by car and some of the boys can spend a lot of time travelling to and from school.

5.3 Limitations and recommendations for further study

Although dietary intake is an important contributor to the current trends of overweight and obesity in children and youth it was not assessed in this study (Storey et al., 2009). Future studies should look at the influence of quantity and quality of the boys' dietary intake as this may play a role in the both the anthropometric and strength and fitness of the children (Storey et al., 2009).

The current study used a very specific sample population and may not be representative of South African children. Thus, further studies should include a variety of schools, using a cluster sampling approach, in order to be more representative of South African school children. Government schools should also be included to form a more representative sample. Furthermore, it is important to note that Masibambane is a relatively well-resourced school in a low SES area, and therefore other government schools in rural and township areas may provide a different view of children of that age. A study of this kind would give a more representative picture of what is happening across the socioeconomic brackets in SA. Furthermore, in order to provide useful normative values, a larger sample size is recommended.

Future studies should include girls into the sample population as well as include a wider age range e.g. 9 to 17 age groups. The current study showed a trend for the differences between the children to get larger with age, and therefore studies addressing older children may provide useful further information on this pattern. Studies of such a nature would inform policy about the current health and fitness status of a wider range of South African children. Information from such a study can be valuable to influence policy and allow for intervention strategies to be implemented. This will be even more effective should different genders and age groups require different interventions.

Lastly, specific SES of each participant was not recorded in this study, and may provide useful information on home SES status that has been shown to play a role in not only physical characteristics, but physical activity levels as well (Kantomaa et al., 2007; Mutunga et al., 2006).

Chapter Six

6. Conclusion

In conclusion, the current study provided valuable data on anthropometric and physical fitness data on two specific schools in the Johannesburg area. It provides useful information on which to base further studies in this field. Anthropometric data revealed that boys from both schools were either on or below average when compared to their peers from developed countries. The study also demonstrated that overweight and obesity may be prevalent in this study, as suggested by other South African literature. From a physical fitness perspective, the boys from both schools have an acceptable level of fitness for health purposes, with the St John's boys performing well into the 75th percentile for most fitness components when compared to the developed world. The St John's boys are significantly bigger, stronger and possess and superior cardiovascular fitness levels compared to their Masibambane counterparts, and the trend for the St John's boys to perform better, increased with age.

Despite their superior anthropometric and physical fitness results, it is of concern that a portion of the St John's boys do not meet the recommended daily physical activity levels, despite all the readily available facilities and resources. In addition, the amount of time spent in sedentary pursuits is of concern in the St John's boys, and warrants further investigation as well as possible intervention. Furthermore, this study showed major differences in types of physical activity performed in different communities in SA.

South Africa has a diverse ethnic, social and economic population, with each of these factors playing a role in the physical fitness, and therefore health, of our nation's children. This study highlights the differences in anthropometric, physical fitness and activity levels present in different community settings. It highlights the need for interventions into reducing overweight and obesity, as well as the importance of physical activity promotion in young children living in South Africa.

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