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EFFECT OF A SHORT-TERM PHYSICAL ACTIVITY PROGRAM ON SELECTED ANTHROPOMETRIC INDICES OF PRIMARY SCHOOL PUPILS IN ALEXANDRA, JOHANNESBURG

OTOLORIN OPEYEMI

A dissertation submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, in fulfilment of the requirements for Master of Science in Physiotherapy.

Johannesburg, 2016

DECLARATION

I**, Otolorin Opeyemi**, hereby declare that the work in this dissertation, unless where acknowledged, is mine. This work is submitted in fulfilment for the degree of Master of Science in Physiotherapy by research only, faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa



Signature

15th February, 2016

Date

DEDICATION

To My Parents

Thank you

PUBLICATIONS AND PRESENTATIONS

Poster Presentation: “Effect of a short-term physical activity program on selected anthropometric indices of primary school pupils in Alexandra, Johannesburg – A Pilot Study” at the 6th Cross Faculty Postgraduate Research of the University of the Witwatersrand, Johannesburg, 28th – 29th October, 2014

ABSTRACT

Introduction: Obesity and overweight in childhood is a global concern. The increased surge in prevalence of overweight and obesity in low-and middle-income countries, particularly in childhood, has been the reason for many studies including this. In Africa, childhood overweight and obesity is seen to be at par with what was obtainable in developed countries just over a decade ago, and figures from South Africa are reported to be among the highest in Sub Saharan Africa. The growing concern for childhood overweight and obesity has necessitated the introduction of various forms of intervention programs. School-based intervention programs therefore may be used to engage learners in more physical activities than they would normally partake of. This study aimed to establish the prevalence of childhood overweight and obesity and evaluate the effect of such school-based physical activity program on selected anthropometric indices and fitness among primary school children, albeit short-term.

Methodology: This study was divided into 2 parts.

Part A - Prevalence study: cross sectional descriptive study was used among learners in grades1 and 2 in 4 schools in Johannesburg East District. Anthropometric measurements (weight, height, BMI, waist-hip ratio, waist-height ratio, and skin-fold thicknesses) were taken once-off. The Global School-based Health Survey was administered.

Part B - Intervention study: a longitudinal study that compared the effect of physical activities on overweight/obesity and fitness for a 6 weeks period at 2 schools. Forty six learners chosen by convenience participated in the study. Pre- and post- intervention anthropometric measures and the 20m shuttle run test were taken at 6 weeks and 3 months. Independent and Paired samples t-tests were used to analyse data. Significance level was set at 0.05.

Results:

Part A – Prevalence study: The participants were 580, 25.6% were overweight (obesity included) boys = 30.6% and girls = 21%.Underweight was recorded at 7.5%. A combination of fast-foods and food security were the major nutritional contribution to overweight/obesity in this population. Majority of participants spent more than 2hours in sedentary activities (56.2%), less than one day of Physical Education (71.7%) and active for less than one day of 60mins/week (55.7%)

Part B – Intervention study: Total numbers of participants were 46 for the intervention study. There was a significant difference in BMI between groups (*p=0.001)* at 6 weeks with no significant improvement in fitness levels between groups at 6 weeks (*p=0.947).* At 3 months, results indicate that the intervention group maintained the improvements gained in BMI just immediately after the intervention period.

Conclusion: Among participants, the prevalence of childhood overweight and obesity was 25.6% and underweight was 7.5%. Also, the study indicates the benefits of school based intervention

programmes in improving the health of school going children and the need for intervention programs that are tailored to address the growing concern of childhood overweight and obesity.
Keywords: Childhood obesity, Overweight, Prevalence, School-based intervention, physical fitness, South Africa

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DEFINITION OF TERMS AND ABBREVIATIONS

Adiposity Rebound	: Period of Increasing BMI after the early Childhood Nadir
BAI	: Body Adiposity Index
BMI	: Body Mass Index
Catch-up Growth	: The Increased Growth Rate following Intrauterine Growth Retardation
CDC	: Centre for Diseases and Control Prevention
cm	: centimetre
CVD	: Cardiovascular Diseases
FAFH	: Food Away From Home
g	: Gram
GSHS	: Global School-Based Health Survey
HOD	: Head of Department
IOTF	: International Obesity Task Force
Kg	: Kilogram
KOTA	: Savoury meal of wors, atchar, Russian sausages, fries, cheese and a quarter loaf of bread
LIC	: Low income communities
m	: Metre
m^2	: Square metre
MET	: Metabolic Equivalent values
NCDs	: Non-Communicable Diseases
NYRBS	: National Youth Risk Behaviour Survey
OW/OB	: Overweight and obesity
PA	: Physical Activity
PE	: Physical Education
R^2	: Coefficient of determination/ measure of goodness-of-fit of linear regression
RCTs	: Randomised Controlled Trials
SES	: Socio-Economic Status
SFT	: Skin-Fold Thickness
SI	: Systeme International d'Unites (International System of Units)
SPSS	: Statistical Package for the Social Sciences
UW	: Underweight
UK	: United Kingdom
US	: United States of America
WC	: Waist Circumference
WHO	: World Health Organisation
WHR	: Waist-Hip Ratio
WHtR	: Waist-Height Ratio

CHAPTER 1

1. INTRODUCTION

"The rise of childhood obesity has placed the health of an entire generation at risk" – Tom Vilsack (2010)

Behavioural changes and lifestyle modification have been at the fore front of reshaping history with regards to the health status of an individual. New data is showing the increasing preference for poor dietary pattern, lack of exercises or reduced physical activity in children, young adults and adults as risk factors to obesity and preventable non communicable diseases.

On that note, this chapter introduces obesity in all age groups globally, as well as childhood obesity in Africa and South Africa. Also, the problem statement, research question, main aim, objectives and significance of the study will be discussed.

1.1 BACKGROUND

Overweight and obesity (OW/OB) are terms that refer to "abnormal or excessive fat accumulation, whereby they may have adverse effects on an individual's health and well-being" (World Health Organisation (WHO), 2011). The spotlight on obesity shone brighter in 2013 when the American Medical Association classified obesity as a 'disease', although this was met with a lot of resistance by people who think it is not worth the classification (Fitzgerald, 2013). Ranked second highest cause of death in the world after smoking, obesity and diseases of lifestyle have overtaken smoking-related health problems as the world's number 1 killer (WHO, 2014a).

The prevalence of obesity worldwide had nearly doubled among those aged 20 years and over, with a whopping 35% being overweight and 11% obese as at 2013 (WHO, 2014a). Obesity is on the rise among people living in the urban areas of both low-income and middle-income countries and once thought to be a disease of affluence; obesity is gaining grounds in developing countries (de Onis et al, 2010). Despite this increasing prevalence, it would seem that overweight and obesity in adulthood has reached a plateau, while it is on the rise in childhood (Ng et al, 2014); with 43 million children under the age of 5 overweight and or obese in 2013 (WHO, 2014a). It was estimated that ten percent of school-aged children were overweight and 1 quarter of them were obese worldwide (Dietz et al, 2005; Lobstein, 2004). However, current trends place the prevalence of childhood obesity at 23.8% for boys and 22.6% for girls in developed countries (Morgen and Sorensen, 2014).

Not much different a pattern is seen in developing countries where the prevalence of obesity in all population has reached 12.9% (Morgen and Sorensen, 2014). The increasing prevalence of childhood obesity globally is expected to rise if no measures are put in place to curb them (Mushtaq et al 2011b; de Onis, 2010).

In Africa, different opinions exist as to what socioeconomic population are more at risk of OW/OB. According to Prentice (2006), children living in the urban areas are more susceptible to developing obesity in childhood translating to OW/OB adolescents, and even OW/OB adults. This is because in the urban areas, more and more options of adopting western lifestyles and diet inclusive are available. Contrary to Prentice (2006), a study based in Uganda by Baalwa et al (2010) looked at rural-urban overweight/obesity, and found no significant rural-urban differences in the prevalence of overweight. However, the study found significant gender differences in the prevalence of obesity among young adults (Baalwa et al, 2010). Sub-Saharan Africa is reported to be among the fastest growing rates of OW/OB in Africa with South Africa noted to have the highest prevalence of obesity among all age groups (Ng et al, 2014). According to the National Youth Risks Behaviour Survey (NYRBS) done in 2002 and 2008 in South Africa, overweight prevalence increased from 17% to 20%, obesity increased from 4% to 5% and a reduction in the underweight category from 9% in 2002 to 8% in 2008 (Reddy et al 2002, 2008). According to the NYRBS, overweight was more in males, while more females were obese. Rossouw et al (2012) in their study concluded that childhood OW/OB in South Africa may be dependent on age, gender and socioeconomic status of the population.

Childhood overweight and obesity are not only dependent on age, gender and population. It would seem that lifestyle modification is an important factor in the health implication of a population. Exchanging quality time spent outdoors for lots of time in front of digital devices is a contributing factor to increased weight gain in children and adolescents (Gilbert-Diamond et al, 2014; Mendoza et al, 2007). Other factors identified to contribute to OW/OB among Portuguese children in a study by Padez et al (2005), include increased television viewing, paternal and maternal obesity and increased birth weight. In South Africa, Rossouw et al (2012) identified increasing westernisation of lifestyle, including higher consumption rates of fast foods, reduced physical activities as some factors that may lead to higher percentage of the population being overweight and or obese. Therefore, prevention and treatment of obesity must start during childhood. It is surprising that relatively few intervention programs are available for obese children and adolescents and that treatment is initiated for 20% of obese children (Nemet et al, 2005).

According to the Ottawa charter, the action areas for promoting health include “building healthy public policies, creating a supportive environment and developing personal skills” (WHO, 1986). Countries like South Africa, through the Health Basic Education -Integrated School Health Policy (2012) aim to provide preventive and promotive services that address the health needs of school-going children and youth with regards to both their immediate and future health, through health promotion and education. The implementation and monitoring of such policies is imperative to ensuring the promotion of health and addressing childhood obesity for school going children.

School based interventions are currently being utilised as a tool to deal with childhood obesity. A school based intervention carried out in Switzerland reported that a multi-component Physical activity (PA) intervention may help to improve the health and fitness of children and improve health later in life (Kriemlar et al, 2010). Kain et al (2004) conducted a study to determine the effect of a 6 month nutritional and PA intervention in primary school children and found that the intervention showed a huge positive effect on physical fitness in both genders and decreased adiposity in boys. A group randomised controlled trial of 10 schools in Leeds which used teacher training, modification of school meals and development of school active plans targeting the curriculum, physical education amongst others was successful in producing changes such as, increased consumption of vegetables, behavioural changes and improved overall understanding and knowledge at school level (Rudolf et al, 2007). Kemp and Pienaar (2010) studied the effect of a multi-component (PA, diet and behavioural modification) intervention program on self-perception among overweight and obese school children in South Africa and found that children in the intervention group not only had improved self-perception, but also lost significant amount of weight, especially with the skin-fold measurements. Results like this may help to inform school policies that seek to promote health among pupils.

Measures of obesity need to be looked into, as measuring obesity has been debated world-wide, especially with conflicting interests as to what the right measure of obesity is. There is an ongoing conflict on the proper classification and use of body mass index, body mass index z-scores and body mass index percentiles (Wang and Chen, 2012; Daniels, 2009). In light of these, several other alternatives to the BMI such as the waist circumference, skin fold thickness, have been used in several studies, and are discussed in the literature review chapter. Anthropometry is the study of the measurement of the human body in terms of dimensions of bone, muscle and adipose tissue (Wang and Chen, 2012); while anthropometric measures are combined with each other or with other data to calculate anthropometric indices (for example: waist circumference, waist-hip ratio, waist-height ratio). BMI is obtained by dividing the weight of an individual by the square of their height

and it indicates the weight status of an individual (Wang and Chen, 2012). Anthropometric indices were for the first time predictive of obesity for Pakistani school-aged children (Mushtaq et al, 2011a). A survey carried out among Greek-Cypriot children of mean age 11.4±0.4 years, revealed that waist circumference and waist-height ratio were better predictors of cardiovascular diseases' risk than body mass index, identifying trunk obesity as a risk factor associated with cardiovascular diseases (Savva et al, 2000). In Hong-Kong, China, high waist circumference was shown by Lettie et al (2011) to be a predictor of hypertension in adolescents, while increased PA was a protective factor. Hence, advocating obesity prevention, promoting PA in adolescents and children and incorporating waist circumference into screening protocols may increase awareness for cardiovascular risk (Lettie et al, 2011).

1.2 PROBLEM STATEMENT

The prevalence of childhood obesity is on the rise world-wide including among school going children (WHO, 2014a). Also, more data on the prevalence of childhood overweight and obesity in low socioeconomic settings are lacking. School based interventions have been shown to improve diet, PA and prevent obesity particularly so in high income countries (Khambalia et al, 2012; Brown et al, 2009b). Population studies on prevalence of obesity among South African adults and determinants of obesity among adolescents are readily available, but there is a dearth of literature on school-based intervention programs among primary school pupils in South Africa addressing childhood obesity (Kruger et al, 2005; Puone et al, 2002). More studies on school-based intervention programs addressing childhood obesity are needed using control groups with more detailed documentation from middle- and low-income countries (Verstraeten et al, 2012; Irwin et al, 2010; Doak et al, 2006). This study aims to fill this gap and provide literature on school-based intervention programs among primary school pupils.

1.3 RESEARCH QUESTION

What is the prevalence of childhood overweight and obesity among school going children?

Can a physical activity programme have effect on anthropometric index and physical fitness of school going children who are overweight or obese?

1.4 AIM OF STUDY

To determine the prevalence of childhood overweight and obesity among school going children

To determine the effect of a short term intervention programme on selected anthropometric indices and physical fitness of primary school children in Alexandra, Johannesburg.

1.5 OBJECTIVES OF THE STUDY

1. To determine the prevalence of OW/OB among primary school going children in Alexandra
2. To establish the contribution of nutrition to OW/OB among school going children in Alexandra
3. To determine the physical activity involvement of primary school pupils before the intervention study
4. To determine the effect of short-term PA program on selected anthropometric indices and physical fitness of the participating pupils.
5. To determine if there are benefits at 3 months of short-term PA program on selected anthropometric indices and physical fitness of the participating pupils.

1.6 SIGNIFICANCE OF THE STUDY

It is safe to say that physical activities play key roles in maintaining and improving one's health, children inclusive. However, the effect of a short-term intervention program on selected anthropometric indices is lacking among primary school pupils in a low to middle socio economic environment like Alexandra Township. The insight gained from this study can influence preventative and health promotive services for school going children, which is in line with the objectives of the Health Basic Education Integrated School Health Policy of South Africa (2012). Increasing school-based intervention programs and ensuring adequate documentation will help to address childhood obesity. It may also serve as basis for future research to further increase knowledge base on childhood overweight and obesity in South Africa. Also, policies that encourage more physical and health education classes in primary schools may be based on the results of this study.

CHAPTER 2

2. LITERATURE REVIEW

"We are very concerned with the level of childhood obesity… we don't want this generation of young people to live fewer years than their parents" – Mike Johanns (2015)

2.1 INTRODUCTION

Obesity and overweight is on the rise globally (WHO, 2014a) so much so, that the prevalence is still higher than it was a decade ago (Ng et al, 2014). Sub-Saharan Africa is reported to be among the fastest growing rates of OW/OB in Africa with South Africa having the highest prevalence of obesity among all age groups (Ng et al, 2014). A high prevalence of childhood OW/OB in South Africa has been associated with age, gender, population and socio-economic status (Rossouw et al, 2012).

This chapter will review literature under the following headings:

1. Overweight and obesity in childhood
2. Global prevalence of OW/OB in childhood;
3. Prevalence of OW/OB in childhood in South Africa
4. Contributing factors to OW/OB in childhood;
5. Implications of childhood obesity
6. OW/OB intervention programs:- School based interventions, home and family based interventions and community based interventions;
7. Measurement of obesity:
    a. BMI, BMI z-scores and percentiles: the controversy;
8. Other physical measures;
9. Summary of literature review

2.2 OVERWEIGHT/OBESITY IN CHILDHOOD

Overweight and Obesity are terms that refer to "abnormal or excessive fat accumulation, whereby they may have adverse effects on an individual's health and well-being" (WHO, 2011). Unlike the adult BMI, OW/OB in children is expressed as BMI-for-age (see Appendix N) hence, it is necessary that cut-off points be established because a child's BMI changes with respect to age and height as they developed. Several internationally comparable reference sets are available, "although without normative values for African and Asian children", by the International Obesity Task Force, Centre for Diseases and Control (CDC) and the WHO (Rossouw et al, 2012; Cole et al, 2000). Cameron et al (2009) have been able to derive equations to help determine percentage body fat in African pre-pubertal

children using data from 9 years old boys and girls. These equations vary for boys and girls and may be used to help access the level of OW/OB in African children.

2.3 GLOBAL PREVALENCE OF OVERWEIGHT/OBESITY IN CHILDHOOD

The worldwide prevalence of childhood OW/OB had increased from 4.2% in 1990 to 6.7% in 2010 (de Onis et al, 2010). De Onis et al (2010) also predicted that this trend was expected to reach 9.1%, or approximately 60 million, in 2020. Data from the WHO, suggests that over 40 million children under the age of 5 were overweight or obese in 2012. It would seem that the increasing prevalence in childhood overweight and obesity affects children in developed countries twice as much as those in developing countries (de Onis et al, 2010). Although, these studies have noted the increasing prevalence of childhood OW/OB, several studies (Eaton et al, 2012; Olds et al, 2011, Bluher et al, 2011) have found that the prevalence of obesity in childhood and young adults had either stabilized or reduced in the United State of America and Germany.

A recent study on prevalence of OW/OB by Ng et al (2014) spanning 33 years in several nations acknowledged the stability of the prevalence of obesity in some populations, but still maintained that overall, childhood obesity is on the rise steadily around the globe, irrespective of gender, race/culture and socio-economic status. According to Ng et al (2014) the prevalence of childhood obesity in boys was found to have increased from 8.1% to 12.9% and girls from 8.4% to 13.4% in the period between 1980 and 2013.

In Europe, a study done by Padez et al (2004) checked the prevalence of OW/OB in Portuguese children and following trends from 1970 to 2002, showed an increased prevalence (31%) in 7 to 9 year old children, which was described as the second highest at that time after Italy with 36% prevalence. Padez et al (2004) found overweight prevalence to be 20.3% and obesity to be 11.3% in children. Girls had higher prevalence of overweight than boys at ages 7.5 years and also higher prevalence of obesity except at age 9 years. Prevalence trends in other southern European countries were as follows: Spain 30%, Greece 31% and Italy 36% (Lobstein and Freulut, 2003). Ahrens et al (2014), reported studies of eight European countries that looked at childhood OW/OB population based on factors like parental education and income levels. From this study, the southern European countries had a higher prevalence (>40%) of childhood OW/OB than the northern European countries (<10%). The rise in childhood OW/OB was inversely proportional to rise in socio-economic status and level of education of parents of the participants. Ahrens et al (2014) of their study of European countries; and Ng et al (2011) of their study of the Arabian Gulf states reported “lack of common surveillance systems” and “prevalence of differing standards” among various authors in defining and assessing childhood OW/OB. These 2 studies are of the opinion that these inconsistencies may result in the inadequate reporting

of the true picture of the prevalence of childhood OW/OB. The Arabian Gulf states (Bahrain, Kuwait, Qatar, Saudi Arabia and the United Arab Emirates (UAE) are not left out of the obesity trends. A systemic review of studies involving these countries by Ng et al (2011) points that adolescent OW/OB was highest in Kuwait and estimated at 40% - 60%; while Saudi Arabia had the highest prevalence in pre-schoolers at 8% - 9%. The UAE tops the charts with the highest prevalence in metabolic diseases from OW/OB, which increased with age. Bahrain interestingly had increased prevalence of OW/OB in boys as against Qatar which had higher values for girls (Ng et al, 2011).

There is a growing concern for increasing prevalence of underweight (defined as BMI-for-age $<5^{th}$ percentile (WHO, 2014b)) and overweight/obesity in African countries recently (Mayanga et al, 2014). Also, OW/OB and underweight have been reported to co-exist (Manyanga et al, 2014; Ene-Obong et al, 2012; Gupta et al, 2010) among children of the same population especially those living in urban areas. According to a study by Manyanga et al (2014), Egypt (overweight – 31.4% and obesity – 9.3%) had the highest prevalence of childhood OW/OB amongst 7 African countries Malawi, Benin, Ghana, Mauritania, Djibouti and Morocco. Despite this increasing prevalence, underweight population in Djibouti (31.9%) was quite significant. This may be due to the socio-economic status of the family of these children. In south-western Nigeria, Ene-Obong et al (2012), found the total prevalence of overweight to be 11.4%, obesity 2.8% and underweight to be 13% in a population of school going children. Among the population studied, childhood underweight was at 19%, while overweight/obesity was at 9.4% (Ene-Obong et al, 2012).

2.4 PREVALENCE OF OVERWEIGHT/OBESITY IN CHILDHOOD IN SOUTH AFRICA

South Africa is under-going an epidemiologic transition with chronic non-communicable diseases (NCDs) associated with obesity contributing greatly to the burden of diseases in the country, despite the burden of infectious diseases and under-nutrition (Tollman et al, 2008; Kruger et al, 2001). Contrary to the increasing prevalence of underweight in other African countries as discussed above, Pienaar (2015) and Toriola et al (2012) found a significant decrease in the prevalence of underweight and an increasing prevalence in childhood OW/OB in South Africa. That is, Africa, South Africa, may be moving from the far end of the malnutrition spectrum to the robust part, especially with increasing childhood overweight and obesity. A prevalence study based in South Africa on OW/OB among primary school children aged 6 to 13 years in 5 provinces showed a trend in OW/OB among South African children that is similar to values obtained in developed countries about a decade ago (Lambert et al, 2006). Prevalence of obesity was 3.2% for boys and 4.9% for girls among the population studied, while overweight had a prevalence of 14.9% for the boys and 17.9% for the girls.

Clarence Suh Yah (2014), in a study of 17 year old adolescents in Soweto, found increased prevalence of overweight within the group studied; with girls having a higher prevalence of overweight (19.3%) than boys (8.1%). Studies indicate that in children and adolescents, OW/OB is more prevalent in girls than in boys (Kimani-Murage, 2010; Lambert et al, 2006; Kruger et al, 2005; Somer, 2004). This is further proved by the Youth Risk Behaviour Survey (Reddy et al, 2008) done in all provinces of South Africa involving learners in grade levels 8 – 11. More females were overweight (27.8%) as compared with the male (11.2%) learners. Also, females had a higher prevalence of obesity (7.2%) than the males (3.3%), and this may be due to smaller households, and increased physical inactivity. Also, childhood overweight and obesity have reported in the Agincourt district of Mpumulanga (Kimani-Murage et al, 2010) and in Limpopo (Mamabalo et al, 2005).

2.5 CONTRIBUTING FACTORS TO OVERWEIGHT/OBESITY IN CHILDHOOD

Studies by Steyn et al (2005) and Goedecke et al (2005) found that children less than 9 years of age who live in urban areas of South Africa may be more OW/OB than their counterparts in rural regions. As discussed above, adoption of western food patterns and lifestyle modifications may be major contributing factors to the increasing childhood overweight and obesity trend. Hence, nutritionally deprived children may move from under-nutrition to extreme over-nutrition in adulthood, as against the popular paradigm obese children become obese adults (Reilly et al, 2003). Also, environmental factors have been found to be more pronounced than genetic factor in childhood overweight and obesity (Moschonis et al, 2007).

A cohort study based in the United Kingdom had over 9,000 children aged 7 years including parents of these children participate. From the study, factors that contribute to obesity in children were identified (Reilly et al, 2005). The contributing eight factors are: parental obesity; very early increased BMI; adiposity rebound by 43 months; 8 hours of television weekly at age 3; catch-up growth at 8 months and 18 months; increased birth weight and short sleep duration of less than 10.5 hours at age 3. These eight factors will be discussed under the following 4 main headings as identified by Reilley et al (2005):

- Intrauterine and Perinatal Factors
- Infant feeding and weaning practise
- Family characteristics and demographics
- Lifestyle in early childhood
    - Sedentary behaviour
    - Sleep duration
    - Dietary pattern

2.5.1 **Intrauterine and Perinatal Factors**

Literature indicates that there is a link between intrauterine, perinatal factors and childhood overweight/obesity (Yu et al, 2013; Van Lieshout et al, 2011). This link is based on a theory that "the effect of certain environmental factors during specific, critical periods of early development can lead to permanent physiological and metabolic adaptations that although serve the purpose of improving the chances of foetal and postnatal survival, may become detrimental in the long term and may be expressed at different life stages in the presence of certain environmental influences" (Hales and Ozanne, 2003; Godfrey and Baker, 2000). Oken et al (2007) reported that children of women who gained an "excessive" amount of weight in pregnancy, had more than 4 times the risk of being overweight at age 3, compared with children of women who gained an "inadequate" amount of weight. Moschonis et al (2007) found that certain factors such as maternal smoking in pregnancy and parental overweight were indicative of possible OW/OB at preschool age for a growing child.

Perinatal factor of weight gain before or during pregnancy has being identified as risk factor for babies being large for gestational age at birth (Cresswell et al, 2012), due to the crossing of food through the placenta to the foetus. Similarly, Yu et al (2013), in a systemic review found that children born to overweight/obese women were found to be large for gestational age, and more so, increases the chances of having an OW/OB sibling. Therefore there is a need to promote health before and during pregnancy by managing weight gain to lessen the risk of childhood OW/OB.

2.5.2 **Infant Feeding and Weaning Practices**

Since over 2 decades ago, there had been an ongoing debate on the benefits of breast-feeding over formula-feeding of infants. A systemic review of 9 studies by Arenz et al (2004) showed that breast-feeding seemed to have a small but consistent protective effect against obesity in children. Likewise, a longitudinal study by Gillman et al (2001) of 8186 girls and 7155 boys (who were participants in the Growing Up Today Study) aged 9 to 14 years, showed that participants who were fed breast milk more than infant formulas, or who were breast-fed for longer periods, had lower risks of being overweight during older childhood and adolescence. Several studies still reiterate the point that breast-feeding was and is a protective factor against childhood obesity (Bergmann et al, 2003; Armstrong and Reilly, 2002; Gillman et al, 2001).

Although, breastfeeding is beneficial, it will not be the only meal plan for a growing child. At some point in life, solids will be introduced. Pushing for prolonged breastfeeding periods

and delayed onset of introduction of solids had been the focus of many studies (Zhu et al, 2015; Griffiths et al, 2009). However, Veit et al (2012) suggests that rather than time of introduction of solids, quality and quantity of solid meals and childhood OW/OB be researched more. From these findings, parents and caregivers ought to look into food patterns and encourage healthy eating habits in childhood as early as possible.

2.5.3 Family Characteristics and Demographics

The role of the home environment in the development of obesity in childhood had been recognised for a while now, but only few studies have documented the extent to which it plays in the development of obesity (Muthuri et al, 2014). Maternal obesity (before or during pregnancy), low/lower family income, and lower cognitive stimulation have significantly increased the risks of developing childhood obesity; higher levels of cognitive stimulation however, were a protective factor against childhood obesity (van Lieshout et al, 2011). Moschonis et al, (2007) reported a link between paternal obesity and childhood OW/OB in all age groups. The study found that children born to overweight/obese parents were more likely to be overweight and or obese in childhood.

Urban living as against rural living is also indicated in the increasing prevalence of childhood OW/OB (Muthuri et al, 2014). In the Arab nations, urbanization increased, which has resulted in the increased prevalence of childhood obesity in children and even in the adult population (Badran and Laher, 2011). Children who live in the south-western region of Saudi Arabia have a lower rate of obesity, as against children who live in cities in the eastern and western regions who had a prevalence of 14% and 10% respectively (Chaker and Salameh, 2006). Contrary to these findings, Baalwa et al (2010) did not find any significant difference in rural to urban relationship of OW/OB.

Family income is an important factor as it determines types of foods consumed. The higher the socioeconomic status, the more predisposed a child is to OW/OB. For example, in Kuwait, high income families were said to eat more meat and milk than low income families (Salazar-Martinez et al, 2006). Families of affluence in Egypt had a prevalence of 10% as compared to poorer families, 3% (Salazar-Martinez et al, 2006).

2.5.4 Lifestyle in Early Childhood:

The rise in non-communicable disease has been associated with lifestyle behaviours e.g. sedentary behaviour (Liou et al, 2010), unhealthy dietary intake (Bahreynian et al, 2013). These factors are modifiable and maybe of less impart if addressed early.

2.5.4.1 **Sedentary behaviour**

Physical Activity (PA) is a protective factor against OW/OB; while sedentary choice of television (TV) watching and night-time snacking are considered risk factors (Liou et al, 2010). TV viewing time reduced to less than or equal to 1 hour/day does not often lead to OW/OB in children according to Liou et al (2010) and Tremblay and Willms (2003), but increased TV watching time of greater than or equal to 4 hours/day is linked to childhood OW/OB.

Exchanging quality time spent outdoors for lots of time in front of digital devices has been linked with increased weight gain in children and adolescents (Gilbert-Diamond et al, 2014; Mendoza et al, 2007). Similar findings have been mentioned in studies by Padez et al (2005) and Hancoux and Poulton (2006), that increased television viewing is a risk for obesity. Hancoux and Poulton (2006) concluded that television viewing was indeed a significant contributor not only to childhood obesity, but obesity in adolescents and adults as well, and may be a better predictor of obesity than physical inactivity and dietary pattern (Kimbro et al, 2011).

Contrary to these studies, a meta-analysis on relationships between media use, body fatness and physical activity in children argued that, although important, television viewing was not clinically relevant as a causative factor of obesity in childhood (Marshall et al, 2004). Zimmerman and Bell (2010) are of the opinion that television advertising rather than just viewing per se is associated with obesity. The study found that the advertisements, commercials between programs were the predictors of obesity in childhood. Similarly, a study by Caroli et al (2004) looked at the role of television viewing as a preventive tool with regards to childhood obesity and concurred with these findings. The study revealed that fast food adverts on television may affect food choices, but strict regulations of television content with good information on nutrition and healthy eating patterns may be used to prevent childhood obesity.

2.5.4.2 **Sleep duration**

Reduced sleep duration have been thought to influence weight, through decreased PA from tiredness and increased energy intake, by giving greater opportunity to eat (Zimmerman and Bell, 2010).

However, the exact mechanism through which sleep duration influences the balance between energy intake and expenditure is unknown (Zimmerman and Bell, 2010). An explanation may be through the regulation of the production of body weight hormones, and that sleep may affect energy balance (Taheri, 2006). While comparing the effect of sleep

duration on childhood obesity, Bell and Zimmerman (2010) concluded that napping can never substitute for insufficient night time sleep in the prevention of obesity. Overall, reduced sleep duration in early life is a modifiable risk factor with implications for obesity prevention and treatment (Reilley et al, 2005).

von Kries et al (2002) showed that the impact of sleep duration was considerable and similar to other known and confirmed risk factors for OW/OB such as excessive television viewing, and playing video games. Sleep may not be the only answer to the obesity pandemic, but its effect should be considered seriously, as even small changes in the energy balance are beneficial. Promoting good sleep could be part of the obesity prevention approach.

2.5.4.3 **Dietary pattern**

Among the factors contributing to childhood OW/OB, the dietary behaviour of children is major (Lobstein et al, 2004). van Slujis et al (2008) in their study of 9 to 10 year old British children, concluded that daily consumption of fruits and vegetables be encouraged in this age group, despite that these same group of children met the national PA guidelines. It would seem that a healthy food pattern was necessary even when daily PA limit is met.

A systemic review by Yang et al (2012) of Asian nations looking at the relationship between dietary pattern and OW/OB in children and adolescence found there were several significant although inconsistent statistical associations, between dietary pattern and childhood/adolescence overweight. The dietary patterns identified included increased consumption of high energy foods, meat, take-outs and fast foods, as well as low consumption of fruits and vegetables. A major limitation of this study was the absence of set standards to determine dietary pattern and overweight in the studies reviewed, however, Yang et al (2012) concluded that their findings were absolute given the circumstances. Another study on the major dietary patterns and its association with OW/OB, found a significant relationship between healthy diet and BMI status for school children in Iran (Bahreynian et al, 2013). The study found that overweight girls were more likely to have a “western” and “sweet dairy” food pattern, compared to the schoolboys.

Fast food restaurants have become a main-stay in the food industry, and may be found everywhere (Zive et al, 2002: Cram et al, 2002); influencing dietary choices of both young and old alike. The massive portion of foods served in fast food restaurants, with their high energy density, appeal to senses, high content of saturated and trans fats, and low fibre make consuming such lead to OW/OB (Ebbeling et al, 2002). Bowman et al (2004) in a study of 4-16 year olds in the United States found that consumption of fast foods had a

negative effect on quality of diet and may increase risk for obesity in children. A study by Fox et al (2004) evaluating the feeding pattern of infants 4 months up to 24 months of age, found increased consumption of sweetened beverages, baked desserts and some form of candy. Davis and Carpenter (2009) concluded that having fast food restaurants at close proximities to schools may influence dietary choices of pupils, hence, policy makers ought to look into this. From these findings, parents and caregivers ought to look into food patterns and encourage healthy eating habits in childhood, as children imitate what they see.

Studies (Saavedra et al 2013; Fox et al, 2004) have shown strong similarities in feeding patterns of infants and adults. Saavedra et al (2013) noted that by 18 months of age, a child's diet may already be similar to that of an adult, while Fox et al (2004) noticed the similarity earlier on in age at 7 months. Dattilo et al (2012) concluded that although OW/OB were already established in infancy and childhood, this stage is still a good time to address the issue. This study reported that the exclusivity of breast-feeding, timely introduction of nutrient dense and energy appropriate foods are ways to intervene. It is important to note that genetic predisposition alone is an insufficient argument to support the increased prevalence of childhood obesity. This is because the causes of obesity in childhood are multi-factorial (Dattilo et al, 2012).

2.6 IMPLICATIONS OF OVERWEIGHT/OBESITY IN CHILDHOOD

Childhood obesity has been documented in low- and middle-income countries as the major contributor to paediatric metabolic syndrome risk (Verstraeten et al, 2012; Irwin et al, 2010; Kelishadi, 2007; Doak et al, 2006; Somer, 2004). Obesity in childhood is not without health implications in later life, as it has been linked not only to obesity in adolescence and adulthood; it is also a precursor to developing metabolic diseases and the metabolic syndrome in adolescence and adulthood (Moschonis, et al, 2007). Also, of note is the documented fact that obese children and adolescent are likely to become obese adults and are at risk of cardiovascular diseases, premature death, and impaired social, educational and economic productivity (Lanigan and Singhal, 2009; Reilly et al, 2003). Also, research has shown that metabolic diseases arising from childhood obesity in adulthood may be more difficult to treat than metabolic diseases from adult-onset obesity (Cheung et al, 2004; Reilly et al, 2003).

Globally, the increasing burden of NCDs such as CVD, diabetes and cancer is such that is common as well in developing countries. With the double burden of infectious and non-infectious disease, it is important to understand the basis for their increasing prevalence and then come up with strategies to combat the epidemic (Boutayeb, 2006). Studies

(Galvan et al, 2013; Gunnarsdottir et al, 2012), have shown that psychological maladjustments (peer pressure and poor peer relationships), social rejection and poor academic performances are characteristic of OW/OB children. Furthermore, Galvan et al (2013) in a study involving Chilean children found that the normal weight children were better off with cognitive development when compared with their OW/OB counterpart in low income countries.

In South Africa, research has shown that there is a direct link between OW/OB and NCDs in children and adolescents. The chances of South African children developing NCDs are pretty alarming especially for girls with a 16% probability and only a 1% for boys, especially because the prevalence was higher in girls than boys (Kimani-Murage et al, 2010). Children born to mothers who had gestational diabetes, were overweight and obese are at risk of developing metabolic syndrome in childhood and adolescence. This was shown by Boney et al (2005) when they found that children with increased birth-weight born to mothers with gestational diabetes or were obese (even without gestational diabetes) were at risk for developing metabolic syndrome in childhood. Also in South Africa, there are studies linking OW/OB to stunting (Mamabolo et al, 2005; Mukuddem-Petersen and Kruger, 2004). A study by Mamabolo et al (2005) looked at the prevalence of stunting and childhood overweight in Limpopo and found co-existence of stunting and OW/OB in the same child of <5 years of age. In the Agincourt district of Mpumulanga, South Africa, Kimani-Murage et al (2010) looked at the prevalence of stunting and OW/OB. The study showed a moderate prevalence of stunting and OW/OB in early childhood, and also from age 14.

According to the Ottawa charter for health promotion, the 5 action areas for promoting health include, building public health policies, creating safe environment, developing personal skills, strengthening community action and reorienting health services (WHO, 1986). If the fight against childhood obesity is to be won, it is imperative to address childhood obesity employing these actions areas for health promotion. Clearly, advocating for preventive measures and intervention programs aimed at addressing childhood obesity need to be encouraged. Gupta et al, (2013) concurs that lifestyle modifications, advocacy and government policies are needed in developing countries of the world as they are currently faced with an increasing statistics of childhood OW/OB.

2.7 OVERWEIGHT AND OBESITY INTERVENTION PROGRAMS

Health promotion practices are a major factor in decreasing the prevalence of childhood overweight and obesity. These practices may be influenced by government policies, which will encourage active participation by all. In South Africa, the National Development Plan Vision 2030 seeks to integrate and encourage health promoting lifestyles among its citizens

(National Development Plan, 2011), despite the double burden of infectious and non-infectious diseases. The Department of Health Strategic Plan 2014-2019, seeks to reduce the prevalence of overweight and obesity in adult men and women, thus there is a need for early intervention at childhood level. Intervention programs come in varying forms and look at all possible means (stand alone or in combination) via school-, family- and community-based programs to improve physical activities and encourage a lifestyle of health promoting activities. Some also, look at knowledge-base of nutrition, increasing vegetable consumption, reducing the intake of carbonated drinks and intra-family relationships as it affects OW/OB in childhood.

2.7.1 School-Based Intervention Programs

Developing personal skills is necessary to promoting health and ensuring healthy living practices. Equipping school-going children at an early age with such knowledge and information will empower them to live healthy and continually make healthy decisions and lifestyle choices. Schools are being encouraged to become “health promoting” through “constant strengthening of its capacity as a healthy setting for living, learning and working” (School and Youth Health – WHO, 2015).

A review by Steward-Brown (2006) highlighted the need for schools to have their own health-promoting programs which are inclusive of their social and physical environment. This makes for a more holistic approach, tailored to meet specific health needs of pupils in such schools. Stewart-Brown (2006) continues in the review that, school-based programs promoting PA, healthy eating and mental health have been proven to be more effective than other forms of school-based programs. This review concluded that, although family involvement in intervention programs made some more effective than others, not having any form of intervention at all, was at the detriment of the school populace, hence schools were encouraged to be ‘health promoting’ rather than have occasional ‘health promotion programs’.

Children and adolescents have to be helped to make healthy food choices and develop great dietary habits (Post-Skagegard et al, 2002). Schools could be a good place to provide nutrition and help develop such habits (Jimenez-Cruz et al, 2002), since the environment is a key player in determining food choices (Lytle and Kubik, 2003). Vereecken et al (2005) in their study of school food policy in Belgium-Flanders, found that a school food policy was effective in reducing the consumption of sweets, savoury foods and carbonated drinks and also be sure that the importance of healthy food choices are promoted.

Studies (Bleich et al, 2013; Johnson et al, 2012) reviewing school-based intervention programs targeting OW/OB in children have been found to be effective in improving the knowledge base of nutrition, consumption of vegetables, PA and preventing weight gain. They also looked into the possibility of combining these school-based interventions with the family or community. Such combined interventions, especially with the community were more effective. Contrary to this review, Harris et al (2009) in a systemic review of some school-based intervention program in Canada, found no significant difference in BMI (which was the main outcome measure, besides others such as waist circumference, skin-fold thickness, percentage body fat, sum of body fat) in pupils in elementary schools. They found that including some other forms of intervention along with the PA for 6 months or more still had no significant change, even when adjusted for sex. However, their conclusion emphasises the importance of effective school-based intervention programs still.

Research has shown that decreased participation in PA and Physical Education classes (PE) in public schools leads to an inversely proportional increase in childhood OW/OB among pupils (Hedley et al, 2004). According to Donnelly and Lambourne (2011), PA and PE in schools serve to boost academic performances and cognitive abilities. They reason that PA/ PE are cost effective and can be enjoyed by both teachers and students. However, Donnelly and Lambourne (2011) found that even in the U.S, public schools have either taken out PE classes, or have allocated very few school-times; therefore, they recommend that PA/PE be incorporated even into the teaching module.
Preventive measures as well as promotion of healthy lifestyles in schools are a good way to curb the increasing obesity prevalence in childhood. The WHO (2015), under the Global School Health Policy, encourages member countries to implement policies to address varying health needs of school children. In South Africa, the revision of the National School Health Policy in 2011 was necessary to “promote a long and healthy life for all South Africans”. So also does the Health Basic Education Integrated School Health Program cater to the health needs of grades 0-12 learners by ensuring to improve their general health, through the provision of “promotive and preventive services that addresses the health needs of school-going children” (Health Basic Education Integrated School Health Policy, 2012).

Furthermore, children at primary schools are still developing character traits and habits that will be taken into adolescence and adulthood; hence, involving the family and an understanding of the parent-child relationship can be a great tool in obesity prevention (Trost et al, 2003).

2.7.2 Family-Based Intervention Programs

The parent-child relationship should be seen as a bi-directional approach, as choices are influenced by the family, because the family is the "primary social force of influence" on children (Ventura and Birch, 2008). A major factor that may help understand this perspective is to study the parent-child relationships during activities like feeding, playing and eating. Skouteris et al (2011) in a systemic review of family-based intervention programs concluded that an understanding of the parent-child relationship during these activities will serve better in development of intervention programs targeting childhood obesity. They believe this concept has been left out of most studies. This is a strong indication of the importance of understanding the parent-child relationship.

Family based intervention programs had mostly studied the impact of parental influence (beliefs and practises) on children (Ventura and Birch, 2008). A study by Petricevic et al (2012) in a sample of Croatian school-aged children and their families, looked at parents' perception of their children's weight status; and found that parents of overweight (including obese) children did not perceive their children as either obese or overweight. This is in agreement with other studies (Huang et al, 2007; Eckstein et al, 2006) who had explored the angle that perhaps, parents of OW/OB were to blame for over-feeding their children.

A longitudinal study done in Australia by Campbell et al (2013) found that a parent-focused intervention program was helpful in reducing consumption of soda, sweet snacks and TV viewing in children at 9 months and 20 months respectively. Gruber et al (2009) points that family interventions offer a more dynamic approach; which influences and encourages healthy behavioural changes not only in the children, but in adults as well. In a review of Randomised Control Trials (RCTs) involving the participation of 1 or more adult family members of OW/OB children, Wrotniak et al (2004) concluded that actual weight-loss of said adults/family member(s) was predictive of their overweight/obese child's weight-loss or prevention of further weight-gain.

Hence, the importance of including families in intervention program, if childhood obesity is to be curbed.

2.7.3 Community-Based Intervention Programs

Tremblay and Willms (2003) observed that any form of involvement in active leisure activities (low-, middle- and high-intensity) even including art-works, may prevent/delay the presence of OW/OB. PA encouraged by walking to schools has since decreased in the United Kingdom (UK) with more and more pupils riding the bus and private cars (Department of the Environment, Transport, 2000) thereby reducing the total hours of PA

daily. This was further supported by Cooper et al (2003) in their study of active (walk/ride a bike) transport to schools in the UK, where they found that for boys, active transport encouraged higher PA even after school hours.

School curricula seem fully-packed, with teachers having to try to meet up. This may be a major limitation of school-based intervention programs (Jago and Baranowski, 2004). This is where community-based programs come into play. They target a larger population at a time, hence, building a sense of community, without hampering on the school curriculum. And although only a few studies have reported significant changes in anthropometric indices, still, others have been influential in addressing consumption of sweetened beverages and increased the consumption of actual fruits and vegetables (Reilly et al, 2006).

Taylor et al (2007) in a report of their 2-year community intervention program concluded that non-curricular PA may be effective in reducing BMI z-score and waist circumference of school going children. They achieved this through community activities like long walks and simple dietary messages that encouraged healthy eating. Community programs involving school going children in a low-income community in the United Kingdom, showed significant difference in just 6 months into its 2-year program. Rudolf et al (2007) were able to conclude that a community program in low-income communities targeting overweight children can be administered by trained personnel when supervised by health professionals.

2.8 MEASUREMENT OF CHILDHOOD OVERWEIGHT/OBESITY

Literature highlights the lack of national regular surveillance systems to monitor prevalence of obesity and the variation in defining and assessing childhood OW/OB which results in the inadequate reporting of the true picture of the prevalence of childhood OW/OB (Ahrens et al, 2014; Ng et al, 2011). Surveys like the global school-based health survey core questionnaire (GSHS) developed by the WHO provide a set standard and consistency as they have been used in prevalence studies for several countries to access feeding patterns and physical activity of participants (WHO, 2013). The GSHS are a compilation of survey questions on varying factors affecting the health and well-being of school going children (WHO, 2013). In Swaziland (GSHS, 2013b) among the 13 to17 age group, obesity was 3.8% with the female population having a higher a prevalence of obesity at 5.5% while among the males it was 1.8%. Forty-three percent of these students consumed carbonated soft drinks 1 or more times per day. When compared with datasets from Fiji (GSHS, 2010a) obesity was at 5.2% in 2010, while the United Arab Emirates recorded 14.4%. Data sets like these may be a form of identification of the general population’s level of childhood overweight and obesity.

de Onis (2004), indicated that early identification of excessive weight gain, through regular monitoring of height, weight and BMI-for age, is essential to stopping the increasing prevalence of childhood obesity, by introducing an intervention program of sorts. Anthropometric measures of weight, height and skin-fold thickness were shown by Starc and Strel (2010) to help predict a progression of childhood obesity into young adulthood among Slovenian school children from 1997-2008. Although commonly used, the BMI has been shown to provide general adiposity in a paediatric population, but poor accuracy in predicting fatness in an individual.

2.8.1 BMI, BMI Z-Scores and Percentiles: The Controversy

The BMI is a non-invasive, inexpensive measurement, associated with little or no harm, cheap and easy to use in practise method to determine OW/OB. Hence, a current recommendation for evaluating obesity in the clinical setting supports the use of BMI percentiles, as the most useful method for assessing increasing body fat (Barlow, 2007). This is because BMI correlates with body fat and also with cardiovascular factors (Mei et al, 2002; Freedman et al, 2001). Increased BMI may serve as predictor of adult obesity as well as future morbidity or mortality. BMI therefore is safe to use for screening purposes as it has reasonable sensitivity for identifying children with high fat accumulation (Field et al, 2005).

BMI z-scores and percentiles are both often used to access anthropometric measures of weight in children. However, both have their strengths and weaknesses. Although, the percentiles have been used largely because of the difficulty in interpreting the z-scores by the general public, the BMI alone isn't enough to describe OW/OB in children as it does not differentiate fat from lean mass (Wang and Chan, 2012). The BMI percentiles also, may not adequately describe the risk for co-morbidities and is thought to not optimally stratify children and adolescent with very high BMI; despite this the BMI is used more frequently and appropriately by the general public and in clinical settings, because it is easier to interpret (Daniels, 2009).

The advantages of using the Z-scores over the percentiles are as follows: "they are calculated based on the distribution of the reference population (mean and standard deviation), and thus reflect that reference distribution; second, as standardized quantities, they can be compared across ages, sexes, and anthropometric measures; third, Z-scores can be analyzed as a continuous variable in studies. In addition, they can quantify extreme growth status at both ends of the distribution". However, Z-scores are not straightforward to explain to the public and are hard to use in clinical settings (Wang and Chen, 2012). Finally,

Cole et al (2000) proposed that their classification was acceptable internationally because the cut-off points for BMI for OW/OB by sex between ages 2 and 18 years, was defined to pass through BMI of 25 and 30Kg/m^2 at age 18. Hence 2 datasets were made, 1 for the boys and the other for girls, to clinically represent OW/OB as represented by sex and age in months. These charts are similar to the CDC Data Table of BMI-for-age Charts, although the CDC chart extends to the 20 years age mark.

2.8.2 **Other Physical Measures**

Waist circumference (WC) has been shown to assess adiposity in children at 12 years of age by Maffeis et al (2001). Also, according to Brannsether et al (2011), the 85^{th} and 95^{th} percentiles were representative cut-off values using WC and Waist-Height Ratio (WHtR) for overweight and obesity in Norwegian 4-18 years of age. Comparing relative BMI, triceps and subscapular skin folds, sum of 4 skin folds and percentage fat mass, over a 4 year period, Maffeis et al (2001) concluded that waist circumference is a great tool, since visceral/trunk/abdominal adiposity has been associated with obesity and cardiovascular disease risk in children. Savva et al (2000) concluded their comparison between BMI and waist circumference and waist-hip ratio, that waist circumference and waist-hip ratio are better predictors of obesity and CVD risk than BMI. Also, Mushtaq et al (2011a) have been able to draw reference percentiles for waist circumference to help predict metabolic and CVD risk factors.

Although highly accurate in quantifying body fat and body fat distribution; underwater weighing, DEXA, Medical Resonance Imaging (MRI), and Computer Tomography Scan (CT scan), are technically complex, hence, makes them difficult for common daily use (Piers et al, 2000). However a new means of assessing obesity is the Body Adiposity Index (BAI), which can be calculated by dividing a person's hip circumference by their height and subtracting 18

$$BAI = \frac{\text{Hip circumference}}{(\text{Height})^{1.5}} - 18$$

The simplicity of BAI makes it easier for everyday and common use by the population (Bergman et al, 2011), and in clinical settings where reliable scales are not easily accessed. It is said that BAI estimates percentage adiposity directly.

The triceps skin-fold thickness measurements and BMI were used to assess OW/OB among school going children in Lagos, Nigeria by Izuora et al (2013). The study found the prevalence of obesity to be quite low, and found prevalence of overweight to be pretty high among the population studied. A benefit of the waist-height ratio is that it identified central

(intra-abdominal) obesity among normal weight and overweight/obese children and identifying those with risk for related cardio-metabolic disorders (Mokha et al, 2010).

2.9 SUMMARY OF LITERATURE REVIEW

Childhood obesity had once been thought of as limited to children living in urban areas of developed countries; recent studies of undeveloped and developing countries reveal otherwise. This is seen also, in population studies done in South Africa. While childhood obesity remains a part of the urban setting, children living in low-income areas of the urban settings show increasing prevalence of OW/OB. Thus, overweight (including obesity) and underweight can be seen in children of the same family, school and community.

Factors responsible for childhood OW/OB were identified. With communities becoming more urbanised, intervention programs are necessary to not only prevent, but also address the impact of OW/OB in childhood. New studies now encourage any form of physical activity as no form of physical activity is detrimental to the health of an individual. Family income levels and demographics are also factors that may contribute to early development of childhood overweight and obesity. Seeking better living conditions is not bad, but lifestyle modifications must be addressed early on. Rural–urban migration is quite common in developing countries; so also is a shift in the underweight category to the overweight and obese category. This move may be another factor responsible for the shift in underweight to overweight and obesity in childhood.

Although the BMI had been used overtime to access the weight status of a population, it is becoming increasingly unreliable. Other forms of accessing weight status have been looked into even in prevalence studies. Measures such as the waist circumference and skin-fold thickness have been shown to predict not only weight status, but also tell if a person is at risk of developing metabolic diseases. Metabolic diseases have been associated with OW/OB, even in children. As obese children tend to become obese adults, it is imperative that childhood OW/OB is addressed quickly. In addressing the increasing prevalence of childhood OW/OB, intervention programs have been successful in increasing PA, decreasing physical inactivity and encouraging healthy dietary behaviours at schools, homes and the communities.

The next chapter explains the methods employed in carrying out this study.

CHAPTER 3

3. METHODOLOGY

3.1 INTRODUCTION

This chapter presents the 'How" of the research, by discussing the study design, study setting, participants and data collection procedures. Participant's right to privacy and ethical considerations are also addressed.

The chapter on methodology will be in 3 parts:
Part A: Prevalence Study
Part B: Pilot Study
Part C: Intervention Study

PART A: PREVALENCE STUDY

Prevalence is defined as the proportion of the population at risk or affected by a disease at a specific point in time (The British Medical Journal (BMJ), 2016).

3.2 STUDY DESIGN

A quantitative, cross-sectional descriptive design was used for the prevalence study. This study design was chosen for the prevalence study because it involved identifying the population to be studied at a given time, taking measurements of variables on an individual basis, and also assessing past and current diet and physical activity levels. Also, in this type of study, the researcher has no control whatsoever on their dietary and physical activity lifestyle.

3.3 STUDY SETTING

This study was carried out in government primary schools based in Alexandra Township, Johannesburg East District of Gauteng Province (Appendix A). All schools in the study cater to children in grade R to grade 7, as some of the schools in the same district were not up to grade 7. The schools were selected by convenience. Four schools situated close together along the highway and attended by children of same socioeconomic status in Alexandra were used. The prevalence study involved all 4 primary schools in a cluster.

3.4 STUDY POPULATION

The study population comprised pupils from grade level 1-2 from 4 government primary schools in a locality within the Alexandra Township. Alexandra is a low income community, situated close to more affluent Sandton community. Found in the Gauteng province and

City of Johannesburg Municipality, Alexandra was established in 1912. Most residents are black Africans from the Census (2011). Alexandra has such a rich history built on the struggles for acceptance of the black community as permanent residences of the city (Wikipedia, 2015).

Inclusion Criteria:

Pupils should have been enrolled at the 4 schools at the time of study. All who had parental consent, gave individual assent were drafted into the Prevalence study.

Exclusion Criteria:

Pupils without parental consent, and individual assent.

3.5 SAMPLE SIZE CALCULATION FOR PREVALENCE STUDY

For the prevalence study, all pupils were invited and all were accommodated who had parental consent and had given individual assent.

Sample size was not the same in the four schools because response in consent from parents of pupils varied from school to school with schools 1 and 2 recording the highest consent from parents and assent of pupils.

3.6 PARTICIPANT RECRUITMENT

The recruitment began mid-August to the third week of September 2014. Consecutive sampling method was employed to get as many participants as were available. This method also discourages intentional and unintentional manipulation by teachers at the schools. This non-probability sampling method was used as it provides access to all available participants, which may make it a better representation of the entire population.

The researcher met deputy principals and Heads of Department, Foundation in all 4 schools to inform them about the study (Appendix A).

Information sheets for parents (appendix B) were then given to the HOD Foundation, for onward transfer to class teachers and on to pupils. Forms returned without parental consent were excluded from the prevalence study.

Pupils with parental consent were given the ‘Pupil information sheet’ (appendix C) to sign by writing their names, if they would like to be in the study.

Measurements were carried out during assembly and break time before lunch was served at the schools.

3.7 DATA COLLECTION TOOLS AND MEASUREMENTS

Measuring Instrument

3.7.1 Height Meter

A stadiometer (floor model) measuring from 20cm to 205 cm without weighing scale attached was used for measuring the height of participants and was recorded to the nearest 0.1m.

3.7.2 Weighing Scale

A Nova analog weighing scale, which was calibrated and checked to minimise errors and recorded to the nearest 0.1, S.I unit in Kg

3.7.3 Tape Measure

A tape measure by H&M was used for the waist and hip circumferences and recorded to the nearest 0.1 S.I unit in centimetres (cm).

3.7.4 Skin-fold Calliper

To measure triceps skin-fold to the nearest 0.1 mm; the slimguide skin-fold callipers were used.

3.7.5 Scientific Calculator

To calculate values for waits-hip ratios, BMI, waist-height ratios (Wang and Chen, 2012)

Anthropometric Indices Measured

3.7.6 Weight Measurement

For the weight measurement, each child was asked to stand on the weighing scale, body weight evenly distributed on both feet. Weight was recorded to the nearest 100g Wang and Chen, 2012)

3.7.7 Height Measurement

Participant is asked to stand on the stadiometer, with feet slightly apart, back of head, shoulders, buttocks and heels touching the frame of the stadiometer. The participant was asked to look straight ahead at a point marked ‘X’, so as to ensure accurate positioning, and the head board was pulled down to rest firmly but gently on the head. Readings were recorded to the nearest 0.1cm (Wang and Chen, 2012)

3.7.8 **Waist Circumference and Hip Circumference Measurements**

WC has been identified as a better predictor of obesity and CVD risk (Mushtaq et al, 2011a). The waist circumference in cm is divided by the height (cm) of the participant. With minimal clothing on, an inelastic tape-measure was used. Participant is standing erect with arms at the sides and feet only slightly apart, while tester places tape around the abdomen at the level of the umbilicus with the participant in mid-expiratory position (this was demonstrated to pupils). Hip circumference was recorded at the widest point in cm over the greater trochanters, and the waist-to-hip ratio calculated Wang and Chen, 2012). Pupils were given numbers as identity to help prevent bias and also blind the researcher.

3.7.9 **Skin-fold Measurements**

Skin-fold measurements were done in 5 locations for each participant. It varied slightly; with males having a triceps measurement, while the females had a calf measurement and the rest were the, biceps, subscapular, suprailiac and thigh (Cameron et al, 2004). According to Cameron et al (2004), fat distribution varied between boys and girls.

Using a non-elastic tape-measure, midway bony landmarks is marked with a non-permanent ink pen. The thumb and fore-finger are used to lightly pick-up skin-fold. The jaws of the calliper are closed around the skin-fold at a right-angle to the fold and held in place for about 3 seconds (Wang and Chen, 2012). Measurements were done on the right side of the body for all participants and recorded to the nearest 0.1mm.

3.7.10 **Body Mass Index (BMI)**

The BMI is a cheap and easy to use method of determining weight status of an individual. This was calculated by dividing the weight of a participant in Kg by the square of their height in m (Wang and Chen, 2012).

3.7.11 **Waist – Hip Ratio (WHR)**

Ratio of the waist circumference in cm divided by the hip circumference in cm (Wang and Chen, 2012).

3.7.12 **Waist – Height Ratio (WHtR)**

This is useful in identifying central obesity and individuals at risk for related cardio-metabolic disorders (Mokha et al, 2010). The waist circumference in cm is divided by the height (cm) of the participant (Wang and Chen, 2012).

3.8 **OUTCOME MEASURES**

3.8.1 **The Global School-Based Health Survey (GSHS): Core Questionnaires**

The GSHS is a compilation of 10 surveys on both health and behavioural needs of school

going children and adolescents (WHO, 2015). According to the WHO, it helps to "provide accurate data on health behaviours and protective factors among students", so as to among other things "help countries develop priorities, establish programs and advocate for resources for school- and youth-health programs and policies". It is also aimed at "establishing trends in the prevalence of health behaviours and protective factors by country for use in school- and youth-health promotion" (WHO, 2015).

The GSHS core questionnaires used in this study were the Global School-Based Health Survey Dietary Behaviour Core Questionnaire (appendix D) and the Global School-Based Health Survey PA Core Questionnaire (appendix E). Both had been deduced from their previous versions which were much more extensive, updated January of 2013. The core questions still serve the purposes for which they were intended, albeit in a less cumbersome way.

The GSHS-dietary behaviour is a 5-item questionnaire inquiring about dietary behaviour of school pupils with respect to breakfast, fast-foods, carbonated drinks, fruit and vegetable consumption. It has been used in several countries for nationally representative data from school going children (WHO, 2013).

The GSHS-PA is a 4-item questionnaire, inquiring about daily activities, duration and frequency. This questionnaire was used to determine current level of PA of participants and also to know if participants partook of Physical Education classes at their respective schools. PA was described to the pupils as any activity that basically increased their heart rate or made them sweat, breathe hard, which can be done in sports as well as riding a bicycle, walking, running, playing after school hours with friends.

This questionnaire, asks about activities in the last 7 days and also within the current school year in which the questionnaire was administered.

3.9 DATA COLLECTION PROCEDURE

The procedure was dully explained to participants and also to the parents of participants in the Pupil Information sheet and Parents' Information sheet. Rights to withdraw at any stage of the study without any consequence to the participants and confidentiality of individual data were also explained to participants, in written form and verbally through the trained research assistants.

The same procedure was followed at all participating schools.

- The questionnaire and anthropometric measures were administered by research assistants during morning assembly and break period. Together with class teachers,

research assistants ensure that pupils did not miss out on any class and lunch meals.

- At each school, participating pupils were called out to the school clinic or makeshift research room made available, depending on each school's facility. Pupils were screened to give room for privacy when taking anthropometric measures. Measurements were recorded on pre-assigned bio-data sheets (appendix F).
- The GSHS were administered in groups in an interview format by the research assistants. The questionnaires were administered to all participants first, thereafter, their anthropometric measures were obtained. Hence, not all who answered the questionnaires had their anthropometric indices taken, as school attendance by pupils vary.
- Measurements were carried out during assembly and break time before lunch was served at the schools.

3.9.1 **Validity**

The GSHS dietary module core-expanded questionnaire used in the pilot study is a 32-item questionnaire that asked about the eating behaviours, attitude, knowledge, skills and sources of information and role of media in advertisement in sale of foods from restaurants. From the pilot study, it was observed that learners have no use of the internet now and also do not own mobile phones, hence do not know much about caloric intake (question 8). This was not appropriate for the age group and class. The GSHS core questionnaire (an abridged version of the GSHS Dietary Module), still asks about eating vegetables, at fast foods which are what may contribute nutritionally to OW/OB in children, hence objective 2 will still be covered.

The researcher after piloting the administration of these questionnaires, decided to present the options in the questions as 3 instead of 7. This was to enable easier comprehension as too many options confused the participants. This was demonstrated during piloting, when participants would indicate more than one option for a particular question. For example, question 2 of the GSHS CORE Module Dietary Behaviour

During the past 30 days, how many times per day did you usually eat fruit, such as apples, oranges, bananas?

a. I did not eat fruit during the past 30 days b. Less than 1 time per day c. 1 time per day d. 2 times per day e. 3 times per day f. 4 times per day g. 5 or more times per day

Hence, researcher after much consideration and deliberation, decided to group the multiple choice answers into just 3, without losing the goal of the question as shown below

During the past 30 days, how many times per day did you usually eat fruit, such as apples, oranges, bananas?

a. I did not eat fruit during the past 30 days b. 1 time per day c. More than 1 times per day

3.9.2 **Reliability**

A pilot study was carried out to ensure reliability of tools. Research assistants were taught before commencing the pilot study how to take the measurements.. Asking the research assistants to be a part of the pilot study further helped familiarise them with the instruments to be used, hence enhancing their skills and confidence.

PART B: PILOT STUDY

The pilot study was done by carrying out the administration of the Global School-based Health Survey – PA and Dietary Modules, and also the anthropometric measurements.

3.10 **AIM OF PILOT STUDY**

To determine the feasibility of the main study.

3.11 **OBJECTIVES OF PILOT STUDY**

Highlight areas that need to be improved upon when conducting the main study, so as to be as accurate as possible and minimise errors.

Familiarise researcher and assistants with the instruments and other outcome measures to be used in the main study.

3.12 **SAMPLE POPULATION FOR PILOT STUDY**

The sample size of 10 per cent of the total sample size of the Intervention study was used for the pilot study. Biometric and anthropometric data were collected. All anthropometric measurements were done by research assistants. Total number of 10 pupils participated in the pilot; 5 from grade 1 and another 5 learners from grade 2 were included in the study. This was done so that each grade will be well represented in the piloting. Consent from parents and assents from pupils were obtained.

3.13 **PROCEDURE FOR PILOT STUDY**

- On first contact with learners:

Researcher administered both questionnaires to participants. However, researcher discovered that learners in grades 1 and 2 are being taught in native language 'Northern Sotho' and 'Southern Sotho', hence could not comprehend nor respond appropriately to outcome measures which were in the English language. Due to the language barrier, researcher met and discussed with class teachers of learners. They agreed to help and were trained to administer the questionnaires, without elaborating in any way. These questionnaires were administered in a group setting of 5 learners in each group.

The anthropometric measures of height, weight, BMI, waist circumference, hip circumference, waist-hip ratio, waist-height ratio, skin-fold thickness and blood pressure were taken by research assistants.

- On second contact with learners:

  The trained teachers administered the questionnaires as follows:
  - Grade 2 had both the GSHS PA and dietary behaviour module administered.
  - Grade 1 had only the GSHS PA administered, as lunch break was over by then.
  - A third teacher who didn't know that the questionnaires were written in English, confirmed that learners were not in any way given clues while the teachers read the questions out in the language understood by learners.

  The anthropometric measures as above were retaken by research assistants. This was to familiarise them with the measurements and check intra-tester reliability.

3.14 FINDINGS FROM PILOT STUDY

- The GSHS Core questionnaires for both dietary and physical activity modules will be used in the prevalence study
- Schools had limited time to permit learners out of the classroom to participate in the study, therefore attempting to translate the questionnaires, doing a validation which would require frequent visits with learners and would not allow them be a part of the regular but important school activities. Hence, the afore-mentioned approach was sought.
- It was agreed that the contact times with pupils for the prevalence and intervention studies be early during assembly times and the first half of the break period. This is to enable pupils be part of the academic calendar of the school.
- Physical fitness test (20m shuttle run) could not be piloted because, researcher had only a part of the break-time and learners had to go get some lunch before returning to the classroom

PART C: INTERVENTION STUDY

3.15 STUDY DESIGN

The intervention study was an experimental study to determine the effect of physical activity on selected anthropometric indices and fitness level of participants which was compared with a control group.

3.16 STUDY SETTING

The intervention study involved only 2 of the 4 primary schools; 1 as an intervention group and the other as control group.

3.17 STUDY POPULATION

The study population comprised pupils from grade level 1-2 from 4 government primary schools in a locality within the Alexandra Township. Alexandra is a low income community, situated close to more affluent Sandton community. Found in the Gauteng province and City of Johannesburg Municipality, Alexandra was established in 1912. Most residents are black Africans from the Census (2011). Alexandra has such a rich history built on the struggles for acceptance of the black community as permanent residences of the city (Wikipedia, 2015).

Inclusion Criteria:

- current pupils at selected primary schools in Alexandra, within selected grade levels.
- apparently healthy, not known to have any form of debilitating illness (informed consent form appendix C).
- children whose parents have given their consent and also assented to the study themselves (appendix D)
- Pupils with BMI-for-age scores from the 75th percentile and over were selected from both schools to be a part of the intervention study.

Exclusion Criteria:

- pupils who do not fall within the specified grade levels.
- Pupils not willing to participate or without parental consent will be excluded.
- Pupils with conditions in which exercise is contra-indicated or with neurological deficits that alter muscle tone and affect balance. Also, asthmatic pupils and those with frequent nose-bleeds and headaches were excluded from the intervention.

Withdrawal Criteria:

- Unwillingness on the part of the pupil to continue with study.
- Parental wish to withdraw child from study.

3.18 SAMPLE SIZE CALCULATION FOR THE INTERVENTION STUDY

Sample size was calculated using the sample size formula for difference in means using 1 of the physical indices, BMI, to be measured. According to Nemet et al (2005) a standard deviation of ± 1.0 was used which gave a rather small sample size. For this study, assuming a variation in population as compared to the earlier study, standard deviation was adjusted for at ±1.5 giving a variance of 2.25, power of 90% which has a value of 1.28, significance of 1.96, $\alpha = 0.5$ and difference to be the sum of mean differences for both intervention and control groups, minimum sample size of 21 participants will be needed for each group (control and intervention) to detect a difference in means of 1.5. All pupils in Grade levels 1-2 (aged 6-9 years) were invited to participate in the study. After the selection process, a total of 46 participants were selected in schools 1 and 2. In school 1, the intervention group had 24 participants at the first week. School 2, the control group had 22 participants.

3.19 PHYSICAL MEASUREMENTS IN INTERVENTION STUDY

Measurements for the intervention study were taken at baseline, 6 weeks and 3 months from the baseline by research assistant. Assessments were carried out by three assistants. Research assistants registered students at the University of Witwatersrand running a PhD in Physiotherapy (2) and Msc. Nursing degrees (1). Researcher went over the measurements, the purpose for these measurements with the assistants. They also participated in the pilot study. For these measures, excluding the 20m shuttle run test, participants wore minimum clothing. Shoes, hats, and hair ornaments were removed. Also, the girls were measured first in the room set-up for the sole purpose of measurements, thereafter the boys were assessed.

The anthropometric measures were the same as the prevalence study and these have been described in Part A, Section 3.6.

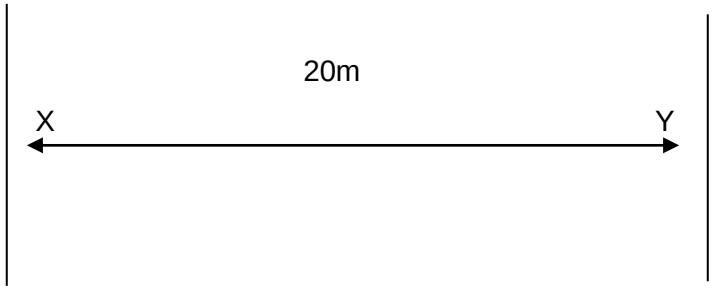
The only different measurements are the 20m shuttle run tests and the blood pressure which are described below.

3.19.1 Physical Fitness: 20m Shuttle Run Test

The 20m shuttle run test was developed when it became necessary to have standardised tests that are applicable to children of all age groups worldwide (ALPHA, 2007). These tests are valid, reliable, safe, and cost-friendly. They were developed by the working group under the Instruments for Assessing Levels of Physical Activity and Fitness (ALPHA) to

assess health-related physical fitness in children and adolescents (ALPHA, 2007). It is used to assess cardio-respiratory fitness of participants in the intervention study only. The test was carried out on a plain flat surface (school play area).

A 20m margin was mapped out and end lines drawn in the dirt as markers. Participants were grouped into 5 groups of 10. The fitness test was clearly explained and then demonstrated for participants. Participants were asked to listen to the whistle and simply excuse themselves once they feel they couldn't go on. Initially, participants were instructed to start out slowly but steady and may increase pace gradually. Participants who couldn't meet up with the end lines (X and Y) on 2 consecutive occasions as the whistle, and or became fatigued were taken out. Participants were asked to note their level number, and adequate records were taken. 20m shuttle run test was performed thrice, once pre-intervention, once, post-intervention and lastly, once at follow-up.



3.19.2 **Blood Pressure, Respiratory Rate**

Increasing prevalence of cardiovascular diseases (CVD) risk-factor cluster in children call for regular screening of children in all age groups (Anderson, 2011), with special focus on the systolic blood pressure. The blood pressure is measured alongside other items like the skin-fold thickness, total cholesterol and more.

Individual blood pressure was taken for each participant in the intervention study and required protocols were observed. Participants were reassured that no harm was coming to them. Each child was in a chair and told to relax. The left upper limb was placed on a table and the person taking measurements sat at face level in front of the child. For the anxious participant, time was given to them to calm down as taking measurements at that time may affect the reading.

The respiratory rate was also measured by the digital blood pressure monitor

3.19.3 **Heart Rate**

Heart rate of participants was measured by observing closely and noting the expansion of the anterior chest wall in breathing in sixty seconds

Record Keeping

3.19.4 **Bio-Data Form**

This form (appendix F) contains demographic data of participants and the anthropometric data to be collected. It was completed by research assistant when filling in the anthropometric data measured.

3.19.5 **Daily Attendance Record**:

This form (appendix G) helped to keep daily attendance and also records of heart rate, respiratory rate and blood pressure before and after exercise.

3.20 **THE INTERVENTION**

Intervention involved physical activities based on the recommendations from the PA guidelines for children and adolescent by Rink et al (2010) and Ainsworth et al, 2000. Two primary schools were chosen to be the control and intervention schools by convenience. Both groups had their baseline anthropometric measures taken by research assistants during the prevalence study. However, physical fitness tests (the 20m shuttle run test) blood pressures were done for the control and intervention group pre- and post-intervention by research assistants. The intervention was carried out by the researcher. Each session began with warm up exercises of 5minutes each day and ended with a cool down, consisting of a combination of stretches and light aerobic exercise, and lasted 30-45 minutes. Pupils were put into 2 groups; grouping enabled more control. Below are the 6 weeks exercise programs (moderate – vigorous intensity) with metabolic equivalent values (MET).

- Stair climbing (no running) – 3.5 (MET)
- Football – 4.0 (MET)
- Brisk walking – 5.0 (MET)
- Catch and Foursquare – 5.0 (MET)
- Aerobic dance class – 6.5 (MET)
- Running (tag, races) – 7.0 (MET)

See Appendix H for break-down of exercises.

3.21 **ETHICAL CONSIDERATIONS**

Ethical approval was sought from the Ethics and Research Committee at the University of Witwatersrand (No: M140617), Gauteng Department of Education, Johannesburg East District Office, and Principals of all 4 schools gave permissions to conduct the study in

primary schools in Alexandra (appendices I-M). Informed consent of the parents of participants and assent from participants were obtained by asking parents/guardians pupils for their signatures (appendices B-C). The information included explicit information on the aims and objectives of the research. Right of withdrawal, anonymity and confidentiality of information were explained to the participants, through the class teachers who spoke in the language of learning, and parents of participants in the write up. Feedback of parental consent or otherwise was encouraged by imploring school authorities ask parents to consider as important.

Intent of research was duly explained to pupils using the four principles of ethics namely

- Autonomy: the pupils were informed that they could remove themselves from the study at anytime without any adverse effects to them.
- Beneficience: the researcher informed pupils in the assent form that the study was to benefit the overall health of the population of students, as it helps know where to focus with respect to childhood overweight and obesity. In no way is the study to be discriminatory or attribute stigma to anyone.
- Non-maleficience: Pupils were told all aspects of the study as pertains to them, and were allowed to ask questions when researcher obtained their assent and picked up consent forms attested to by parents/guardians
- Justice: pupils were treated as equals, not based on gender, colour, class

Parents, who were concerned about the overall status of their children, were duly attended to, without putting other participants' data at risk.

3.22 DATA ANALYSIS

The table below gives an outline of the statistical tools used to analyse data in this study. Data analysis was done using the SPSS version 22. Significance p was set at < 0.05

The BMI-for-age was calculated using the Anthropometric Reference Data for Children and Adults: United States, 2007–2010 United States Department of Health and Human Services Centres for Disease Control and Prevention National Centre for Health Statistics, vital and Health Statistics (2012) (appendix N).

Table 3.1: Statistical Tests and Tools used in the Study

Objective	Outcome Measure	Type Of Data	Statistical Test
1	Main outcome – BMI Secondary outcome – Weight, Waist and Hip circumferences, Waist/hip ratio, Waist-height ratio, Biceps-Subscapular-Suprailiac-Thigh skin-fold	Continuous data	Means and Standard Deviation

2	GSHS- Dietary Module, BMI	Ordinal data	Spearman Rho's Correlation Linear Regression – Stepwise method
3	GSHS – Physical Activity Module	Ordinal data	Frequencies
4	BMI, 20m shuttle run test, Weight, Waist and Hip circumferences, Waist/hip ratio, Waist-height ratio, Triceps-Biceps-Subscapular-Suprailiac-Thigh-Calf skin-fold	Continuous data	Means, Standard deviation, t-Test (Paired Samples and Independent Samples), Analysis of CoVariance

Analysis of Covariance (ANCOVA) was performed to determine the effect of baseline variables in the control and in the intervention groups on the post intervention measures. For the purpose of this study, reference values for WC AND BMI used were from the CDC Anthropometric Reference Data for Children and Adults: United States, 2007 – 2010. WHtR values at less than 0.46 males and 0.45 females were considered low, while values above that were considered high. WC reference values were depicted as low (< 0.9males and < 0.85 females), normal (0.9 males and 0.85 females) and high (>0.9 males and >0.85 females) (WHO, 2008)

3.23 SUMMARY OF THE METHODOLOGY

This is a school-based physical activity intervention in 3 parts i.e. Part A (Prevalence Study), Part B (Pilot Study) and Part C (Intervention Study).

Part A (Prevalence Study) is a quantitative cross-sectional descriptive study, hence anthropometric measurement and the GSHS questions were once off. It had all participants who had both parental consent and informed assent.

Part B (Pilot Study) was carried out to determine the feasibility of the study. Factors such as language barrier, time constraints were identified and necessary adjustments made to enable effective running of the main study

Part C (Intervention Study) is an experimental study that compared effect of physical activity on some mentioned anthropometric indices and fitness of the participants. The study had an intervention group and a control group for comparison. Both groups were children with BMI greater than the 75th percentile. Measurements were taken at baseline, 6 weeks and 3 months from baseline for both groups.

CHAPTER 4

4. RESULTS

4.1 INTRODUCTION

The results of the prevalence and intervention studies are presented in 3 parts: Part A – Socio-Demographic Data, Part B - Prevalence Study and Part C – Intervention Study in this chapter.

The prevalence study involved a once-off measurement of anthropometric indices and response from the Global School-Based Health Survey (GSHS) questionnaires comprising the Physical Activity and Dietary Behaviour Modules of pupils in Grade 1 and 2 of 4 participating schools in Alexandra, Johannesburg.

The intervention study was 6 weeks of designed exercise program for the intervention group, while the control group had no exercises, but was free to carryout regular day-to-day activities. Also, anthropometric measures and physical fitness tests were obtained pre- and 6 weeks post intervention. A 3 month follow up assessment, from the baseline anthropometric measurements of participants of the intervention study, was done. Results of within group analyses and between groups analyses are also presented in this chapter. The results are presented graphically and by tables.

The first part comprises results of the overweight and obesity prevalence among participants, dietary contribution to overweight/obesity and the physical activity involvement of participants.

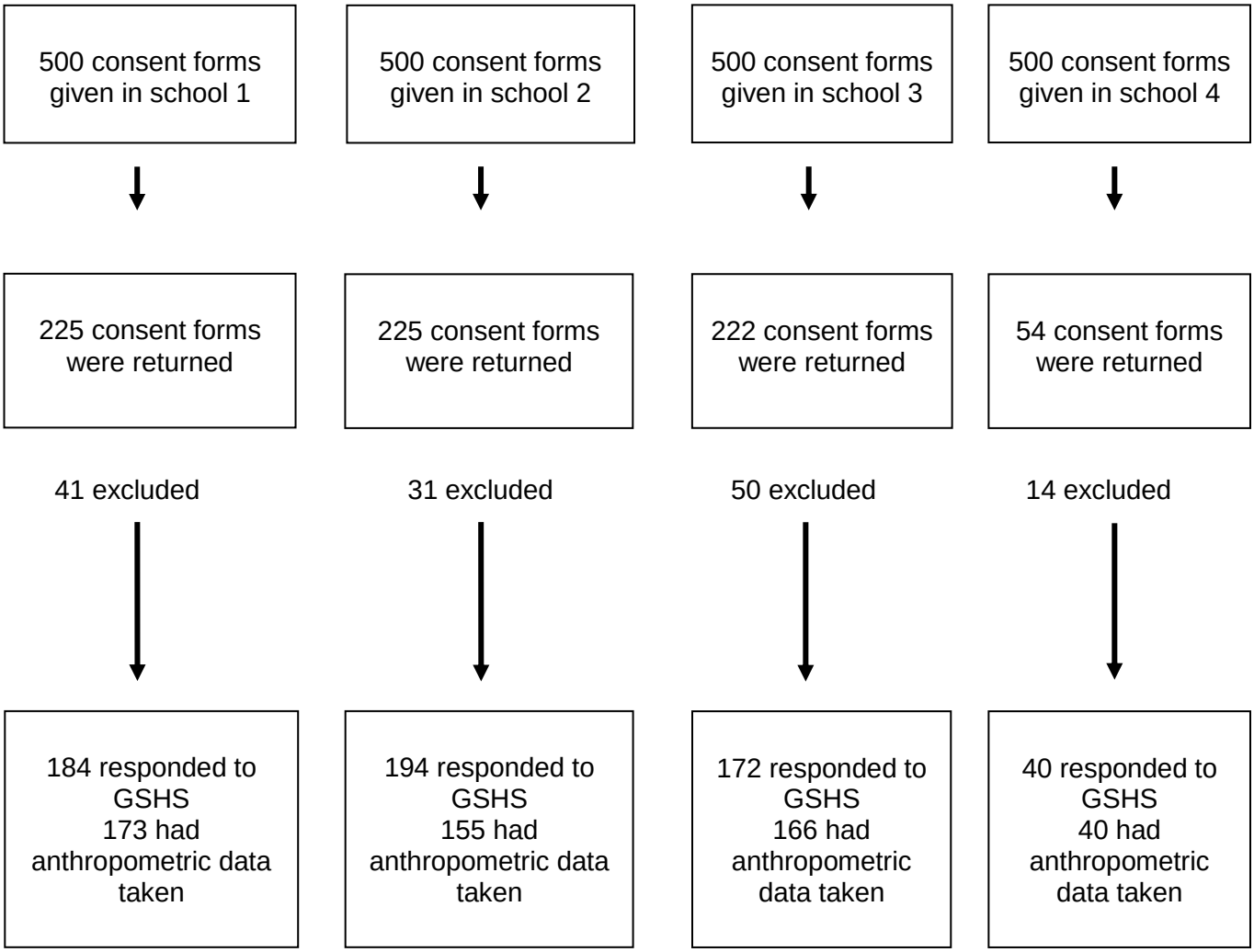


Figure 4.1: Flow of Participants' Recruitment in the Prevalence Study

Due to limited contact time with learners, anthropometric measures were not all taken the same week in all 4 schools. Questionnaires were administered in interview format and were not done on the same day as the anthropometric measurements. Hence, not all participants had both anthropometric and questionnaires administered to them. This explains the disparity in population who had their anthropometric data taken and those who had the questionnaire administered to them

PART A: SOCIO-DEMOGRAPHIC DATA

4.2 SOCIO-DEMOGRAPHIC PROFILE OF PARTICIPANTS

Table 4.1: **Frequency Distribution of Socio-Demographic Profile of Participants (% in columns)**

		School 1 n(%)	School 2 n(%)	School 3 n (%)	School 4 n(%)
Variables (N=580)		**n=184**	**n=189**	**n=167**	**n=40**
Gender	Male	83(45.1)	90(47.6)	76(45.5)	19(47.5)
	Female	101(54.9)	99(52.4)	91(54.5)	21(52.5)
Age(yr)	Mean age ± SD	7.06±0.89	7.31±0.96	7.43±0.89	6.8±0.82
Grades	1	98(53.3)	88(46.6)	65(38.9)	19(47.5)
	2	86(46.7)	101(53.4)	102(61.1)	21(52.5)

There were generally more female participants from each school than males. School 4 had the least number of participants.

PART B: PREVALENCE STUDY

4.3 PREVALENCE OF OVERWEIGHT/OBESITY

The first objective of the study was to determine the prevalence of overweight and obesity among grade 1 and 2 pupils of 4 primary schools in a cluster in Alexandra. BMI is the primary outcome measure in the study.

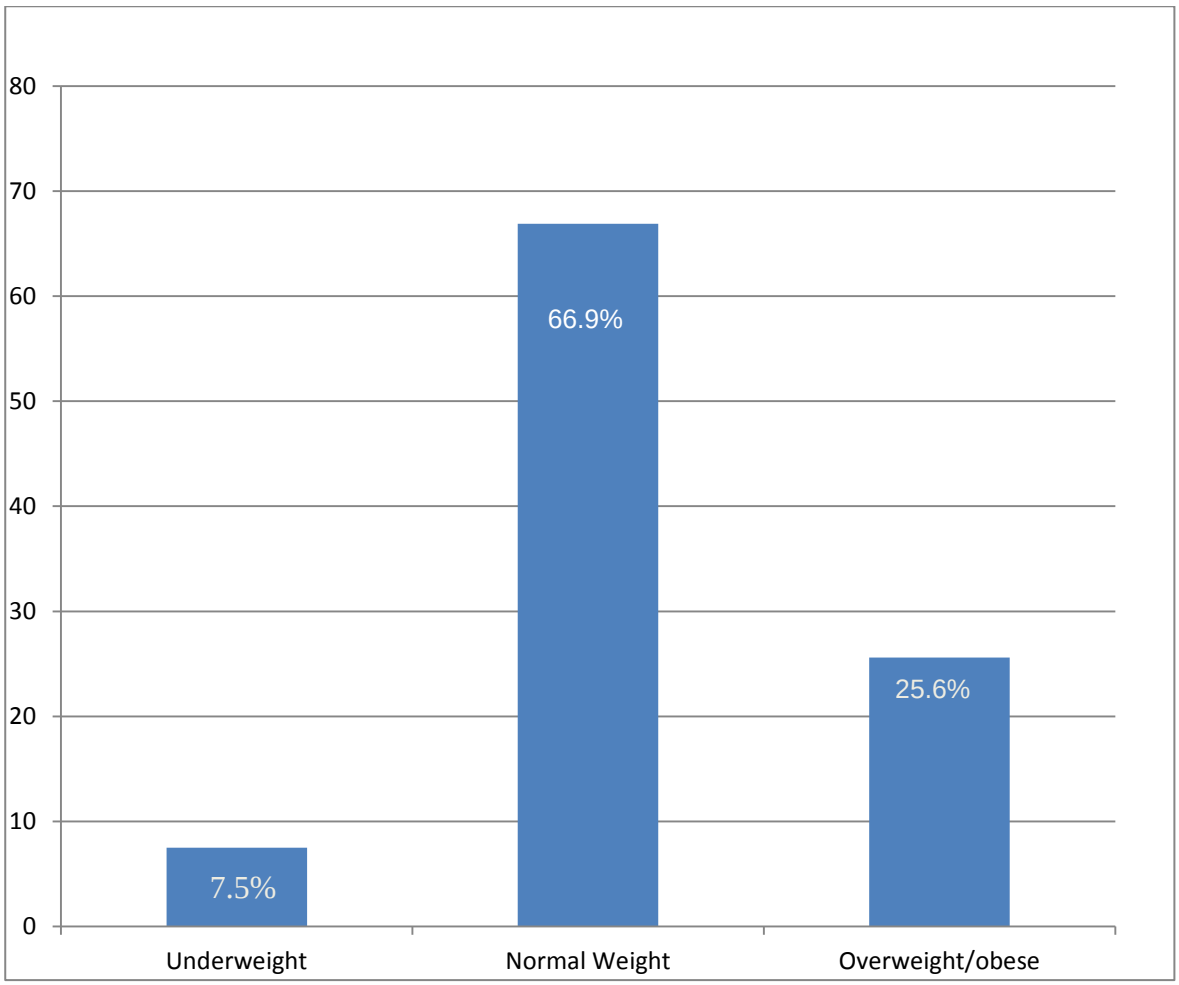


Figure 4.2: Distribution of Weight among Population using the BMI

The prevalence of obesity and overweight among this population group was 25.6%, while underweight was at 7.5%.

Table 4.2: BMI, Waist Circumference, Waist-hip Ratio, and Waist-height Ratio by Sex of Participants

		Male n(%)	**Female** n(%)
		n=268	n=312
BMI	Underweight	19(7.1)	23(7.9)
	Normal Weight	167(62.3)	207(71.1)
	Overweight/obese	**82(30.6)**	**61(21)**
Waist Circumference	Normal	266(99.3)	287(98.6)
	High	**2(0.7)**	**4(1.4)**
Waist-Hip Ratio	Low	131(48.9)	19(6.5)
	Normal	135(50.4)	142(48.8)
	High	2(0.7)	130(44.7)
Waist-Height Ratio	Low	165(61.6)	170(58.4)
	High	103(38.4)	121(41.6)

In this population 30.6% males and 21% female were overweight and or obese. Females had a higher population with increased waist circumference at 1.4% and males at 0.7%.

Table 4.3: Anthropometric Description by Sex of Participants

Variable	**Sex**		***P-Values***
	Male n = 268 $\bar{X}$ ± S.D	**Female n = 312** $\bar{X}$ ± S.D	
Height (m)	1.19±0.0	1.17±0.07	***0.000***
Weight (kg)	23.67±4.46	22.24±3.97	***0.000***
BMI (kg/m^2)	16.43±2.39	16.04±2.20	*0.046*
BMI Percentile	2.23±0.57	2.13±0.52	*0.024*
Waist Circumference (cm)	56.00±4.34	55.72±4.47	*0.454*
Waist Circumference Percentile	2.01±0.86	2.01±0.12	*0.472*
Hip Circumference (cm)	64.94±5.37	65.17±5.67	*0.629*
Waist-Hip Ratio	0.52±0.52	1.38±0.61	***0.000***
Waist-Height Ratio	1.38±0.49	1.42±0.49	*0.449*
Biceps (mm)	5.68±2.04	6.30±2.35	***0.001***
Subscapular (mm)	6.51±1.99	7.74±2.8	***0.000***
Suprailiac (mm)	6.31±2.56	7.71±3.16	***0.000***
Thigh (mm)	11.71±3.89	14.57±4.78	***0.000***

There is significant difference in the height (males are taller) and weight (males weigh more) of the population. However, there is no significant difference in their BMI (*p=0.046*). There is significant difference in the waist-hip ratio of participants with females having a higher value compared to the males (*p=0.000*). There is a significant difference in the skin-fold thickness measured with females having greater values (biceps *p=0.001*; subscapular *p= 0.000*; suprailiac *p=0.000* and thigh *p=0.000*). The Calf and Triceps skin-fold thickness were excluded because they were exclusive to a specific gender and not across both genders.

4.4 CONTRIBUTION OF NUTRITION TO OVERWEIGHT/OBESITY

The second objective was to establish the contribution of nutrition to overweight/obesity among school pupils in Alexandra, with BMI as the main Outcome Measure. Spearman's Rho correlation and linear regression (stepwise method) were used. Correlation between variables of the GSHS-Dietary Behaviour Module and the BMI will be depicted in Table 4.4. Table 4.5 will depict the Predictors in the model

Table 4.4: Correlation between variables of the GSHS-Dietary Behaviour Module and the BMI (p<0.05)

		Eats Fruits	Eats Vegetables	Eats Fast-foods	Carbonated Drinks	BMI
Hungry at Home	Coefficient Sig. (2-tailed) N	-0.783 *0.000* 580	-0.744 *0.000* 580	-0.670 *0.000* 580	-0.759 *0.000* 580	-0.018 *0.665* 559
Eats Fruits	Coefficient Sig. (2-tailed) N		0.835 *0.000* 580	0.788 *0.000* 580	0.806 *0.000* 580	0.058 *0.175* 559
Eats vegetable	Coefficient Sig. (2-tailed) N			0.785 *0.000* 580	0.847 *0.000* 580	0.051 *0.225* 559
Eats Fast-foods	Coefficient Sig. (2-tailed) N				0.890 *0.000* 580	**0.117** ***0.006*** **559**
Carbonated Drinks	Coefficient Sig. (2-tailed) N					**0.101** ***0.016*** **559**

There is a significant positive correlation between BMI/"eats fast-foods" and BMI/ "carbonated drinks" with þ= 0.117, *p<0.05* and þ=0.101, *p<0.05* with low association. The low association shows that other factors may be influential in contributing to BMI of participants.

Table 4.5: Predictors in the model, using the Linear Regression-Stepwise Method

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	15.566	.225		69.189	**0.000**
	Eats Fast-foods	.444	.137	.136	3.251	**0.001**
2	(Constant)	14.781	.413		35.820	**0.000**
	Eats Fast-foods	.722	.183	.222	3.941	**0.000**
	Hungry at Home	.373	.164	.128	2.267	0.024

Using the Linear regression (stepwise method), 2 models fit: the "eats fast-food", which is a strong predictor of change in BMI with R^2= 1.9%, and a combination of "hungry at home and eats fast-foods" which together account for R^2= 2.8% of the change in BMI. Other factors such as the "eats fruits", "eats vegetables", and "carbonated drinks" were excluded due to their Co-linearity effects in the models.

Therefore, "eats fast-food" and a combination of "eats fast-food and hungry at home" are the 2 predictors of change in BMI of the population studied. Other factors were excluded due to their co-linearity.

Table 4.6: Global School Health Survey: Dietary Module

Questions No	GSHS – Dietary Module	n (%)
1. During the past 30 days, how often did you go hungry because there was no food in your home?	a) Always hungry	173 (31.2)
	b) Sometimes hungry	**226 (39.0)**
	c) Never hungry	181 (29.8)
2. During the past 30 days, how many times per day did you usually eat fruit, such as apples, oranges, bananas?	a) Did not eat fruits	51 (8.8)
	b) Ate fruit 1time/day	215 (37.1)
	c) Ate>1fruit/day	**314 (54.1)**
3. During the past 30 days, how many times per day did you usually eat vegetables such as spinach, lettuce?	a) No vegetables	54 (9.3)
	b) Ate vegetables 1time/day	158 (27.2)
	c) Ate vegetables>1time/day	**368 (63.4)**
4. During the past 30 days, how many times per day did you usually drink carbonated soft drinks such as Coke, Iron Brew, Fanta?	a) No carbonated drinks	77 (13.3)
	b) Carbonated drinks 1time/day	158 (27.2)
	c) Carbonated drinks>1time/day	**345 (59.5)**
5. During the past 7 days, on how many days did you eat "KOTA" or food from a fast food, restaurant, such as KFC, Chicken-Licken?	a) No fast-foods	70 (12.1)
	b) Ate fast-foods 1 day	146 (25.1)
	c) Ate fast-foods>1day	**364 (62.8)**

Most participants were sometimes hungry (39.0%), however those who were never hungry (29.8%) were fewer in number when compared to those who were always hungry (31.2%).

Participants in all 4 schools generally ate more than 1 fruit in a day ranging from apples, to oranges, peaches and plum which are readily available and affordable and were sometimes served to participants at school.

As seen with fruits, a greater percentage (63.4%) of participants enjoyed vegetables more than 1 time in a day.

Fewer participants (13.3%) said they have had no carbonated drinks in the past 30 days prior to the questioning. And a much more percent still maintained that they had enjoyed carbonated drinks in the past 30 days. Results indicated that more participants (87.9%) have had food from a fast-food outlet/restaurant or eaten “KOTA” (meal of Russian sausages, atchar, cheese, wors, fries and quarter loaf of bread) in the past 7 days.

4.5 PHYSICAL ACTIVITY INVOLVEMENT OF PRIMARY SCHOOL PUPILS

Table 4.7: Global School Health Survey: Physical Activity Module

Questions No	GSHS – Physical Activity Module	n(%)
1. During the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day? Add up all the time you spent in any kind of physical activity each day?	a) Active <1dayof 60mins/week	**323(55.7)**
	b) Active 1day of 60mins/week	136(23.4)
	c) Active>1day of 60mins/week	121(20.9)
2. During the past 7 days, on how many days did you walk or ride a bicycle to or from school?	a) <1day of walk to school	189(32.6)
	b) 1day of walk to school	62(10.7)
	c) Walked to school >1 day	**329(56.7)**
3. During this school year, on how many days did you go to physical education and lifestyle (PE) class each week?	a) <1day of PE	**416(71.7)**
	b) 1day of PE	100(17.2)
	c) >1day of PE	64(11.1)
4. How much time do you spend during a typical or usual day sitting and watching television, playing computer games, talking with friends, or doing other sitting activities, such as hand-washing laundry?	a) <1hour	69(11.9)
	b) 1 -2 hours	185(31.9)
	c) >2hours	**326(56.2)**

Only 32.6% of participants said they walked for less than 1 day to school in the last 7 days (this means they walked 1 half and rode in a vehicle the other half), however 67.4% reported to have walked for 1 day and more in the last week. Attendance at Physical

Education (PE) classes for less than a day (which is not equal to the regular amount of time spent in other subjects) was reported at 71.7%. More participants, 88.1%, reported watching television or being engaged in sitting activities for at least an hour in the past week.

PART C: INTERVENTION STUDY

Results of the intervention study are presented in the third part of this chapter. It begins with the socio demographic profile of participants who took part in the intervention study.

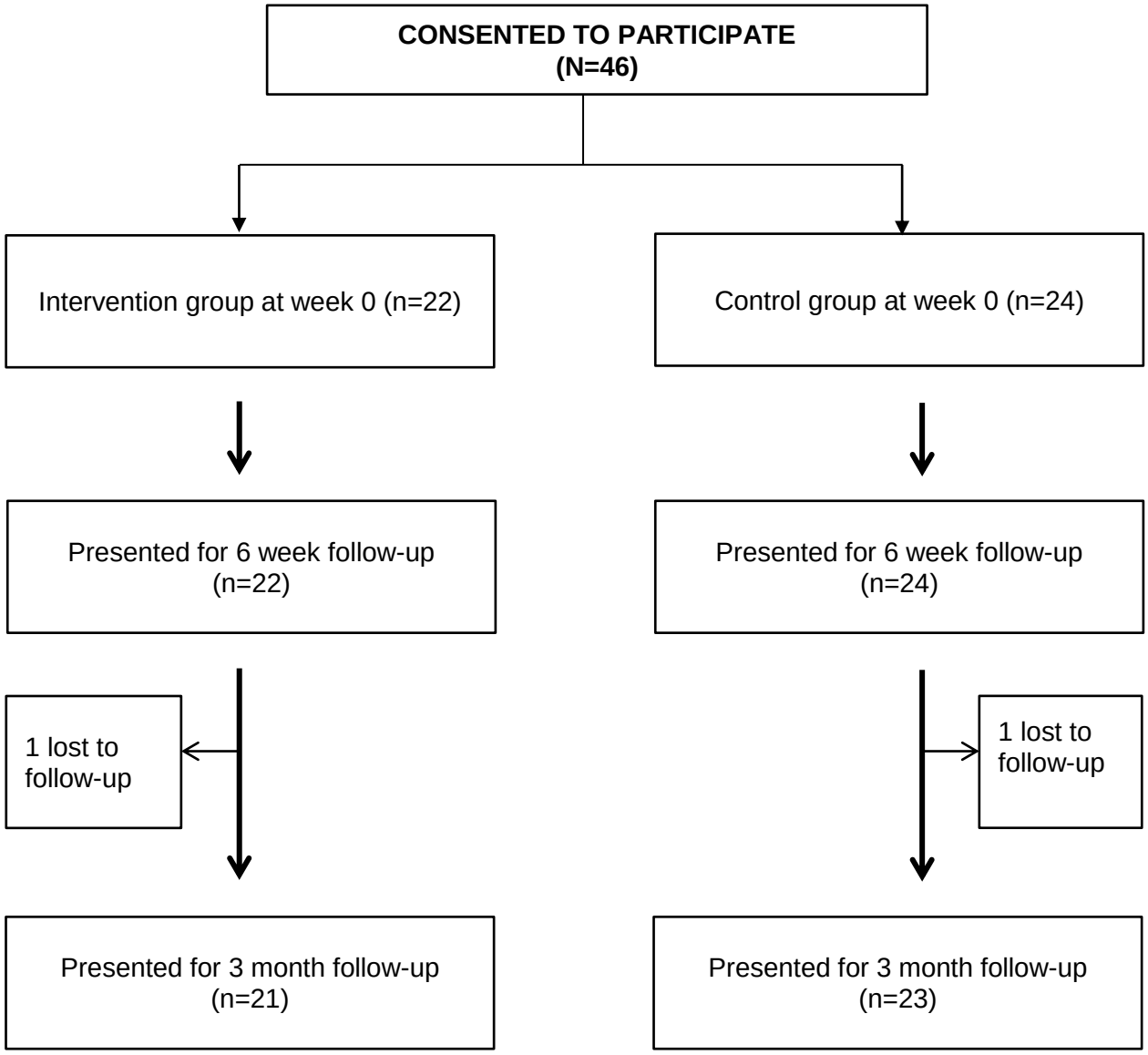


Figure 4.3: **Flow of Participants in the Main Study from Baseline to Follow-Up and Showing Loss of Participants at Follow-Up**

4.6 SOCIO-DEMOGRAPHIC PROFILE OF PARTICIPANTS IN THE INTERVENTION STUDY

A total of 46 participants were in the intervention study, with 24 in the Control Group and 22 in the Intervention group. Twenty participants were in the first grade, while 26 were in the second grade. All participants had their anthropometric measures and cardiovascular measures taken at baseline and after the 6 weeks intervention period. These measures are represented in the tables below.

Table 4.8: Socio-Demographic Profile of Participants of the Intervention Study

Total n		**Control Group**	**Intervention Group**
Sex (n=46)	Male (n=21)	14(58.2)	7(31.8)
	Female(n=25)	10(41.7)	15(68.2)
Grade (n=46)	Grade 1 (n-20)	13(54.2)	7(31.8)
	Grade 2 (n=26)	11(45.8)	15(68.2)

4.7 EFFECTS OF SHORT-TERM INTERVENTION ON SELECTED ANTHROPOMETRIC MEASURES AND PHYSICAL FITNESS

Table 4.9: Results within Groups at Baseline and 6 Weeks for the Control Group

	Control Group		
	Baseline	6 weeks	P-values
Males (n=29)	14	14	
Females(n=17)	10	10	
20m Fitness Test	2.28±0.63	3.63±1.56	**.001**
BMI	15.47±1.21	17.6±1.52	**.000**
Waist Circumference	55.42±3.29	56.32±3.17	.201
Hip Circumference	66.07±4.77	66.47±5.13	.618
Waist-Hip Ratio	0.84±0.05	0.85±0.04	.643
Waist-Height Ratio	1.33±0.48	1.45±0.50	.266
Biceps	5.85±1.62	5.06±1.27	**.005**
Triceps	8±2.66	7.14±1.97	**.010**
Calf	12.7±3.91	10.85±2.8	**.017**
Subscapular	7.85±2.01	6.41±1.56	**.000**
Suprailiac	9.2±3.07	8.27±2.89	**.072**
Thigh	13.81±4.08	13.33±3.44	.410

There was an increase in fitness level for the control group. The control group also had an increase in BMI after 6 weeks and reductions in biceps, triceps, calf, subscapular and suprailiac.

Table 4.10: Results within Group at Baseline and 6 Weeks for the Intervention Group

	Intervention Group		
	Baseline	6 weeks	*P-values*
Males (N=29)	15	15	
Females(N=17)	7	7	
20m Fitness Test	2.27±0.65	3.6±1.32	***.000***
BMI	19.14±2.93	19.62±2.36	*.388*
Waist Circumference	62.0±5.2	60.3±5.2	***.000***
Hip Circumference	73.8±6.6	71.9±6.1	***.047***
Waist-Hip Ratio	0.84±0.03	0.84±0.04	*.186*
Waist-Height Ratio	1.77±0.42	1.77±0.42	*1.000*
Biceps	9.75±3.25	7.38±2.87	***.000***
Triceps	11.21±3.05	9.64±2.05	*.094*
Calf	16.26±4.99	13.86±3.15	***.039***
Subscapular	12.15±4.87	10.45±5.05	***.005***
Suprailiac	14.5±5.06	13.2±5.59	*.096*
Thigh	22.0±7.88	19.61±7.73	***.042***

The intervention group recorded significant improvements in Fitness, waist circumference, hip circumference, biceps, calf, subscapular and thigh at 6 weeks. However, the intervention group did not increase in BMI.

There were significant differences between the baseline values of some variables of control and intervention subjects. Analysis of Covariance (ANCOVA) was performed to determine the influence of the baseline values of these variables on measures of same variables 6 weeks post intervention.

Table 4.11: Results at Baseline between Control and Intervention Groups

	Control (n=24) **Baseline**	Intervention (n=22) **Baseline**	P-values
20m Fitness Test	2.28±0.63	2.27±0.64	0.957
BMI	15.47±1.21	19.14±2.93	**0.000**
Waist Circumference	55.42±3.29	62.02±5.22	**0.000**
Hip Circumference	66.07±4.77	73.86±6.63	**0.000**
Waist-Hip Ratio	0.67±0.70	0.95±0.72	**0.178**
Waist-Height Ratio	1.33±0.48	1.77±0.42	**0.002**
Biceps	5.85±1.62	9.79±3.23	**0.000**
Triceps	8.00±2.66	11.21±3.05	**0.022**
Calf	12.7±3.91	16.26±4.99	**0.070**
Subscapular	7.85±2.01	12.15±4.87	**0.001**
Suprailiac	9.2±3.07	14.5±5.06	**0.000**
Thigh	13.81±4.08	22.04±7.88	**0.000**

No significant improvement in Fitness level between groups at baseline (*p=0.957*) and at 6 weeks (*p=0.947*). However, significant differences were seen at baseline (*p=0.000*) and 6 weeks (*p=0.001*) in the BMI between groups with control group increasing in BMI and intervention group maintaining their BMI.

Table 4.12: Results at 6 Weeks between Control and Intervention Groups

	Control (n=24) **6weeks**	Intervention (n=22) **6weeks**	*P-values*
20m Fitness Test	3.633±1.56	3.6±1.32	*0.947*
BMI	17.6±1.52	19.62±2.36	***0.001***
Waist Circumference	56.32±3.17	60.35±5.17	***0.002***
Hip Circumference	66.47±5.13	71.96±6.19	***0.002***
Waist-Hip Ratio	0.74±0.73	1.0±0.75	***0.124***
Waist-Height Ratio	1.45±0.50	1.77±0.42	***0.028***
Biceps	5.06±1.27	7.38±2.87	***0.002***
Triceps	7.14±1.97	9.64±2.05	***0.014***
Calf	10.85±2.80	13.86±3.15	***0.023***
Subscapular	6.41±1.56	10.45±5.05	***0.001***
Suprailiac	8.27±2.89	13.2±5.59	***0.001***
Thigh	13.33±3.44	19.61±7.73	***0.002***

No significant improvement in Fitness level at 6 weeks (*p=0.947*). However, significant differences were seen at 6 weeks (*p=0.001*) in the BMI between groups with control group increasing in BMI and intervention group maintaining their BMI.

Table 4.13: Results of the ANCOVA analysis at Baseline and 6 Weeks for the Control and Intervention Groups

	Sum of Squares	Df	Mean Square	F	Sig.
BMI	4.332	1	4.332	1.351	0.252
Waist Circumference	40.477	1	40.477	7.012	**0.011**
Hip circumference	0.030	1	0.030	0.002	0.965
Waist – hip Ratio	0.001	1	0.001	0.336	0.565
Waist – height Ratio	0.005	1	0.005	0.024	0.878
Biceps	1.686	1	1.686	0.804	0.375
Triceps	1.438	1	1.438	1.358	0.260
Subscapular	12.671	1	12.671	3.249	0.079
Thigh	5.666	1	5.666	0.378	0.542

The analysis showed no significant influence of the baseline values in both the control and intervention group on the post intervention measurements except for the waist circumference.

4.8 RESULTS OF THE FOLLOW-UP MEASUREMENTS 3 MONTHS FROM BASELINE

The graphs below (Figure 4.3-Figure 4.8) present the results of follow-up measurements at 3 months from baseline for both intervention and control groups graphically.

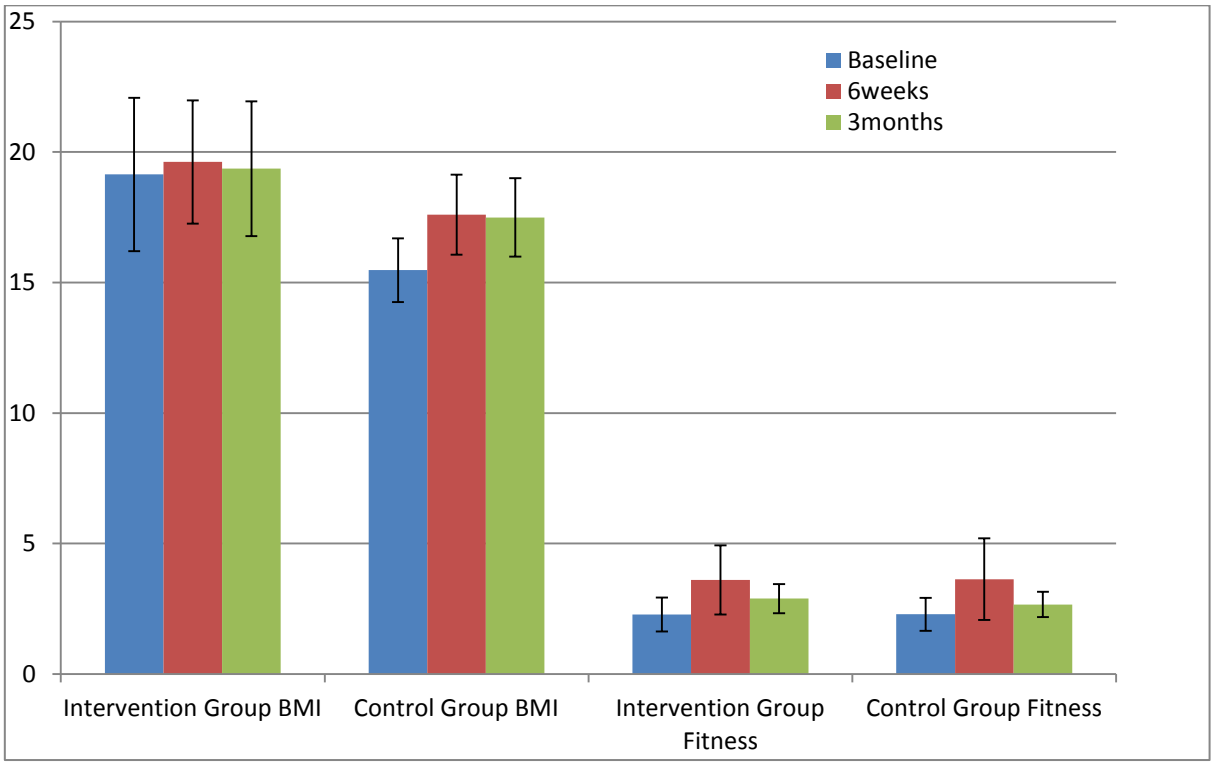


Figure 4.4: **BMI and Fitness Tests for Intervention and Control Groups at Baseline, 6 Weeks and 3 Months from Baseline**

Participants' BMI increased between baseline and 6 weeks and only slightly decreased at 3month follow up for both groups. The Fitness level increased in both groups at 6weeks and dropped at 3months.

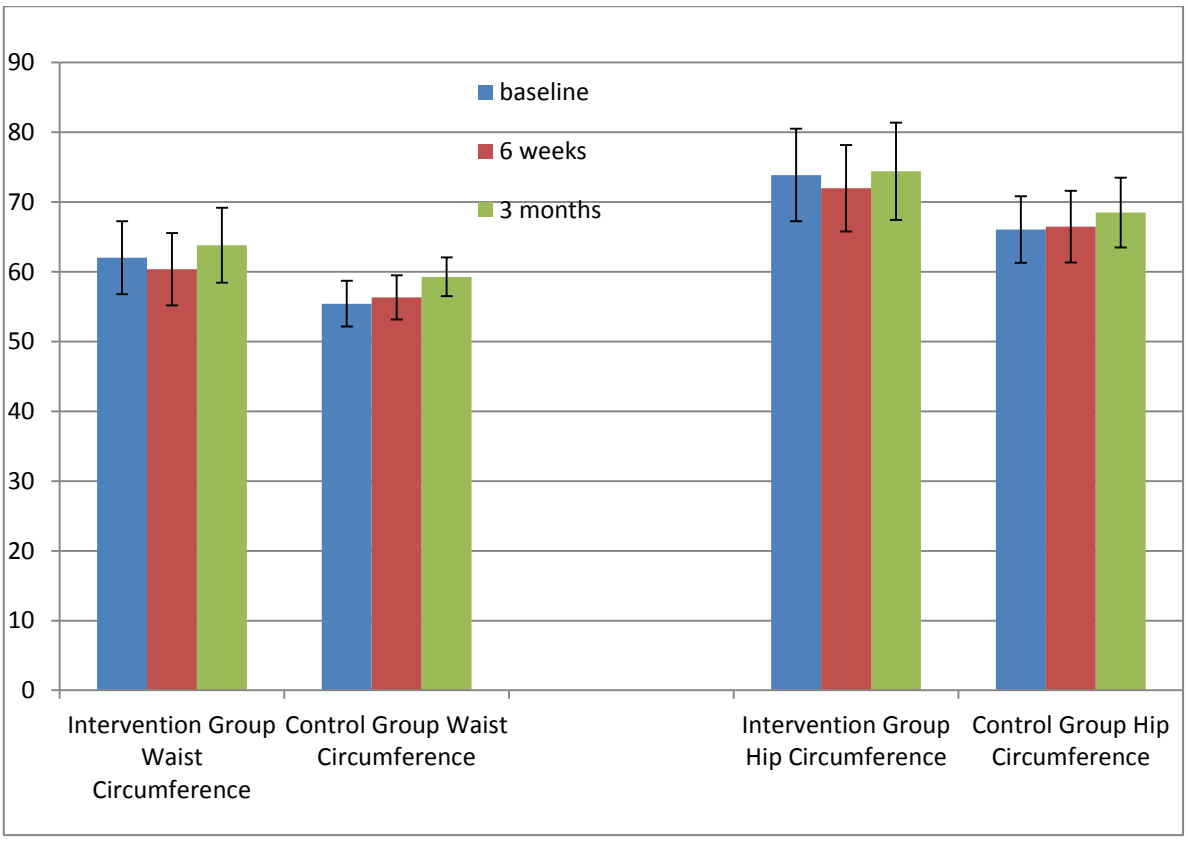


Figure 4.5: **Waist and Hip Circumferences for Intervention and Control Groups at Baseline, 6 Weeks and 3 Months from Baseline**

The intervention group had reduced waist circumference at 6weeks, while the control group added on. Both groups surpassed the initial measurements at the 3month follow up assessment.

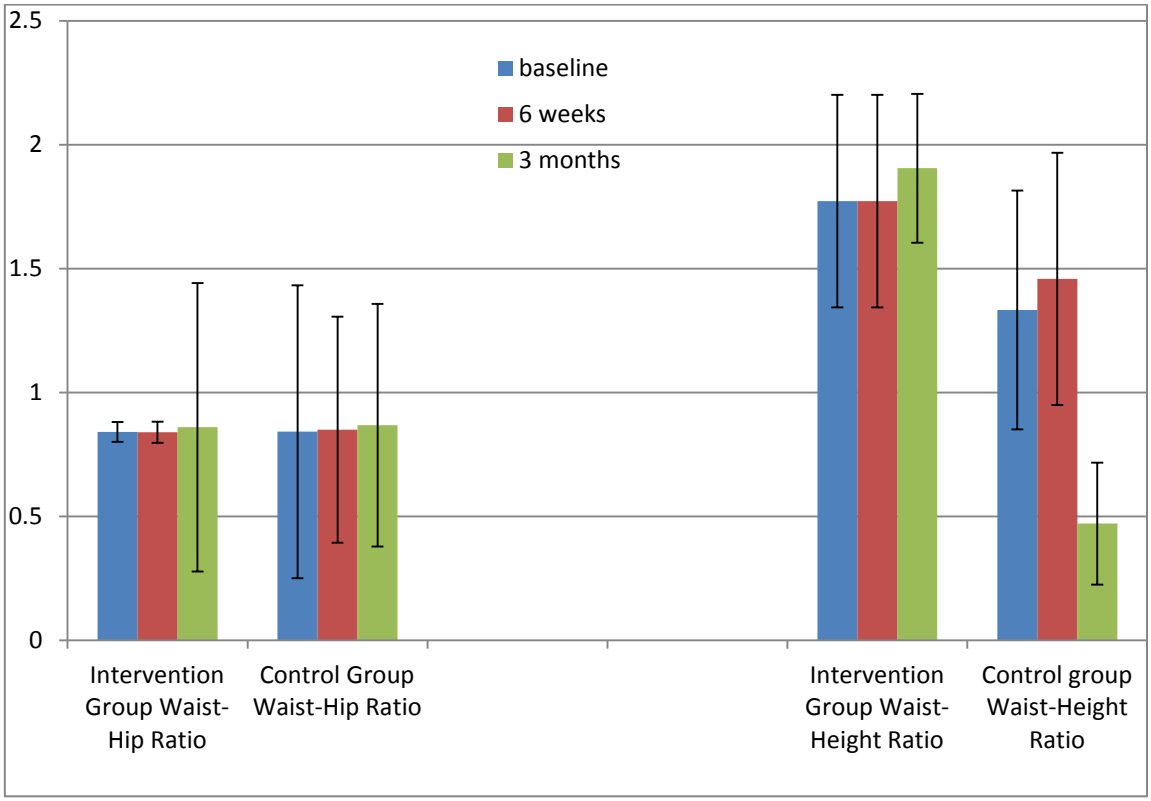


Figure 4.6: **Waist-Hip and Waist-Height Ratios for Intervention and Control Groups at Baseline, 6 Weeks and 3 Months from Baseline**

No significant difference is seen at 6weeks and 3months between groups with respect to their waist-hip ratios.

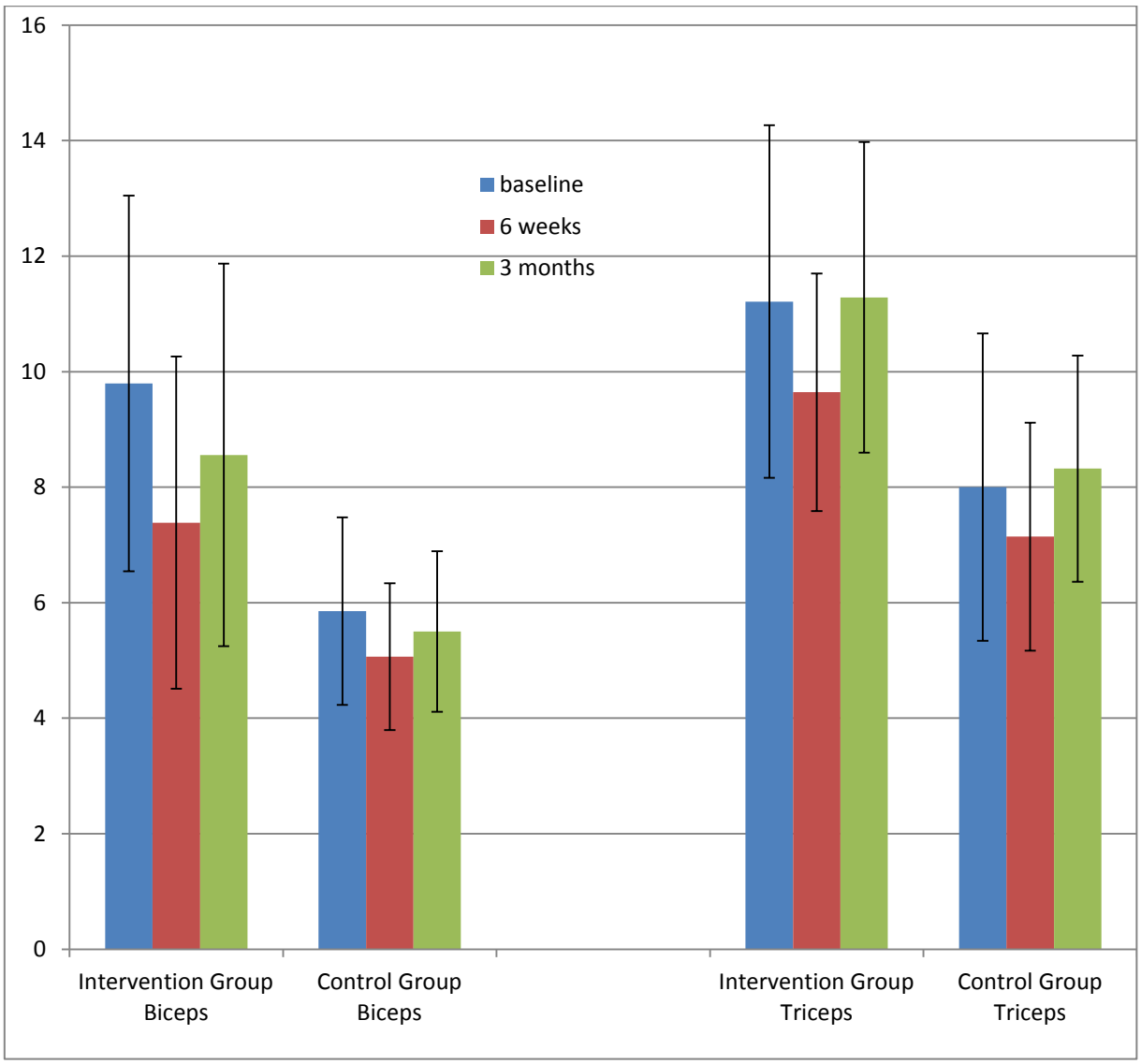


Figure 4.7: **Biceps and Triceps Skin-Folds of Intervention and Control Groups at Baseline, 6 Weeks and 3 Months from Baseline**

Biceps and Triceps skin-fold thickness reduced for both groups at 6 weeks, but no significant improvement at 3months follow up

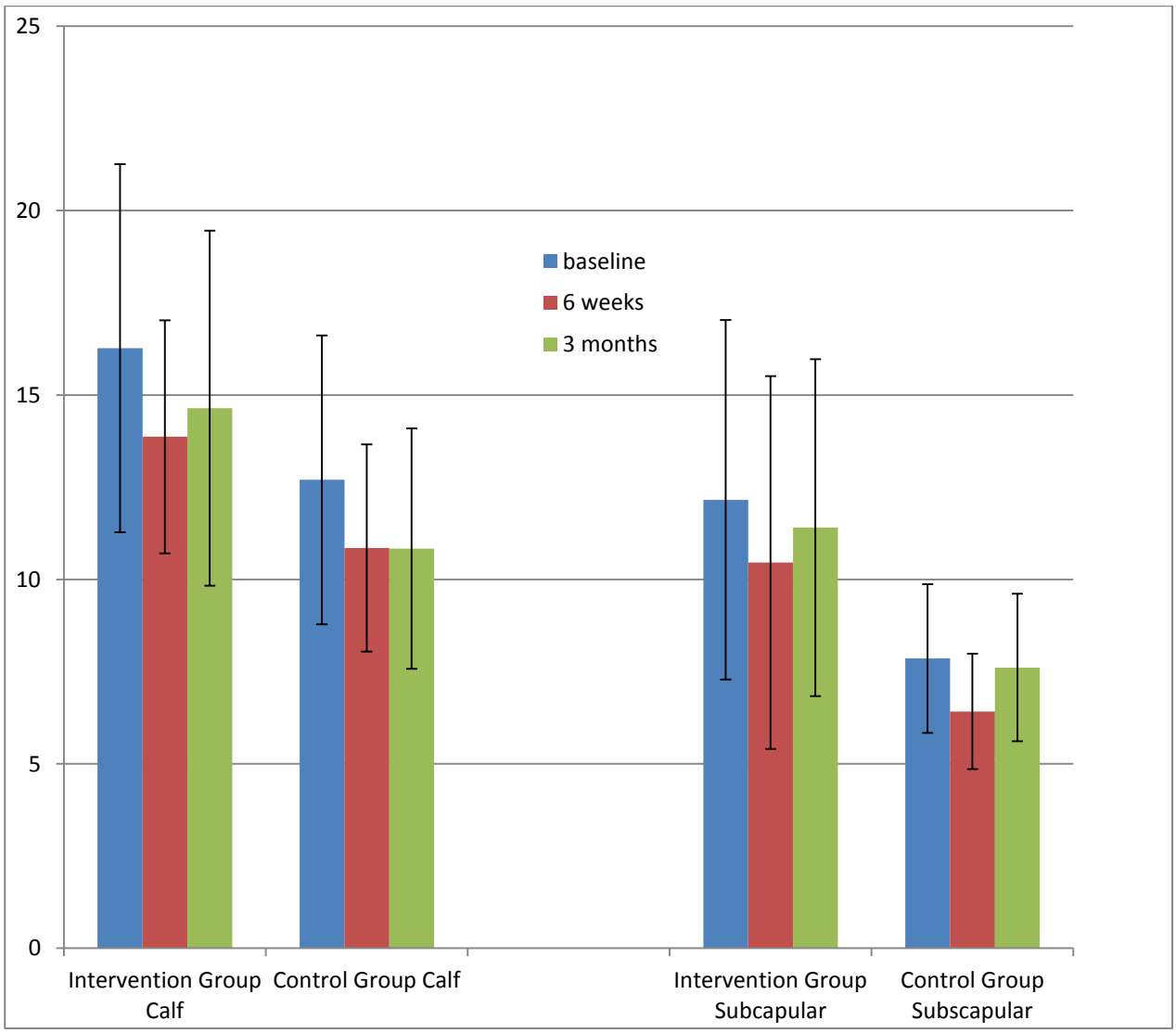


Figure 4.8: **Calf and Subscapular Skin-Folds of Intervention and Control Groups at Baseline, 6 Weeks and 3 Months from Baseline**

At the three months assessment neither group maintained data at 6 weeks for subscapular skin-fold thickness.

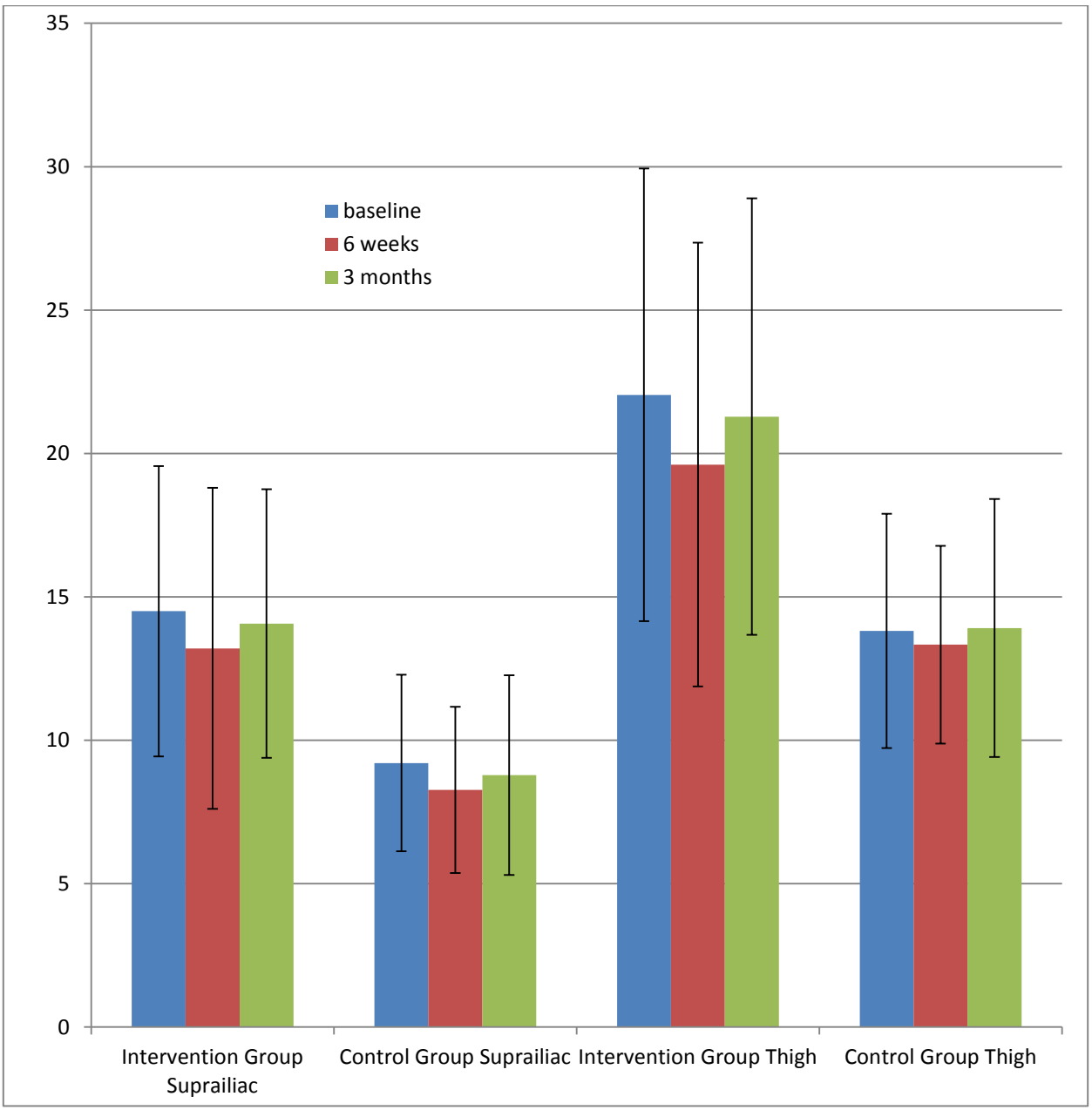


Figure 4.9: **Suprailiac and Thigh Skin-Folds of Intervention and Control Groups at Baseline, 6 Weeks and 3 Months from Baseline**

Participants gained more thickness at the suprailiac and thigh areas at three months assessment.

4.9 SUMMARY OF THE RESULTS

The prevalence of overweight/obese was 25.6% in the population studied. The intervention group and the control group did increase in BMI after 6 weeks.

The next Chapter will discuss the results of this study in relation to the other studies.

CHAPTER 5

5. DISCUSSION

"We must not constantly talk about tackling obesity and warning people about the negative consequences of obesity. Instead, we must be positive – positive about the fun and benefits to be had from healthy living, trying to get rid of people's excuses for being obese by tackling the issue in a positive way – Andrew Lansley"

5.1 INTRODUCTION

This chapter will discuss the results obtained in line with the objectives of the study. The objectives of the study were:

1. To determine the prevalence of overweight and obesity among primary school pupils in Alexandra.

2. To determine the contribution of nutrition to overweight and obesity among school pupils in Alexandra.

3. To determine the physical activity involvement of primary school pupils before the intervention study.

4. To determine the effect of short-term physical activity program on selected anthropometric indices and physical fitness of the participating pupils.

5.2 DEMOGRAPHIC PROFILE OF PARTICIPANTS

Participants in the study all attend schools situated in a cluster in the Johannesburg East district in Alexandra and come from families in the same socio-economic group (Statistics South Africa, 2008/2009). Alexandra is a low-income community bordered by high-end Sandton community. It is known for its high unemployment rate, homelessness and land rifts (Statistics South Africa, 2008/2009).

Three (31.7%; 32.6%; 28.8%) of the 4 schools had more participants than the fourth (6.9%) school as few participants signed up for the study at school 4. No racial profiling was done because the population of the Alexandra is predominantly black. More females participated in the study as compared to the males in each of the 4 schools (Table 4.1). Age ranged from 6 years to 11 years among the population in Grade 1 and 2. This population age-

group is similar to other studies by Colin-Ramirez et al (2010); Graf et al (2005); Sahota et al, (2001).

5.3 PREVALENCE OF CHILDHOOD OVERWEIGHT/OBESITY IN ALEXANDRA

This study found prevalence of childhood OW/OB (25.6%) to be very similar to the National Youth Risks Behaviour Survey (NYRBS) at 22.4% for overweight and 9.7% for obesity (Reddy et al, 2008) among children in the Johannesburg metropolis, Gauteng Province.

All around the world, the increasing prevalence of childhood OW/OB is not new (Ng et al, 2014) and children in developing countries are not left out of the overweight and obesity trends. Other under developed and developing African countries Malawi, Egypt, Benin, Morocco, Mauritania, Ghana and Djibouti, also corroborates the findings in this study with reported increasing prevalence in childhood OW/OB (Manyanga et al, 2014). While the prevalence of OW/OB may not yet be as high as developed countries, the rate of increase in the African continent and some developing nations is alarming (Manyanga et al 2014; Morgen and Sorensen, 2014).

Sub-Saharan Africa is reported to be among the fastest growing rates of OW/OB, with South Africa topping the chart for high OW/OB in all age groups (Ng et al, 2014). Overweight increased from 17% to 20%, while obesity increased from 4% to5% between a 4 year gap in South Africa (Reddy et al, 2010; 2008). This trend has been reported in several provinces (Lambert et al, 2006) and districts in the country by Kimani-Murage et al (2010). Gender differences also help to create a better picture on the real prevalence of childhood OW/OB in South Africa.

Boys and girls in the Gauteng Province had the highest values of all provinces according to the NYRBS (Reddy et al, 2010). In this study, boys were found to have a higher BMI than girls; reason for this is not known. Other studies found similar results in the prevalence of overweight and obesity between boys and girls in Limpopo District of South Africa (Pienaar et al, 2015; Toriolaet al, 2012; Mamabolo et al, 2005). Cultural practices involving boy-child and girl-child preferential treatments may be the influencing factor in these studies, to explain why boys had higher BMI than the girls. Li et al (2014) found that among Chinese children, sexual disparity was a major factor in the perception of OW/OB in childhood. Parents and grandparents tend to consider boys less OW/OB than girls and tend to feed the boys more. This is a culturally acceptable practise as the elderly thought of overweight boys as stronger individuals. Also, other factors listed as risks for OW/OB in childhood such as maternal obesity, low and or lower family income, lower cognitive stimulation, non-professional parents, lower family education, reduced time spent in PA with increasing time

indoors in front of the TV and other mobile devices, increasing preferences for “western” diet, and poor dietary pattern in children may be contributory to the results in this study and others especially those of Low- and Middle-Income communities such as Alexandra (Saavedra et al, 3013; Gulbert-Diamond et al, 2012; Riley et al, 2005).

The increased prevalence of OW/OB in boys as compared to girls found in this study is similar to findings globally by Morgen and Sorensen (2014), in Egypt and Malawi (Manyanga et al, 2014) and also here in Limpopo, South Africa (Toriola et al, 2012). However, Armstrong et al (2006), found something quite on the contrary in their population survey of each province in South Africa, with girls being more OW/OB than the boys. The same is recorded by Lambert et al (2006) in their survey of children aged 6-13 years in 5 provinces of South Africa. Also, according to the NYRBS, girls had a higher prevalence of OW/OB in all of South Africa (Reddy et al, 2008). These results indicate a shift in increased prevalence over the years from girls to boys. This may be as result of the increased responsibilities placed on the girl-child in assisting with domestic chores.

Children from high income families or high SES have been reported as overweight and or obese in South Africa (Pienaar, 2015) and Cameroon (Navti et al, 2014); which may be due to the socio-cultural influence of western diet, mode of transportation and increased use of gadget in favour of outdoor activities. As childhood OW/OB is a major concern in African countries, so also is the percentage population of UW children of utmost importance. It stands to reason to say that underweight should be high among low SES and Low Income Communities (LIC) like Alexandra. However, in light of the increased prevalence of childhood OW/OB in LIC, a small percentage of the participants in this study (7.5%) were still underweight (UW). Disease states and access to good nutrition may be contributory factors, as well as other factors listed above. In this study, a lower prevalence of UW was found when compared to OW/OB. Even from the NYRBS, UW reduced from 9% in 2002 to 8.4% in 2008 (Reddy et al, 2010 and Reddy et al, 2008). Similarly, Pienaar et al, (2015), Toriola et al (2012) found a lower prevalence of UW when compared to OW/OB in South Africa. It is however, necessary to note the UW problem in light of the National School Nutrition Programme (2012). If OW/OB was so noticeable in childhood, why create a school nutrition programme? The National School Nutrition Programme was necessary to introduce a form of feeding program to help curb the problem of under-nutrition in the schools. Hence, these studies further show the already established double burden of disease in developing nations and especially Africa.

In some other African countries, the relative prevalence of UW to OW/OB is similar to this study (Manyanga et al, 2014). In contrast, a relative lower prevalence of overweight

(11.4%) and obesity (2.8%) was found when compared to UW (13%) in a prevalence study by Ene-Obong et al (2012) in Nigeria. This may be due to a mixed SES population. It would help more if the results were from same SES, which may then be compared with other population studies.

5.4 CONTRIBUTION OF NUTRITION TO OVERWEIGHT AND OBESITY IN CHILDHOOD

This study found excessive consumption of carbonated drinks and fast-foods among school-going children in Alexandra. The second objective was to find the influence of nutrition on OW/OB. Nutrition was measured by the variables on the GSHS-Dietary Module namely: Food pattern at home, Consumption of Fruits, Consumption of Vegetables, Intake of Carbonated drinks and Rates of fast-foods intake. These variables have been used previously in different countries to determine dietary pattern and contribution to weight status (WHO, 2013).

Fast-foods (Davis and Carpenter, 2009) and Carbonated drinks (Dubois et al, 2007; Ludwig et al, 2001) have been linked to excessive weight in school-going children. Fast-foods and or processed foods are those that are energy dense, high in sugars, salts and carbohydrates and stored as fat in the liver, under the skin, in the muscle, spaces between organs when not used up. Fast-food consumption and food security in the participants home (that is “hungry at home”) were found to have an effect on BMI of this population using the step wise regression method (þ= .117, $p<0.05$ and þ= .101, $p<0.05$). Food security at home and food dietary pattern at home have been shown to have an effect on childhood OW/OB, either to increase (Salazar-Martinez et al, 2006) or decrease childhood OW/OB (Chakar and Salameh, 2006). This may largely be dependent on income levels, SES and educational level of parents. The effect of the SES on overweight and obesity in childhood affects the dietary pattern of a population, children inclusive (Muthuri et al, 2014). The SES will inform quality and quantity of food consumed, indoor cooking and outdoor (fast foods, restaurants) eating habits are largely dependent on income level,

Studies (Currie et al, 2010; Davis and Carpenter, 2009) have shown that the major influence on childhood overweight and obesity especially among school-going children is the proximity of Food Away From Home (FAFH - fast-foods and food outlets) to schools. Both studies suggest that only fast-foods located close to the schools will eventually impact a child’s BMI. This is similar to the schools in Alexandra, where FAFH outlets selling KOTA (a meal of Russian sausage, cheese, fries, atchar, Wors and quarter loaf of bread, hence the name KOTA), cheese snacks, pastries, sweets, carbonated drinks are located close to the schools. On the contrary, Manyanga et al (2012) did not find any correlation between the variables on the dietary module of the GSHS and BMI.

High consumption of fruits and vegetables did not have any effect, either as contributory to or protective against childhood OW/OB in this study. This is similar to results by Newby (2009), where high rate consumption of fruits and vegetables did not have any contributory effect to reduce OW/OB in participants and contrary to Vioque et al (2008), who found it to be contributory to reducing OW/OB among participants.

5.5 PHYSICAL ACTIVITY INVOLVEMENTS OF PRIMARY SCHOOL PUPILS

The dietary pattern and physical activity involvement of children are very important in the fight against childhood OW/OB. Physical Activity (PA) has been defined as "any bodily movement produced by skeletal muscles that require energy expenditure" (WHO, 2013), which may include: hours spent actively in a day, walk to school, attendance at PE classes and hours spent in sedentary activities. If a child is more sedentary, he/she is likely to be OW/OB (Tremblay and Willms, 2003).

In this study, majority of participants were found to be not physically active; with 55.7% not active for up to 60mins per week, 32.6% walked to school for less than 1 day per week; 71.7% of participants did not attend a full day of PE at their respective schools and 56.2% spending more than 2 hours a day in sedentary activities, including but not limited to television viewing. This may have contributed to the high prevalence of OW/OB in the population. Physical inactivity and absence of PE classes in public schools has led to a proportionate increase in BMI of children (Hedley et al, 2004). PA and PE in schools serve to boost academic performances and cognitive abilities. Hedley et al (2004) reasoned that PA/PE are cost effective and can be enjoyed by both teachers and students, hence should be encouraged. Donnelly and Lambourne (2011) found that even in the United States of America, public schools have either taken out PE classes, or have allocated very few school-times as is the case with the schools studied in Alexandra; therefore, they recommend that PA/PE be re-incorporated even into the teaching module.

Sedentary choice of television (TV) watching and night-time snacking are considered risk factors for childhood OW/OB (Liou et al, 2010). Reduced TV time of less than or equal to 1 hour/day does not often lead to OW/OB in children, but increased TV watching time of greater than or equal to 4 hours/day is linked to childhood OW/OB (Liou et al, 2010; Tremblay and Willms, 2003). This study found a greater percentage of children to watch TV or engage in other sedentary activities for ≥2 hours/day. However, Marshall et al (2004) found that television viewing was not clinically relevant in contributing to childhood obesity. To support this, Zimmerman and Bell (2010) think that it is actually the advertisements on TV, not necessarily the act of TV watching, leads to increased BMI in children. This is

because of the way adverts are constructed. They are highly appealing to the senses and colourful, thereby influencing purchase. Caroli et al (2004) found TV viewing may actually be a tool in the prevention of childhood OW/OB, which involves parents' monitoring TV programs watched by their children.

According to Colin-Ramirez et al (2010) a school-based intervention program to improve PA of Mexican children, was able to positively impact PA and reduce time spent in sedentary activities including but not limited to TV viewing and video games. Hence, school-based intervention of sorts should be widely encouraged.

5.6 EFFECT OF SCHOOL-BASED PHYSICAL ACTIVITY PROGRAM ON ANTHROPOMETRIC INDICES AND PHYSICAL FITNESS

The short-term intervention program employed in this study was for 6 weeks of moderate to vigorous intensity exercises [Stair climbing (no running); Football; Brisk walking; Catch and Foursquare; Aerobic dance class and Running] in a school term. In adults, exercises in combination with other forms of intervention have been found to decrease OW/OB in the long run (Brown et al, 2009). With the increasing trends in childhood obesity, same line of management may be effective in decreasing OW/OB in children (Savoye et al, 2011).

In this study, mean BMI of the intervention group at baseline was 19.14±2.93, and at 6 weeks was 19.62±2.36 with p=0.388 (that is within group). The short-term intervention program had an effect on BMI, with stable parameters in participants of the intervention group; stable parameters in the sense that, there was no significant increase in obesity of participants in the intervention group after 6 weeks, hence maintaining it. This is in agreement with a systemic review by Brown and Summerbell (2008) that short-term PA intervention programs were only successful in helping to maintain BMI of participants. Contrary to this, BMI significantly increased over a period of 6 weeks in the control group. Although, the BMI of the intervention group increased albeit not significantly, it can be argued that a 6 weeks PA intervention program may be helpful in maintaining body weight. It is also possible that a 6 weeks PA intervention program was too short to see much reduction in BMI. Hence, other forms of combined intervention programs with varied time frames may be considered.

Short-term intervention programs that focus on either diet or PA (as is with this study) are more beneficial to children, although more comprehensive reporting of design, appropriateness of development, study design and PA intensity are needed to improve upon already existing information. The current study also measured physical fitness levels

of participants using the 20m beep test. There was significant improvement in fitness level within both groups. A study by Eliakim et al (2002) agrees with the study findings that physical fitness can be improved by PA intervention programs among primary school children. Also, this study found no significant difference in fitness levels between the control and intervention groups at 6 weeks (p=0.947). This may be due to the "learning effect" during the re-assessment at 6 weeks for both groups. Learning effect in exercising testing is not uncommon and has been found to invariably affect outcome of exercise testing (Wu et al, 2003). There was significant difference in BMI between control and intervention groups at 6 weeks (p=0.001), the significance was as a result of the increased BMI of the control group. The intervention group did not have any significant decrease in their BMI. This may be attributed to a lack of specific designed exercise/physical activity program in the control group. This result is not new in research. Summerbell et al (2005), in their review of intervention studies, found that most short-term interventions either did not improve or they did not significantly decrease BMI between groups. Overall, the authors concluded that intervention programs that focus on either PA or diet showed "a small but positive impact on BMI status", when compared with studies that combined both forms of intervention. Surprisingly, this is in contrast to the school of thought, that a single approach form was ineffective and a combination of approaches were more likely to have significant effects (Bleich et al, 2013; Johnson et al, 2012; Kemp and Pienaar, 2010; Kriemlar et al, 2010) .

In a systemic meta-analysis Gonzalez-Suarez et al (2009) looked into the effect of short-term intervention programs on childhood OW/OB, and found that short-term programs were effective in reducing the prevalence of childhood obesity within groups, but not effective in reducing BMI when compared with control group. This is in line with results in this study which proves the effectiveness of short-term intervention program (exercise only) in reducing BMI. A great benefit is that these exercises are easy to administer, do not negatively impact school activities, neither do they fatigue children. Hence, studies must come up with better forms of exercise regime and prescription that may have great effect of decreasing BMI in children and also include education on dangers of fast-foods.

Several studies including by Kemp and Pienaar (2010) and a review by Sharma (2006), reported decreased values for skin fold thickness and waist circumference following a short-term school-based intervention programs focusing on PA, TV and diet modifications. These reports are much similar to findings from this study, where analyses showed a significant decrease in parameters of obesity measures such as the skin fold thickness (biceps p=0.002, subscapular p=0.001, suprailiac p=0.001, and thigh p=0.002). More studies are needed to document the effect of short-term school-based intervention

programs on skin fold thickness and measures of central obesity (Sharma, 2006), as there are more studies depicting these measures as outcomes to determine prevalence of childhood OW/OB (Lettie et al, 2011; Mushtaq et al, 2011a). A physical activity intervention program has been successful in reducing measures of central obesity of waist and hip circumferences (Slentz et al, 2004). Short-term intervention in this study was also able to cause significant decreases in waist and hip circumferences, between groups with the intervention group reflecting a greater decrease in these parameters.

Follow up assessment of anthropometric indices 3-month from baseline showed a lapse in achievements gotten over the 6-weeks intervention period, which may be due to the holiday in between and children not being encouraged to be physically active. This shows that whatever positive impact the short-term intervention made, was lost shortly after. Similarly, Chang et al (2008) reported that improvements in anthropometric indices among participants were not sustained at follow up in their own study. Hence, intervention programs are to be continued and encouraged to be a part of the curriculum.

5.7 SUMMARY OF DISCUSSION

Findings from this study support previous results that there is a double burden of diseases in Africa, with increasing prevalence of childhood OW/OB in children from low SES. There is an upward shift in OW/OB and a corresponding downward shift in UW. Also, boys had a higher prevalence of OW/OB than girls in the population. Consumption of fast-foods and carbonated drinks, food security at home are the major dietary contributors to change in BMI. Fruits and vegetables, even when consumed in high rates, have no effect on BMI. Children in this study, engage in little forms of PA, even at school, with increased duration of sedentary activities. Short-term intervention program was found to have an effect on BMI, by helping to maintain the weight status after a 6 weeks period, however, the fitness of both groups increased. This may be due to ‘unrestricting the control group from taking part in other PA’.

The next chapter concludes the study, including limitations of the study and recommendations.

CHAPTER 6

6. CONCLUSION

"Fixing obesity is going to require a change in our relationship with food. I'm hopeful that we begin to see a turnaround in this childhood obesity epidemic" – Olshansky S.J (2015).

6.1 INTRODUCTION

This study aimed to evaluate the effect of a short-term intervention program on selected anthropometric indices and physical fitness of primary school children in Alexandra, Johannesburg.

The objectives of the study were:

1. To determine the prevalence of OW/OB among primary school pupils in Alexandra,
2. To establish the contribution of nutrition to OW/OB among school pupils in Alexandra,
3. To determine the physical activity involvement of primary school pupils before the intervention study; and
4. To determine the effect of short-term PA program on selected anthropometric indices and physical fitness of the participating pupils.

6.2 CONCLUSIONS FROM THE STUDY

- There is a moderate prevalence of Overweight/Obesity among low SES children in Johannesburg East District primary schools.
- Underweight children were also present in the same community
- Boys have a higher prevalence of OW/OB when compared with girls
- Girls have higher WHR and WHtR compared to boys in this population studied.
- Girls have a higher biceps, subscapular, suprailiac and thigh skin-fold thickness in the same age group
- This alarming trend of overweight/obesity is further influenced by high consumption rates of fast-foods and carbonated drinks in this group of children, despite high consumption of fruits and vegetables. High rate consumption of fruits and vegetables did not impact BMI
- In this population, food security at home and fast-foods have the most significant influence on BMI.
- In light of underweight children, the school nutrition programme is therefore supported as most of these children come from low SES families. However, quality of food can be improved.

- Primary school children in the Johannesburg East District have little involvement in physical activities, with an increased participation in sedentary activities e.g. watching TV for more than 2hours
- Children in this study do not enjoy a full day (same time as spent in other subjects) of PE at their schools
- Short-term intervention program was found to be effective in 6 weeks of moderate to vigorous intensity on BMI status of the intervention group by maintaining it.
- There was no significant difference in fitness level of intervention group and control group
- Short-term intervention caused a significant decrease in some of the other parameters of obesity measures biceps, subscapular, suprailiac, thigh and skin-fold measurement of the intervention group when compare with the control group
- Short-term intervention was able to cause significant decreases in waist and hip circumferences between groups with the intervention group reflecting a greater decrease in these parameters
- Follow up assessment shows that improvements and adjustments to anthropometric data following a short-term intervention were not sustained.

6.3 LIMITATIONS OF STUDY

- The control group were not limited or restricted from taking part in any form of PA. Hence, their results may have been influenced.
- Due to the tight school curriculum, exercises were for 30-45 minutes in the intervention school.
- Dietary pattern of the intervention group was not monitored during the intervention phase.
- The study did not ascertain demographics (such as educational level, income level, health status) of parents of participants including specific income levels, parental obesity status, and family education. Also, the study did not determine cognitive level of participants. All these have been documented as contributory factors to childhood OW/OB in LIC.
- In the initial draft, the 4 schools were to be put into 2 groups to serve as the control and intervention schools. However, of the 4 schools, 3 school authorities gave the researcher and assistants same time frame for contact time with learners. The 1 school that didn't became the intervention school, while 1 of the other 3 was conveniently chosen as the control school.

- In 2 of the schools, researcher encountered low response with the consent form. For a week after the deadline for the return of consent forms, only 10 learners had turned in

theirs. Researcher, met with the Deputy Principal, HOD Foundation to discuss possible solutions to this challenge. It was concluded that the Deputy Principal and HOD Foundation meet with all class teachers of grades 1 and 2 learners and implore them to remind learners to return these forms. Researcher was also scheduled to meet with these class teachers. Also, researcher provided incentives to returning the forms, so that learners who brought put in their consent forms were rewarded. Of these 2 schools, response rate picked up in 1, however, the other school had a low response rate still.

- Due to limited contact time with learners, anthropometric measures were not all taken the same week in all 4 schools.

- Questionnaires were administered in interview format and were not done on the same day as the anthropometric measurements. Hence, not all participants had both anthropometric and questionnaires administered. Participants were taken out of the classroom to the staffroom were questionnaires were administered.

- Due to the delayed response in consent forms and the limited contact time with learners, the first week of the prevalence study was used to sort out the challenges and make final arrangements with the schools. These arrangements were delayed because of the slow response rates with the consent forms

- Researcher was to negotiate for an hour with the learners, however, only 30-45 minutes was allocated to researcher. This is because, the school curriculum is full. Hence, researcher met with pupils early during assembly times so as not to disrupt classroom participation.

- Participants were provided lunch daily in their schools. Lunch included a mix of vegetables and a fruit at least once a week, this may affect outcome.

- The 20-meter shuttle run test used to evaluate physical fitness of participants was done in-groups of ten. This may pose a limitation to the study as participants may result to “competing” and not necessarily following through with instructions.

6.4 RECOMMENDATION FOR RESEARCH

- Further studies that will include survey of dietary intake at home of children in Low SES.
- Further research should be conducted to really define the connection between fast-foods and dietary pattern at home to overweight and obesity in low SES.

- Comparative analysis of response based on sex of participants to short-term PA intervention programs among children of low SES.
- Increased duration of intervention program.
- Demographics of parents of participants including specific income levels, parental obesity status, and family education and including cognitive level of participants be considered in future research.

6.5 RECOMMENDATION FOR CLINICAL PRACTISE

- Life orientation lessons on nutritional education and awareness program be done at schools.

6.6 RECOMMENDATIONS FOR GOVERNMENT POLICIES

- This study recommends that short-term exercise programs be incorporated in the school curriculum. They are a fun way to improve fitness and cognition of school-going children.
- Diverse short-term exercises be designed for schools in low SES who are without playgrounds and that will make use of available resources.
- Physical Education classes be made mandatory and a full day worth of teaching time be allocated, just like other studies.
- Fast-food joints and outlets be moved away from school locations.
- Primary schools be encouraged to have a playground and if not available, exercises be structured to suit available infrastructure.
- Government policies be encouraged to have organic foods available at cheaper prices that are readily available to families in LIC.
- Government could also encourage vegetable farming policies, although consumption of fruits and vegetables had no significant effect on BMI in this study, it may reduce the frequency of eating fast-foods and give a sense of good food security at home.

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APPENDIX A

COPY OF LETTER SENT TO PRIMARY SCHOOLS

The Principal,
------- Primary School,
Alexandra

Dear Sir/Ma,

LETTER OF INTRODUCTION AND PERMISSION TO PARTICIPATE IN A STUDENT RESEARCH

My name is Otolorin Opeyemi a post-graduate student at the University of the Witwatersrand. As part of the requirements for a Masters (Msc) degree in Physiotherapy, I will be working on a study on the **"Effect of a short-term physical activity program on selected anthropometric indices of primary school pupils in Alexandra, Johannesburg**".

With the global surge and increase in childhood obesity, intervention programs are being designed to help reduce the prevalence of overweight and obesity in school-aged children. The aim of this study is to determine the effect of an intervention program on some selected body measurements (height, weight, waist circumference, hip circumference, waist-hip ratio, waist-height ratio, body mass index and triceps skin fold) of primary school children in Alexandra, Johannesburg.

An exercise program has been designed for pupils but I will need to check if these exercises will have an impact on body measurements and compare with another group of pupils in the same grade levels who are not participating in the exercises.

This study will have me working with pupils in Grades 1-2 aged 6 - 9 years. Duration for this study will be six (6) weeks. A session will take about forty-five (45) minutes and will be held three (3) times a week. Also, pupils will be required to fill survey forms that will give information about their physical activities and eating habits.

Participation is totally voluntary. No pupil will be compelled to take part in this study. Pupils can withdraw at any point in the course of the program and confidentiality will be maintained

Please contact the following for further enquiries:

Human Research Ethics Committee (Medical): Prof P Cleaton-Jones, HREC (Medical) Chairperson, Tel 011 717 2301, peter.cleaton-jones@wits.ac.za.
Secretariat: Ms Z Ndlovu, Tel 717 1252, Zanele.ndlovu@wits.ac.za,
Ms A Keshav, Tel 011 717 2700, anisa.keshav@wits.ac.za

Thank you for your time.

Otolorin Opeyemi
Postgraduate Student
Department of Physiotherapy
University of the Witwatersrand
Johannesburg, South Africa
083 – 751 – 7809
Otolorin.Opeyemi@students.wits.ac.za

Dr. MED Maleka
Supervisor
Department of Physiotherapy
University of the Witwatersrand
Johannesburg, South Africa
Morake.Maleka@wits.ac.za

APPENDIX B

INFORMATION SHEET FOR PARENTS OF PUPILS

Dear Parents/Guardians,

Hello, my name is Opeyemi Otolorin. I am a physiotherapist and I am currently completing a Masters (Msc) degree in physiotherapy at Wits University. As part of the requirements for a MSc. at University of the Witwatersrand, I am studying overweight and obesity in primary school pupils of Grade 1 – 2, hence I have to carry out a study. The study wants to know if exercises are of any benefit to primary school pupils or not and to know of the percentage of pupils who are overweight and obese. Your child's school has agreed to participate in this study and that is why I am writing to you. Before you decide, please read through the letter.

The study will have the pupils put into two groups. One group will participate in exercises outlined by me in their schools and the second group will just carry on with their regular play activities**. Please note that your child maybe in either groups**. It will take place three times a week for six weeks during the third term. The study entails that your child/children/ward will have their weight, height, waist/hip circumference and skin fold measurements taken with minimal clothing on.

I am asking because I need your permission to have your child/children/ward participate in this study.

Please note that participation is voluntary. You have the option of withdrawing your child/children/ward at any time if you feel uncomfortable. Also, I will ask your child/children/ward, and if he/she says no even after you have consented, he/she will not be coerced in any way to take part in this study.

I will ensure that no clues to your child/children/ward's identity appear in the dissertation (final write-up). Any information given will be entirely anonymous. The data (information gotten from pupils) will be kept confidential for the duration of the study. On completion of the dissertation, they may be retained for a further six months and then destroyed.

The results will be presented in the dissertation. They will be seen by my supervisor, a second marker and the external examiner. The dissertation may be read by future students in the course. The study may be published in a research journal.

I don't envisage any negative consequences of your child/children/ward in taking part; however, I would appreciate it, if you let me know on the form overleaf if your child/children/ward has any health condition that may not let him/her participate. Or, if you're just concerned about their health lately.

The Department of Physiotherapy, University Ethics Committee, Gauteng Department of Education, have all reviewed this study before asking you.

If you agree to have your child/children/ward take part in the study, please sign the consent form overleaf and kindly return this form to the school by the 10th of August, 2014.

Thank you very much for your time.

Opeyemi Otolorin
083 751 7809
opeyemi.otolorin@students.wits.ac.za

CONSENT FORM

I……agree / do not agree (please indicate as appropriate) to have my child/children/ward participate in Opeyemi's research.

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

My child has these health conditions: (please list below)

1.
2.
3.
4.

I am willing to have my child/children/ward participate voluntarily.

I understand that I can withdraw my child/children/ward from the study, without repercussions, at any time, whether before it starts or while they are already participating.

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

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

Signed……. Date……..

APPENDIX C

PUPILS INFORMATION SHEET

Dear Pupil,

Hello and how are you? My name is Opeyemi “Yemi” Otolorin. I am a physiotherapist and I am studying overweight and obesity in primary school pupils of Grade 1 -2. Your school has kindly allowed me to come and ask all pupils (Grade 1- 2) if they want to participate. The reason I am doing this study is to find out if exercising for a short time will make any difference in your body and to know how many pupils are overweight / obese in your school. I am writing this letter to you because your class and age fall into the category of children who will take part in this study.

Before you make any decision please read through this letter.

This study will take place at your school and will last about 20 minutes or the length of your P.E class during the Third term, three (3) times a week for six (6) weeks. You will have your height, weight, and waist / hip circumference, and skin fold measurements taken.

You will also answer questions from a survey to let me know if you exercise or not and another survey form to help me know about your eating habits. We will take part in some exercises I have designed for you. You will learn about exercising and how it helps you grow and stay health.

Your name will not be in any report of the results of this study, so no one knows it is you. Your parents need to give us permission for you to be in this study. You do not have to be in this study if you don’t want to, even if your parents have already given us permission.

You may stop being in the study at any time. If you want to stop, just tell me so right away. If you decide to stop, no one will be angry or upset with you. You can ask questions at any time.

If you have questions you should ask me. If you or your parents have other questions, worries, or complaints you should call me on 083751 7809. Kindly sign on the next page if you want to be in this study and please return this form to school by the 10th of August, 2014!

Thank you very much for your time

Opeyemi Otolorin

SIGNATURE PAGE

Title of Study: Effect of a short-term physical activity program on selected anthropometric indices of primary school pupils in Alexandra, Johannesburg

Principal Investigator: Otolorin Opeyemi

If you sign your name on this page, it means that you agree to take part in this research study. You may change your mind any time for any reason.

_____ _____

Sign your name here
if you want to be in the study Date

I have explained this study to and answered questions of the child whose name is at the top of this form. I informed the child that he or she could stop being in the study and can ask questions at any time. From my observations, the child seemed to agree to take part in the study.

_____ _____

Name and Signature of
Researcher Obtaining Assent Date

APPENDIX D

GSHS CORE QUESTIONNAIRE DIETARY BEHAVIOUR MODULE

Number : _____ Age:_____ Grade:_____

Sex : M_____ F_____

- *There are no right and wrong answers — this is not a test.*
- *Please answer all the questions as honestly and accurately as you can — this is very important.*

This next question asks about you going hungry or without food

1. During the past 30 days, how often did you go hungry because there was not enough food in your home?
   a. Never b. Sometimes c. Always

The next 4 questions ask about what you might eat and drink.

2. During the past 30 days, how many times per day did you usually eat fruit, such as apples, oranges, bananas?
   a. I did not eat fruit during the past 30 days b. 1 time per day c. More than 1 times per day

3. During the past 30 days, how many times per day did you usually eat vegetables such as spinach, lettuce?
   a. I did not eat vegetables during the past 30 days b. 1 time per day
   c. More than 1 times per day

4. During the past 30 days, how many times per day did you usually drink carbonated soft drinks such as Coke, Iron Brew, Fanta?
   a. I did not drink carbonated soft drinks during the past 30 days b. 1 time per day
   c. More than 1 times per day

5. During the past 7 days, on how many days did you eat food from a fast food restaurant, such as KFC, Chicken Licken?
   a. 0 days b. 1 day c. More than 1 days

APPENDIX E

GSHS CORE QUESTIONNAIRE PHYSICAL ACTIVITY MODULE

Number : _____ Age:_____ Grade:_____

Sex : M_____ F_____

- *There are no right and wrong answers — this is not a test.*
- *Please answer all the questions as honestly and accurately as you can — this is very important.*

The next 3 questions ask about physical activity. Physical activity is any activity that increases your heart rate and makes you breathe hard. Physical activity can be done in sports, playing with friends, or walking to school. Some examples of physical activity are running, fast walking, riding a bike, dancing, and football.

1. During the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day? Add up all the time you spent in any kind of physical activity each day.
   a. 0 days b. 1 day c. 2 days

2. During the past 7 days, on how many days did you walk or ride a bicycle to or from school?
   a. 0 days b. 1 day c. 2 days

3. During this school year, on how many days did you go to physical education and lifestyle (PE) class each week?
   a. 0 days b. 1 day c. 2 or more days

The next question asks about the time you spend mostly sitting when you are not in school or doing homework

4. How much time do you spend during a typical or usual day sitting and watching television, playing computer games, talking with friends, or doing other sitting activities, such as hand-washing laundry?
   a Less than 1 hour per day b. 1 to 2 hours per day c. more than 2 hours per day

APPENDIX F

BIO-DATA FORM

FOR RESEARCH ASSISTANTS ONLY:

SEX:

STUDY NUMBER: AGE:

SCHOOL: GRADE LEVEL:

BLOOD PRESSURE: A B C

HEART RATE: A B C

RESPIRATORY RATE: A B C

20-M SHUTTLE RUN TEST: A B C

A =baseline B=6 weeks C = 3 months

ANTHROPOMETRY	**BASELINE**	**SIX WEEKS**	**THREE MONTHS**
Height			
Weight			
Body Mass Index (BMI)			
Waist Circumference			
Hip Circumference			
Waist-Hip Ratio			
Waist-Height Ratio			
SKIN-FOLD			
▪ Triceps			
▪ Biceps			
▪ Subscapular			
▪ Suprailiac			
▪ Thigh			
▪ Calf			

APPENDIX G

DAILY ATTENDANCE RECORD

PUPIL NUMBER: _____ GRADE: _____

S/N	DATES	RR	HR	BP	DID ACTIVITY?
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					
14.					
15.					
16.					
17.					
18.					
19.					
20.					
21.					
22.					
23.					
24.					

APPENDIX H

BREAK-DOWN OF WEEKLY EXERCISES

Each session began with warm-up exercises of between five to ten minutes and will end with diaphragmatic breathing technique to cool down as well.

Warm-ups: Jog on the spot – 3minutes
Stretches – 3X / 2minutes

EXERCISES AND MET VALUES

Stair climbing (no running) – 3.5 Football – 4.0 Brisk walking – 5.0
Catch and Foursquare – 5.0 Aerobic dance class – 6.5
Running (tag, races) – 7.0
Cool down: diaphragmatic breathing technique – 3x (demonstrated to pupils)

Week One

Stair climbing will be done in groups to limit the incidence of injuries. First aid will be made available during play. A game of catch will have children put into groups of four to encourage participation.

Week Two

The game of football is loved by many, children inclusive. With the world cup around the corner, everyone is in the know about the game. With this game, children will be put in to groups as well. Soccer balls will be made available

Week Three

Brisk walking will be done in groups. Children will be supervised to ensure they comply with instructions. To make it more fun, brisk walking will be intercepted with repetitive arm and leg movements.

Week Four

A game of catch and foursquare will be explained to participants. Play balls will be provided.

Week Five

Dance classes will be organised for pupils. Pupils will be arranged in lines to give adequate space to spread limbs without hurting the person beside them. The principal researcher will give instructions on dance moves. Choice of music will be in pupils' native languages and country favourites.

Week Six

Races will be organised for pupils in batches after an initial round of running for all participants. Instructions will be given on safety during play. First aid will be made available for the period of the study. Also, children will be grouped to participate in competitive races. Groups will be changed per week to also encourage socialisation.

APPENDIX I

ETHICAL CLEARANCE

M140617

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M140617

NAME: (Principal Investigator)	Ms Otolorin Opeyemi
DEPARTMENT:	Physiotherapy Goverment Primary Schools in Alexander
PROJECT TITLE:	Effect of Short Term Intervention Program on Selected Anthropometric Indices of Primary School Pupils in Alexander
DATE CONSIDERED:	27/06/2014
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Dr M Maleka and Ms S Pilusa
APPROVED BY:	Professor PE Cleaton-Jones, Chairperson, HREC (Medical)

DATE OF APPROVAL: 13/08/2014

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

APPENDIX J

GAUTENG DEPARTMENT OF EDUCATION, DISTRICT APPROVAL

GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

Enq: Keke Phooko
Tel: 011666 9225

TO : **Principal**

FROM : **Mr R Martin**
Jhb East District Director

DATE : **07 July 2014**

PURPOSE : **Research Permission**

Dear Colleagues

Kindly be informed that Ms Otolorin Opeyemi who is currently enrolled with the University of the Witwatersrand will be conducting research in your school and the research topic is: Effect of a Short Term Intervention Program on Anthropometric Indices of Primary School Learners.

Hope for a positive outcome at the end of the research.

Thanking you for your cooperation.

Yours in Education

.....

Mr R Martin
Johannesburg East District Director

DISTRICT: JOHANNESBURG EAS
Tel: (011) 666 9002, Cell: 082 464 8225, Fax: 086 266 7734 | Email: Raymond.Martin@gauteng.gov.z
142/144 Fourth Street, Benmore, Sandton, Private Bag X9910, Sandton, 214
www.education.gpg.gov.za | Call Centre: 0800 005 17

APPENDIX K

GAUTENG DEPARTMENT OF EDUCATION APPROVAL 2015

GAUTENG PROVINCE
Department: Education
REPUBLIC OF SOUTH AFRICA

For administrative use:
Reference no. D2015 / 319 A

GDE AMENDED RESEARCH APPROVAL LETTER

Date:	**10 October 2014**
Validity of Research Approval:	**9 February 2015 to 2 October 2015**
Previous GDE Research Approval letter reference number	**D2015/136 dated 12 June 2014**
Name of Researcher:	**Otolorin O.A.**
Address of Researcher:	**Department of Physiotherapy**
	Wits Education Campus
	University of Witwatersrand
	2050
Telephone Number:	**083 751 7809**
Email address:	**opewalker@gmail.com**
Research Topic:	**Effect of a short term intervention program on selected anthropometric indices of Primary School pupils in Alexandra**
Number and type of schools:	**FOUR Primary Schools**
District/s/HO	**Johannesburg East**

Re: Approval in Respect of Request to Conduct Research

This letter serves to indicate that approval is hereby granted to the above-mentioned researcher to proceed with research in respect of the study indicated above. The onus rests with the researcher to negotiate appropriate and relevant time schedules with the school/s and/or offices involved to conduct the research. A separate copy of this letter must be presented to both the School (both Principal and SGB) and the District/Head Office Senior Manager confirming that permission has been granted for the research to be conducted.

2014/10/14

The following conditions apply to GDE research. The researcher may proceed with the

1

Making education a societal priority

Office of the Director: Knowledge Management and Research
9th Floor, 111 Commissioner Street, Johannesburg, 2001
P.O. Box 7710, Johannesburg, 2000 Tel: (011) 355 0506
Email: David.Makhado@gauteng.gov.za
Website: www.education.gpg.gov.za

APPENDIX L

GAUTENG DEPARTMENT OF EDUCATION APPROVAL 2014

GAUTENG PROVINCE
Department: Education
REPUBLIC OF SOUTH AFRICA

For administrative use:
Reference no: D2015 / 136

GDE RESEARCH APPROVAL LETTER

Date:	**12 June 2014**
Validity of Research Approval:	**12 June 2014 to 3 October 2014**
Name of Researcher:	**Otolorin O.A.**
Address of Researcher:	**Dept of Physiotherapy**
	Wits Education Campus
	University of Witwatersrand
	2050
Telephone Number:	**083 751 7809**
Email address:	**opewalker@gmail.com**
Research Topic:	**Effect of a short term intervention program on selected anthropometric indices of Primary School pupils in Alexandra**
Number and type of schools:	**FOUR Primary Schools**
District/s/HO	**Johannesburg East**

Re: Approval in Respect of Request to Conduct Research

This letter serves to indicate that approval is hereby granted to the above-mentioned researcher to proceed with research in respect of the study indicated above. The onus rests with the researcher to negotiate appropriate and relevant time schedules with the school/s and/or offices involved to conduct the research. A separate copy of this letter must be presented to both the School (both Principal and SGB) and the District/Head Office Senior Manager confirming that permission has been granted for the research to be conducted.

Mkhado 2014/06/13

The following conditions apply to GDE research. The researcher may proceed with the above study subject to the conditions listed below being met. Approval may be withdrawn should any of the conditions listed below be flouted:

Making education a societal priority

Office of the Director: Knowledge Management and Research
9th Floor, 111 Commissioner Street, Johannesburg, 2001
P.O. Box 7710, Johannesburg, 2000 Tel: (011) 355 0506
Email: David.Makhado@gauteng.gov.za
Website: www.education.gpg.gov.za

APPENDIX M

APPROVAL FROM SCHOOL 1

Iphutheng Primary School

PO Box 245
Bergvleі
2012

Tel: (011) 443 4007 / 011 264 1036
Fax: 086 609 8441

admin@iphuthengprimary.co.za
www.iphuthengprimary.co.za

Ms Zanele Ndlovu
Research Office Secretariate
Senate House Room SH 10005, 10th Floor
Johannesburg
28 July 2014

Dear Madam

PERMISSION TO CONDUCT RESEARCH

This letter serves to grant permission to Ms Otolorin Opeyemi to investigate the Effect of Short Term Intervention Program on Selected Anthropometric Indices of Primary School Pupils in Alexandra.

I, Kgamaka Thobejane, the Principal of Iphutheng Primary School unconditionally approve that she conducts a research with sampled learners in Grade 1 and 2 for a period of six weeks i.e. 18 August to 26 September on Monday Wednesday and Friday. All activities as per agreement with the principal investigator will not interfere with the classroom contact time.

Sincerley,

Kgamaka Thobejane

The Principal

GAUTENG DEPARTMENT OF EDUCATION
IPHUTHENG PRIMARY SCHOOL
CNR LONDON & 18TH AVE
ALEXANDER 2090
P O BOX 245
BERGVLEI 2012
2014 -07- 28
admin@iphuthengprimary.co.za
TEL: 011 443 4007
FAX: 086 609 8441

Block 114, Corner 18th Avenue & London road, Alexandra, 2090

APPROVAL FROM SCHOOL 2

GAUTENG DEPARTMENT OF EDUCATION DISTRICT 9

P.O Box 49
Bergvlei
2010
011 882 1352
EMIS: 700152041

BOVET PRIMARY SCHOOL
KEEP THE LIGHT BURNING

158 Vincent Tshabalala Rd
19th Ave, Alexandra
2090
011 443 5525
email: bovetprimary@ymail.com

28 July 2014

To whom it may concern

Confirmation of research approval

This letter serves to confirm that Ms Otolorim Opeyemi a masters student from Wits has been granted permission to conduct her research at Bovet Primary School as detailed in the letter from GDE dated 12 June 2014 Ref no: D2015/136.

Thanking you in anticipation

Yours truly

M.E. Makasane (Principal)

GAUTENG DEPARTMENT OF EDUCATION
BOVET PRIMARY SCHOOL
P.O BOX 49 BERGVLEI 2012
28 JUL 2014
TEL: (011) 882-1352
FAX: (011) 443-5525

E. Makasane (Principal) M.E Ntlhamu (Deputy Principal) T.S Mudzimu (Deputy Principal)
G.T Ngobeni (HOD Foundation phase) M.E Mabasa (HOD Foundation Phase) F.T Mhlanga (HOD Senior Phase)
N.M Mukhari (HOD Intermediate phase) J. Mashava (HOD Intermediate Phase)

APPROVAL FROM SCHOOL 3

GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

ZENZELENI PRIMARY SCHOOL

P.O. BOX 305
Alexandra
2014
Tel: 011 882-8422
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FUNDA

166-19th Ave
Alexandra
2090
UQHUBEKE

E-mail: zenzeleniprimaryschool@telkomsa.net

28 July 2014

To : Zanele Ndlovu

Administrative officer : - Human Research Ethics Committee **(Medical)**
Tell : 011 1717 – 1252
Email : zanele-ndlovu@wits.co.za

From : **Thandi Gumede** (Principal)

Subject Re : Confirmation of study approval
Protocol Ref No : **M140617**
Protocol title : Effect of a short term intervention program on selected Anthropometric indices of primary school pupils in Alexandra

Principal Investigator : **Ms. Otolorim Opeyeni**

This letter serves to acknowledge receipt of the **Human Research Ethic Committee (Medical)** of the University of the Witwatersrand.

We approve the study by researcher.

GAUTENG DEPARTMENT OF EDUCATION
ZENZELENI PRIMARY SCHOOL
Gumede
2014 -07- 28
166 19th AVENUE ALEXANDRA 2090
P.O.BOX 305 ALEXANDRA 2014
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APPROVAL FROM SCHOOL 4

Ikage Primary School

education
Department: Education
GAUTENG PROVINCE

P.O. Box 2207
BRAMLEY
2018
Tel: 011 443 – 2712

163-19th Avenue
ALEXANDRA
2090
Fax: 011 882-5798

E-mail: ikageprimary@telkomsa.net
Fax to Email: 0866107803

Thuto ke Lesedi — Imfundo Ukukhanya

01 August 2014

To Whom it may Concern

RE: Confirmation of study approval.

This letter serves to confirm that the above-mentioned school has given Ms Otolorin Opeyemi to do her research on the duration stipulated.

May her stay with us be profitable.

Yours in Education

Mrs. M.M. E. Mokwena
Deputy Principal
Tel; 011 4432712
Fax: 0866107803

APPENDIX N

BMI–FOR-AGE PERCENTILE USED

†Standard error not calculated by SUDAAN

[1]Refers to age at time of examination

SE Standard error of mean

SOURCE: CDC/NCHS, National Health and Nutrition Examination Survey

Sex & Age	Number of persons examined	Mean	S.E	5th	10th	15th	25th	50th	75th	85th	90th	95th
MALE												
2years	285	16.7	0.13	14.7	15.1	15.4	15.8	16.6	17.3	18.1	18.3	18.9
3years	202	16.5	0.16	14.4	14.7	15.1	15.4	16.2	17.4	17.8	18.3	19.1
4years	244	16.3	0.10	14.0	14.3	14.7	15.1	16.0	17.0	17.8	18.3	19.9
5years	205	16.3	0.15	13.9	14.1	14.4	15.0	15.7	16.8	18.0	18.5	21.0
6years	193	16.9	0.26	13.8	14.1	14.5	14.8	16.1	17.1	19.8	21.8	23.7
7years	215	16.9	0.21	13.6	14.1	14.4	14.9	15.8	18.1	20.1	21.0	22.8
8years	210	17.9	0.27	14.1	14.5	14.9	15.6	16.7	19.4	21.8	22.9	24.4
9years	190	18.9	0.38	14.1	14.8	15.1	16.0	17.3	21.3	23.6	25.1	27.5
10years	197	19.6	0.35	14.5	15.0	15.5	16.4	18.4	22.2	24.3	25.1	27.1
11years	211	20.5	0.36	15.4	16.0	16.4	17.0	19.1	23.1	25.4	26.4	28.7
12years	159	21.3	0.44	14.6	15.6	16.2	17.5	19.9	24.2	27.0	28.4	30.1
13years	146	21.9	0.47	16.3	17.1	17.6	18.4	20.4	24.8	26.5	29.5	33.7
14years	177	22.4	0.59	16.4	16.8	17.5	18.3	21.0	24.3	27.6	30.0	34.1
15years	160	23.1	0.55	16.8	18.2	18.6	19.3	21.5	25.7	27.6	30.4	33.8
16years	175	24.4	0.46	18.0	18.6	19.5	20.7	22.7	26.9	30.4	31.5	34.4
17years	188	24.9	0.70	17.8	19.0	19.4	20.6	23.3	27.5	30.3	33.2	38.6
18years	142	26.1	0.58	18.8	19.4	20.9	22.1	25.1	29.0	30.7	32.6	36.0
19years	179	25.2	0.46	19.0	20.3	20.6	21.3	24.0	26.7	28.8	31.2	38.8

Sex & Age	Number of persons examined	Mean	S.E	5th	10th	15th	25th	50th	75th	85th	90th	95th
FEMALE												
2years	254	16.5	0.13	14.7	15.1	15.2	15.5	16.4	17.4	18.0	18.4	18.8
3years	189	16.0	0.15	13.9	14.3	14.5	15.0	15.8	16.8	17.7	18.0	19.0
4years	200	16.0	0.11	13.6	14.3	14.5	14.8	15.7	16.6	17.8	18.2	19.1
5years	177	16.5	0.29	13.2	14.2	14.5	15.1	15.8	17.0	18.0	19.8	†
6years	177	16.5	0.25	13.8	14.1	14.3	15.0	15.8	17.3	18.5	19.5	†
7years	207	17.1	0.25	13.7	14.3	14.5	14.8	15.9	18.3	20.3	21.6	23.8
8years	203	18.3	0.38	13.8	14.3	14.7	15.1	17.1	20.5	22.7	23.6	25.4
9years	205	18.7	0.43	14.0	14.7	14.8	15.4	17.3	20.5	23.1	25.3	26.3
10years	183	19.5	0.28	14.1	15.3	15.7	16.3	18.9	21.4	23.3	24.5	27.4
11years	219	20.7	0.48	14.6	15.5	15.9	16.8	19.0	23.6	26.5	29.4	31.3
12years	166	21.3	0.49	†	16.2	16.5	17.9	20.6	23.6	26.6	28.1	30.3
13years	140	22.1	0.51	15.8	16.3	17.1	18.4	20.9	25.1	27.8	29.5	32.4
14years	168	23.5	0.39	17.3	17.8	18.8	20.0	22.4	25.4	27.6	28.5	36.1
15years	137	23.9	0.45	17.9	18.5	19.3	19.9	22.1	26.4	30.6	31.4	34.7
16years	156	23.7	0.39	†	18.6	18.9	20.2	22.1	25.8	30.0	32.0	34.9
17years	143	23.9	0.56	17.7	18.6	19.4	20.2	22.5	26.1	27.4	31.7	36.9
18years	137	24.6	0.61	18.4	19.2	19.4	19.9	21.8	26.9	31.8	33.3	37.7
19years	118	25.5	0.71	16.5	17.9	19.4	21.1	24.0	29.8	32.1	34.0	37.9