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# Relationship between posture, obesity and physical activity levels in children aged 10-13

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# RELATIONSHIP BETWEEN POSTURE, OBESITY AND PHYSICAL ACTIVITY LEVELS IN CHILDREN AGED 10-13

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A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, in partial fulfilment for the degree of MSc Biokinetics

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Johannesburg, South Africa

DECLARATION

I, …… declare that this research report is my own work. It is being submitted for the degree of MSc Biokinetics in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University.

…… (signature)

The ……day of ……., 2016

## DEDICATION

*Dedicated to*

**My late father, Dr J.J.P Lombard**

*For inspiring me with his work ethic, his passion for the human body, and his kindness.*

## ABSTRACT

**Background**: In South Africa, little is known about postural defects, obesity prevalence and Physical Activity (PA) levels of children. The aim of this study was to determine both the prevalence of, as well as the associations between poor posture, obesity and PA in children aged 10 – 13 years.

**Methods:** Body Mass Index, posture and PA were measured in 16 girls and 13 boys (n=29). Physical activity was measured using the Physical Activity Questionnaire for Children and posture was measured using New York Posture Test. Pearson's correlation co-efficient was used to determine the correlation between PA, obesity and poor posture.

**Results:** 90% of participants in this study met PA guidelines, whereas 10% were found to be obese and 7% overweight. 93% presented with some form of postural deviation. Results showed a moderate significant negative correlation between posture and BMI ($r = -0.485$; $p = 0.008$).

**Conclusions:**

Parents, caregivers, educators and health professionals need to help increase awareness and implement strategies that focus on preventing the development of poor postural habits and obesity in children.

**Keywords:** Physical activity, Obesity, Posture, Children

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# CHAPTER ONE: INTRODUCTION

## 1.1. Introduction

Worldwide, advancing civilisation has resulted in a “modernised lifestyle” for children living in urban areas. Children of today have media-dominated leisure activities which lead to a decreased level of physical activity. In addition, they are surrounded by a food-toxic environment, which encourages the consumption of high calorie, convenient, and unhealthy foods (Wasik et al, 2015; Niksic & Rasidagic, 2014; Jehle & Kuhnis, 2011; Malkogeorgos et al, 2010; Stroebel et al, 2009). Ilic & Buric (2014) state that the generally poor health of children can be largely attributed to the modern way of life, characterised by high-calorie diets and low physical activity rates (Popkin & Gordon-Larsen, 2004; Popkin, 2001).

The “modernised lifestyle” that is evident on a global level is becoming more apparent in South Africa. In urban areas of South Africa there appears to be a similar trend whereby children that are raised in these parts are adopting modern ways of living that are not necessarily always good for their health (Monyeki, 2014; Rossouw, Grant and Viljoen, 2012). The literature reveals that physical activity patterns in children have changed over the past few decades and that children are participating in sub-optimal levels of physical activity in addition to exhibiting excessive amounts of sedentary behaviour, such as watching television; playing computer; video games; and engaging in social media (Arundell et al, 2015; Monyeki, 2014; Malkogeorgos et al, 2010; Popkin & Gordon-Larsen, 2004; Popkin, 2001). Children living this modern lifestyle perform so little exercise that “hypokinetic syndrome” is now a term used to describe their lack of physical activity (Ilic & Buric,

2014). This lack of physical activity is partly responsible for the increased incidence of obesity during the last few decades, with as much as 30% of children worldwide classified as obese (Evans, 2011; Jehle & Kuhnis, 2011; Smith et al, 2011; Popkin, 2001). Postural disorders are accompanying the above-mentioned trends to such a degree that some research refers to poor posture as a “disease of civilisation” (Bendikova, Smida and Rozim, 2014; Dudoniene et al, 2013; Torlakovik, Muftic and Kovak, 2013; Hutchful, 2008).

Compared to international research, knowledge is scarce on the rates of physical activity levels, prevalence of overweight and obesity, or postural defects in South African children. Moreover, although there are clinical assumptions linking low levels of physical activity with obesity, as well as poor posture in children, research is required to measure the existence and strength of these associations.

### 1.2. Aim

Therefore the aim of this research was to determine the prevalence of poor posture in children aged 10 – 13 years in the Pretoria East area, and to determine the correlation between posture, levels of physical activity, and Body Mass Index (BMI) in these children.

### 1.3. Objectives

a. To determine the levels of physical activity of children aged 10-13 years
b. To determine BMI’s of children aged 10-13 years.
c. To determine the postures of children aged 10-13 years.
d. To determine the correlation between:

i. BMI and physical activity levels in children.
ii. Posture and physical activity levels in children; and
iii. Posture and BMI's in children;

### 1.4. Hypotheses

The researcher hypothesised that there would be a strong correlation between low levels of physical activity and high BMI scores. Similarly, the researcher hypothesised that there would be a positive correlation between low physical activity scores and low posture scores. Lastly, the researcher hypothesised that there would be a positive correlation between high BMI scores and low posture scores in children aged 10 – 13 years in the Pretoria East area.

# CHAPTER TWO: LITERATURE REVIEW

## 2.1. Physical activity in children

Riner & HuntSellhorst (2013) define physical activity as “any bodily movement produced by skeletal muscles which results in energy expenditure” (Monyeki, 2014). This gives the impression that physical activity can be spontaneous, and without any specific goal in mind. On the other hand, the term “exercise” is defined as “planned, structured, and repetitive bodily movement done to improve or maintain one or more component/s of physical fitness” (Riner &HuntSellhorst, 2013). What separates the two concepts is intention and planning, but both are equally important for the normal growth and development, as well as over-all wellbeing of children. For the purpose of this research, the term “physical activity” will be used to represent any type of bodily movement, including: exercise; fitness training; competitive sport; active play; and activities of daily living (e.g.: walking or cycling for travelling purposes), regardless of the setting, purpose, or intensity of the activity (Longmuir et al, 2014; Monyeki, 2014).

The World Health Organisation (WHO) recently released guidelines that children should accumulate a *minimum* of 60 minutes of physical activity daily that is of moderate or vigorous intensity. This can be quantified as 3 to 6 “Metabolic Equivalents” (METs) or higher - indicating that the activity will require 3 to 6 times the energy required at rest (WHO, 2010). Examples of activities that meet these requirements are brisk walking, cycling and active outdoor playing (Riner & HuntSellhorst, 2013). Any extra amount of physical activity (greater than 60 minutes per day) is believed to provide additional health benefits to children and should be

encouraged. The WHO specifies that of the 60 minutes of physical activity required per day, it should be should be predominantly aerobic in nature. However, they recommend that vigorous-intensity activities that strengthen muscle and bone should be incorporated at least 3 times per week (WHO, 2010).

Conclusions from the First Youth Risk Behaviour Survey in South Africa highlighted that physical activity levels among South African youth have decreased so overwhelmingly over the past decades that fewer than half of children and adolescents aged 5 to 17 years are sufficiently active to achieve optimal growth and development milestones (Monyeki, 2014). The Healthy Active Kids South Africa (HAKSA) Report Card 2014 also found that 50% or less of children and youth are sufficiently active (Draper et al, 2014). Similarly, research done in China and America, found that on average, children accumulate less than one hour of moderate or vigorous physical activity every day (Longmuir et al, 2014; Shan et al, 2010), while in Canada only 7% of children (aged 6-19 years) met the WHO recommendation on a daily basis (Tremblay et al, 2011b; WHO, 2010). This is very alarming since inadequate physical activity levels have a negative impact on several areas of childhood development, including: body composition; fitness levels, academic achievement; and self-esteem (Longmuir et al, 2014; Riner & Sellhorst, 2013; Tremblay et al, 2011*b*).

On the other end of the continuum the term “sedentary behaviour” describes time spent performing activities that do not increase energy expenditure to a notable extent (Monyeki, 2014). Specifically, sedentary time is defined as any behaviour in waking hours associated with a sitting or reclining position that has an energy

expenditure of less than or equal to 1.5 METs (Herman et al, 2014; Milne, 2013). In the United Kingdom, 45% of surveyed children aged 6 to 15 years admitted that they would spend most of their school holidays playing computer games or watching television (Hutchful, 2008). Locally, the Survey of Time Use 2010 found that children between the ages of 10 and 17 years watched an average of almost 3 hours of television per day (Draper et al, 2014). In response to these distressing trends, specific sedentary behaviour guidelines were released in Canada in 2011 where the authors recommend that children and adolescents (aged 5 – 17 years) participate in less than 2 hours of non-academic sedentary time per day (Longmuir et al, 2014; Straker et al, 2013; Tremblay et al, 2011). Decreased physical activity levels and increased sedentary behavior not only affect physiological and psychological parameters, but can also impact children's' posture negatively.

### 2.1.1. Physical activity and posture

When children are of primary school age, they begin their academic careers by sitting down for extended periods, carrying around heavy school bags, and playing less, thus reducing spontaneous movement activities that are characteristic of early childhood (Kratenova et al, 2007). The exercise sessions that occur during physical education (PE) classes are not sufficient stimulus for the musculoskeletal system in terms of volume or focus (Bogdanovic & Marcovic, 2010; Hutchful, 2008). As a result, Kratenova et al (2007) found that children who performed no sports at all (and only attended PE classes) had a significantly higher prevalence of poor posture compared to those children who performed at least 1 hour of sport per week on a consistent basis. This is a concern for South African children since PE in government schools is no longer presented as a stand-alone subject, and is implemented as a

component of Life Orientation as set out by Outcomes Based Education (OBE) guidelines (Sport and dev.org, 2016). In the HAKSA Report Card 2014, it was found that in rural schools the average time that children spent in PE was 30-40 minutes per week, and of those surveyed in urban schools, 34% did not even have PE in the previous week (Draper et al, 2014). This means that children will have to participate in a sport of some kind to meet WHO (2010) guidelines and decreases the likelihood that children are receiving adequate physical activity stimulus in the form of PE classes in these schools.

The lack of physical and physiological stimulus can cause those children who do not participate in sports at school level to develop imbalances in a variety of muscle groups. Specifically, the literature reveals that weakness of the back, chest, abdominal, pelvic and lower quarter muscles are most prevalent and are the main causes of postural abnormalities in children (Pocek, Djordjic and Tubic, 2012; Smith et al, 2011; Bogdanovic & Marcovic, 2010; Shultz, Houglam and Perrin, 2010; Hutchful, 2008; Kratenova et al, 2007). These postural adaptations have both short and long term consequences. Hutchful (2008) refers to a survey done by the British Chiropractic Association in 2008 where it was found that 45% of children will complain of low back pain by the age of 11 years. These children are likely to grow and develop with their imbalances and carry their pain into adulthood, resulting in chronic issues that have long-term financial implications and can impair quality of life drastically.

Compared to rural school children, urbanised children have a considerably higher occurrence of postural disorders (Bogdanovic & Marcovic, 2010). Assuming that all children spend more or less the same amount of time sitting down during classes, one has to examine their leisure-time activities to understand where the discrepancy

occurs. For urban children, technology in the form of television, computers (including laptops and tablets), and cell phones dominate their social scene as well as their free time (Stroebel et al, 2009; Hutchful, 2008). Kratenova et al (2007) found that children who spent more than 2 hours per day engaging with technology during their free time had a higher probability for poor posture. In addition to the development of poor posture, higher rates of sedentary behaviour have been found in overweight and obese children compared to normal-weight children (Olaya-Contreras, Bastidas and Arvidsson, 2015).

### 2.1.2. Physical activity and childhood obesity

De Paula (2012) defines obesity as the degree of fat storage in the body associated with health risks, due to its relationship with several metabolic complications (Rossouw, Grant and Viljoen, 2012). According to the Centers for Disease Control and Prevention, childhood obesity is a medical condition in which the child's weight is substantially higher than what is considered to be normal for age and height (Crothers et al, 2009). Childhood obesity is a multifactorial disease that occurs through a combination of genetic, environmental and behavioural factors (Ciubara et al, 2014; Bahrami et al, 2013; Aleixo et al, 2012; Crothers et al, 2009). The mechanisms which the increasing prevalence of childhood obesity can be attributed to are not fully understood, but the literature reveals that modern lifestyle changes most likely play a major role (Mitchell et al, 2013; Steinberg et al, 2013; Crothers et al, 2009).

Decreased levels of physical activity have been associated with increased childhood obesity rates. For example, the literature reveals that children who are more

sedentary than their peers have a higher risk of suffering from obesity and all its associated complications (Olaya-Contreras, Bastidas and Arvidsson, 2015; Lane, Harrison and Murphy, 2014; Lewis, Fraser and Manby, 2014). Obesity and overweight during childhood are associated with the increased risk of developing insulin resistance, type 2 diabetes mellitus, and a variety of cardiovascular irregularities that that could extend into adulthood (Rossouw, Grant and Viljoen, 2012).

The relationship between physical activity and childhood obesity is rather complex. It is known that weight management requires a shift from sedentary behaviour to a generally more active lifestyle that is sustainable. However, obese children are limited in their capability to be physically active (Lewis, Fraser and Manby, 2014; Shultz et al, 2014). These challenges can be experienced as: the difficulty in performing certain activities; the embarrassment of exposing their bodies; the challenge in performing tasks that require speed, agility and power; alterations in basic motor tasks; elevated work of breathing; and the higher rate of energy expenditure required for movement (Lewis, Fraser and Manby, 2014; Shultz et al, 2014; Aleixo et al, 2012; Pau, Kim and Nussbaum 2012; Berntsen et al, 2011). These challenges that are associated with successful participation in physical activity or exercise can be enough of a deterrent that it might contribute to a more sedentary lifestyle and consequent increase in childhood obesity (Shultz et al, 2014; Rossouw, Grant and Viljoen, 2012). Although consideration should be given to the challenges mentioned above, all children should be continuously encouraged to pursue a physically active lifestyle. The benefits of physical activity go far beyond posture

correction and weight management, and can considerably improve children's quality of life on many levels.

### 2.1.3. Benefits of physical activity

There is considerable evidence for the physical, mental, social and psychological benefits of regular physical activity among children (Muhajarine et al, 2015; Longmuir et al, 2014; Monyeki, 2014; Chaput et al, 2013; Riner & HuntSellhorst, 2013; Bloemers et al, 2012; Tremblay et al, 2011b). The physiological benefits of regular physical activity in children result in increased fitness levels, as well as normal growth and development patterns, including the attainment of fundamental motor skills. Healthy cardiovascular profiles, higher peak bone mass, and the prevention and management of obesity are also found to be side-effects of living a physically active lifestyle (Lewis, Fraser and Manby, 2014; Longmuir et al, 2014; Monyeki, 2014: Riner & HuntSellhorst, 2013). Combined, all these advantages lead to a reduced risk of developing chronic conditions into adolescence and adulthood (Monyeki, 2014).

The physical benefits of regular physical activity in children are generally well-known and understood. However, physical activity contributes to the holistic development of the child, both mentally and psychologically. The mental and social benefits accrued to children who are consistently physically active include: academic achievement, social connectedness, school satisfaction; as well as improved attention and concentration levels (Lewis, Fraser and Manby, 2014; Longmuir et al, 2014). Monyeki (2014) goes as far as to discuss research which found a statistically significant positive correlation between fitness and standardised scores in Language

arts and Mathematics. Physical activity also enhances social development by teaching children the skills to cope with competition, collaboration and team work (Monyeki, 2014).

From a psychosocial perspective, Lewis, Fraser and Manby (2014) state that the psychological wellbeing of children can be greatly improved by incorporating physical activity into their lives on a habitual basis. The main benefits are found to be improved self-esteem, self-image, and body image, enhanced mood, greater acceptance by peers, and enhanced quality of life (Kipp, 2015; Longmuir et al, 2014; Monyeki, 2014; Riner & HuntSellhorst, 2013).

### 2.1.4. Assessment of physical activity

Accurate evaluation of physical activity levels in children is important for three reasons: 1) to understand the relationship between physical activity and health; 2) to monitor trends in behaviour; and 3) to gauge the effectiveness of interventions (Chinapaw et al, 2010, Kowalski, Crocker and Doren, 2004). To objectively measure physical activity, accelerometers, heart rate monitors, pedometers, and movement counters can be used (Chinapaw et al, 2010; Crocker et al, 1997). However, these methods are limited by the operational skills of the human that is using them. Additionally, they can be costly and do not provide information regarding the type of physical activity participated in (Chinapaw et al, 2010).

Self-report questionnaires offer an alternative solution to monitoring physical activity. The Physical Activity Questionnaire for older Children (PAQ-C) (Appendix A) is considered to be a capable questionnaire for determining physical activity levels in

children aged 8-14 years, who are in the school system (Chinapaw et al, 2010; Kowalski, Crocker and Doren, 2004). The PAQ-C is a 7-day recall questionnaire that generally measures physical activity levels at any time during the academic school year (Kowalski, Crocker and Doren, 2004). Table 1.1 describes the strengths and limitations of the PAQ-C. Despite these limitations, questionnaires are often used to estimate physical activity levels in children, and are inexpensive and easy to administer (Chinapaw et al, 2010; Crocker et al, 1997).

**Table 1.1. A summary of the strengths and limitations of the PAQ-C**

| Strengths | Limitations |
|---|---|
| The PAQ-C is a valid and reliable tool used to determine general physical activity levels in childhood | The PAQ-C doesn't provide an estimate of caloric expenditure |
| The PAQ-C uses memory cues such as "break time" and "after school" items to improve children's recall capability | The PAQ-C provides a summary score of physical activity, it does not distinguish between specific activity intensities |
| The PAQ-C is time efficient | The PAQ-C is only applicable to the academic school year – it cannot be used during school-holiday periods |
| The PAQ-C is free of charge and requires no licencing fee | The PAQ-C doesn't provide the specific frequency and/or duration of physical activities |
| The PAQ-C is easy to administer to large groups of study participants | |
| The PAQ-C displays normal distribution properties | |

## 2.2. Childhood obesity

Despite major efforts to promote health awareness, childhood obesity has reached epidemic proportions worldwide (Rankin et al, 2015; Milne, 2013; Steinberg et al, 2013; Aleixo et al, 2012; De Paula, 2012; Shan et al, 2010). It is considered to be one of the most critical global public health concerns of the 21st Century, as the prevalence of childhood overweight and obesity during the last two decades is still on the rise in in low-, middle-, and high-income countries (Sun, Wang and Wang, 2015; Draper et al, 2014; Protic-Gava, Zecak, and Shukova-Stojmanovska, 2014;

Elizondo-Montemayor et al, 2013; Song-hua et al, 2013; Pau, Kim and Nussbaum 2012; Popkin & Gordon-Larsen, 2004). South Africa is considered to be a middle-income country in the final phase of a *nutrition transition.* This means that malnutrition rates are on the decline while the prevalence of over nourishment (overweight and obesity) is on the rise and becoming a public health concern (Draper et al, 2014; Monyeki, 2014; Mchiza & Maunder, 2013; Popkin & Gordon-Larsen, 2004; Popkin, 2001).

Globally, 10% of primary school children (aged 6 – 14 years) are found to be overweight or obese (Mchiza & Maunder, 2013). Childhood obesity was once believed to be a challenge in countries rated as high-income by the World Bank (Rossouw, Grant and Viljoen, 2012). Unfortunately childhood overweight and obesity are now increasing in both low- and middle-income countries, particularly in the urban environments (Benden et al, 2013). The data from these countries reveals a high prevalence in that 22.1% of Brazilian children, 27.9% of Argentinian children and 41.8% of Mexican children are classified as overweight and/or obese. In South Africa, the most recent data revealed a combined overweight and obesity incidence of 13.5% (Mchiza & Maunder 2013). Although the South African values seem less alarming when compared to other middle-income countries, the high prevalence is still a concern and interventions are required to ensure that these youth do not follow the same trends as their international peers (Rossouw, Grant and Viljoen, 2012).

When examining the development of childhood obesity, one cannot deny the influence of genetics (Aleixo et al, 2012; Malkogeorgos et al, 2010), and having overweight or obese parents can be a risk factor (Ciubara et al, 2014). Crothers et al

(2009) state that maternal obesity (both pre-and post-pregnancy), is the strongest independent predictor of childhood obesity. Hormonal conditions, genetic syndromes, gene associations, and certain illnesses are a few of the possible endogenous causes of childhood obesity. Additionally, certain medications, such as steroids and certain antidepressants, may also cause weight gain in children (Crothers et al, 2009).

Crothers et al (2009) admit that although genetics play a role in the development of childhood obesity, a child's behaviour and environmental exposure from a young age can drastically mitigate the effect of genetics (Mchiza & Maunder, 2013). The two main areas of behaviour that are affected by the modernised lifestyle that can be linked to the increase in childhood obesity include: 1) a predominantly sedentary lifestyle, and 2) unhealthy diet (Olaya-Contreras, Bastidas and Arvidsson, 2015; Monyeki, 2014; Mchiza & Maunder, 2013; Mitchell et al, 2013; Shan et al, 2010; Crothers et al, 2009; Stroebel et al, 2009).

Research on the relationship between physical inactivity and obesity is scarce (McVeigh & Meiring, 2014). However, sedentary behaviour has been associated with increased rates of obesity development in childhood (Brault et al, 2015; Saunders, Chaput and Tremblay, 2014; Milne, 2013 Mitchell et al, 2013; Kratenova et al, 2007). McVeigh & Meiring (2013) found that spending more than two hours per day (after school) engaging in sedentary activities was associated with an approximate 7kg increase in body weight for age and gender-matched norms. Even more alarming was the finding that children who spend 4 hours or more per day in sedentary behaviour were more likely to be obese than children who stuck to the guidelines of

two hours or less (McVeigh & Meiring). An additional concern is the possibility that prolonged screen time is often associated with the consumption of energy dense foods, which contributes to the positive calorie balances already experienced by children who are more sedentary in nature (McVeigh & Meiring, 2013).

Mchiza & Maunder (2013) state that energy-dense food in South Africa cost less per unit of energy than lean protein, fruits and vegetables. Buying foods from restaurants and street cafes (take-away or sit down) has become a solution for many families since these offer low-cost, convenient options that save time and provide satiety. Research reveals that approximately one third of children's calories are consumed through restaurant meals, which are often found to be high in fat and carbohydrates, and low on nutritional value (Crothers et al, 2009; Popkin & Gordon-Larsen, 2004). Children who consume large portions of caloric-dense foods, without performing adequate physical activity to manage their caloric balances, will inevitably gain weight (Ciubara et al, 2014).

Crothers et al (2009) state that childhood obesity can lead to a widespread list of complications which can result in cardio-metabolic, pulmonary, gastrointestinal, skeletal, and neurological disorders. Some of these include: reduced bone mineral density; decreased postural and balance control; decreased bone strength; and increased risk of orthopaedic injuries (Sun, Wang and Wang, 2015; Ciubara et al, 2014; Protic-Gava, Zecak, and Shukova-Stojmanovska, 2014; Steinberg et al, 2013; Aleixo et al, 2012; Evans, 2011). Similar research has revealed that childhood obesity can also lead to high blood pressure; increased waist circumference; non-alcoholic fatty liver disease; atherosclerotic disease; type 1 and 2 diabetes mellitus;

alterations in normal motor development; as well as sleep apnoea. Abnormal lung function, and exercise-induced dyspnoea have also been reported in overweight and obese children (Olaya-Contreras, Bastidas and Arvidsson, 2015; Sun et al, 2015; Rankin et al, 2015; Ciubara et al, 2014; Benden et al, 2013; Elizondo-Montemayor et al, 2013; Song-hua et al, 2013; Aleixo et al, 2012; Berntsten et al, 2011; Malkogeorgos et al, 2010; Crothers et al, 2009; Cole et al, 2000).

A distressing fact is that the literature reveals that it is possible for weight patterns to be established from an early age and that overweight and obese children often struggle with these challenges throughout adolescence and into adulthood (Brault et al, 2015; Lane, Harrison and Murphy, 2014; Monyeki, 2014; Elizondo-Montemayor et al, 2013). Research has found that 50-80% of obese children become obese adults, with many of the associated complications affecting their health and functionality on a long term basis (Rankin et al, 2015; Ciubara et al, 2014; McVeigh & Meiring, 2014; Mitchell et al, 2013). In fact, Rossouw, Grant and Viljoen (2012) state that non-communicable diseases associated with obesity could be the cause of 7 out of 10 deaths in low-to-middle income countries (such as South Africa) by 2020.

It is clear that childhood obesity has a multitude of short and long term adverse health consequences, and as a result can pose a serious economic burden on society (Shan et al, 2010). This is why it is critical that interventions are aimed at managing childhood obesity by instilling sustainable behaviour patterns that will help children be healthy in the long run, and prevent the increase of adult obesity rates with their associated co-morbidities.

### 2.2.1. Psychosocial impact of childhood obesity

From a psychosocial perspective, Protic-Gava, Zecak, and Shukova-Stojmanovska (2014) discuss the fact that childhood obesity may further decrease children's levels of overall quality of life due to the psychological distress it can cause, and this is consistent with findings from other researchers (Ciubara et al, 2014; Janssen et al, 2004). Obesity has been shown to negatively impact children's sense of personal wellbeing and general mental health, which are essential components of successful and adaptive functioning throughout childhood development (Crothers, 2009). Obese children are often mocked by their peers, vulnerable to bullying, excluded and discriminated against by children and adults, which can be extremely detrimental to their emotional wellbeing (Ciubara et al, 2014; Crothers, 2009). Exposure to these assaults on a repetitive basis can cause obese children to suffer from negative self-image, low self-esteem, and loneliness (Ciubara et al, 2014).

As a result, the development of depression among obese children is quite common, and often maintained by feelings of low self-esteem (Ciubara et al, 2014; Smith et al, 2011). The unfortunate consequences of childhood depression include: fatigability, low academic performance, feelings of hopelessness, and suicidal tendencies. At the same time, in some cases, paediatric depression can include hetero-aggressive behaviour, fury, and behavioural disorders, often exacerbating the problem of being excluded by peers (Ciubara et al, 2014).

These consequences, coupled with the fact that obese children tend to have fewer friends, means that they tend to participate in fewer physical activities, and as such they are more isolated and sedentary (Crothers et al, 2009). This perpetuates the

vicious cycle of “obesity-exclusion-sedentary activities” and means that the children who should be performing more physical activity are excluding themselves, and decreasing their chances of living healthier lifestyles. Just like the physical effects of childhood obesity, these psychosocial consequences can have a long term effect and can continue into adulthood (Benden et al, 2013; Aleixo et al, 2012; Smith et al, 2011; Janssen et al, 2004). Thus it is important that they are addressed before irreversible behaviour patterns are established.

### 2.2.2. Assessment of childhood obesity

A critical feature of modern-day medical care is the precise and suitable assessment of overweight and obesity in children (Krebs et al, 2007). There are a variety of scientific methods available to measure body composition, both directly and indirectly. The most accurate estimation of body composition can be derived using techniques such as underwater weighing, dual-energy X-ray absorptiometry, total body water, bioelectrical impedance analysis, total body potassium and computed tomography (Mei et al, 2002). Most of these methods are inaccessible, quite complex in nature and extremely costly, limiting their use in small-scale research.

In a clinical setting, anthropometric-based measurements are preferred due to their low cost and ease of administration. These assessment tools include skinfold and circumference measurements, as well as height- and weight-based indexes such as BMI (Mei et al, 2002). BMI is an expression of the weight-to-height relationship as a ratio of $Kg/m^2$ that can be related to age and sex. BMI is quick and easy to determine, and it is considered to be a good indicator for levels of body fat in an individual. BMI can also reliably identify children who are obese, overweight,

underweight, or a healthy weight. Thus it is the most commonly recommended, and widely used method in a clinical setting as well as for research purposes (De Paula, 2012; Dinsdale, Ridler and Ells, 2011; Krebs et al, 2007; Mei et al, 2002).

There is however an important distinction between BMI classification for children and adults that must be noted. Adults (over 18 years of age) have a relatively stable BMI unless a considerable amount (5-10kg) of weight is gained or lost. Adults are classified as obese if their BMI exceeds 30kg/m², or overweight if their BMI is greater than 25kg/m². Individuals with a BMI of less than 18.5kg/m² are usually considered to be underweight (Dinsdale, Ridler and Ells, 2011; de Onis et al, 2007). Children on the other hand experience growth spurts and go through developmental stages when growth patterns differ between boys and girls. Thus the age and sex of the child under investigation must be taken into account to correctly determine their BMI (De Paula, 2012; Dinsdale, Ridler and Ells, 2011; Smith et al, 2011).

### 2.2.3. Childhood obesity and posture

Putting cardiovascular, metabolic, and psychological risks aside, the literature discusses many postural complications associated with childhood obesity. Obesity creates an overload on the musculoskeletal system, specifically the spinal column, thereby modifying its normal curvatures (Aleixo et al, 2012; Smith et al, 2011; Stroebel et al, 2009). These modifications in turn result in decreased stability, causing the body to adapt by seeking mechanical adaptations that present as faulty posture (Song-hua et al, 2013; Aleixo et al, 2012). As with all other consequences of childhood obesity, postural deviations accrued during childhood can remain and

worsen as the child grows and develops, causing severe limitations in adulthood (Smith, 2011).

### 2.3. Posture in children

Posture is defined as the relative position of different body parts in space, observed at a specific moment (Stroebel et al, 2009; Cho, 2008; Penha et al, 2008). Posture is derived from the Latin word “Positura” which means “position” (Milladorvic et al, 2014) and is influenced by both congenital (genetics and gender), and acquired factors (Trzcinska et al, 2013; Smith et al, 2011). Some of the acquired factors that affect posture development include: muscle, bone and ligament growth; diet; disease; physical activity; emotional status; and ergonomics (Niksic & Rasidagic, 2014; Pocek, Djordjic and Tubic, 2012; Smith et al, 2011; Bogdanovic & Marcovic, 2010; Hutchful, 2008; Penha et al, 2008; Kratenova et al, 2007). As so many systems are responsible for the maintenance of good posture, it is considered to be a very significant indicator of suitable physical development and musculoskeletal health (Wasik et al, 2015; Protic-Gava, Zecak, and Shukova-Stojmanovska, 2014; Furian et al, 2013; Torlacovik et al, 2013; Pocek, Djordjic and Tubic, 2012; Penha et al 2008; Stroebel et al, 2009; Mc Evoy & Grimmer, 2005).

Regarding development, childhood is one of the most important stages for the formation of the musculoskeletal system (Castro et al, 2013). Specifically, the maturation process of motor and sensory systems that maintain postural stability reach conclusion around the age of 10 years (Pocek, Djordjic and Tubic, 2012; McEvoy & Grimmer, 2005). Thus the postural alterations that occur after this period may have adverse and permanent implications, into adolescence and adulthood

(Pocek, Djordjic and Tubic, 2012). Consequently, the high prevalence of postural disorders among children has caused growing concern to medical professionals, teachers, and parents (Furian et al, 2013).

Proper posture can only be attained and maintained when correct movement patterns are applied consistently over a period of time (Wasik et al, 2015; Niksic & Rasidagic, 2014). It is known that good posture is aesthetically pleasing, but more importantly, if the body segments are well aligned, normal physical functioning is more likely, allowing for economical and efficient movement patterns (Bendikova, Smida and Rozim, 2014; Protic-Gava, Zecak, and Shukova-Stojmanovska, 2014; Pocek, Djordjic and Tubic, 2012). A child's posture also serves to protect their body from injury by maintaining balance between supporting structures (Sun, Wang and Wang, 2015; Milladorvic et al, 2014), and providing adequate muscle tone for specific activities (Wasik et al, 2015; Mitova, Popova and Gramatikova, 2014).

### 2.3.1. Poor posture in children

Faulty postures are common among children with a prevalence of 30%-40% of school children worldwide affected by some form of postural deviation (Bendikova, Smida and Rozim, 2014; De Paula et al, 2013; Dudoniene et al, 2013; Jehle & Kuhnis, 2011; Cho 2008; Kratenova et al, 2007), and compared to previous generations, the number of children affected by poor posture is increasing (Millardovic, Pausic and Kuzmanic, 2014; Protic-Gava, Zecak, and Shukova-Stojmanovska, 2014; Furian et al, 2013).

Penha et al (2008) state that even though some childhood postural deviations are indicative of normal development and are often corrected by growth; other abnormalities consist of asymmetries that are caused by habit and lifestyle. There are various causes of faulty posture in children, and they are often interlinked. Decreased levels of physical activity, increased childhood obesity rates, increased sedentary time, generalised muscle weakness and improper ergonomics have a combined negative effect on the postural deviations observed in children (Ilic & Buric, 2014; Mitova, Popova and Gramatikova, 2014; Protic-Gava, Zecak, and Shukova-Stojmanovska, 2014; Castro et al, 2013; Evans, 2011; Bogdanovic & Marcovic 2008; Hutchful 2008; Kratenova et al, 2007).

Faulty posture consists of poor interrelations between different parts of the body, and results in defective movement patterns (Mitova, Popova and Gramatikova, 2014; Penha et al 2008). Faulty postures may occur in all anatomical planes and are manifested as alterations in the spinal column and body segments directly attached to the spine (Hagner, Bak and Hagner-Derengowska, 2011). Deviations from ideal posture cause an increased pressure on tissues, muscles and joints, and they can be visually observed in an unrestrained, standing position (Pocek, Djordjic and Tubic, 2012; Hagner, Bak and Hagner-Derengowska, 2011).

To avoid the development of chronic conditions associated with faulty posture, it is beneficial to diagnose postural deviations between the ages of 7 and 14 years (Penha et al, 2008; Hagner, Bak and Hagner-Derengowska, 2011; Stroebel et al, 2009). It is important to distinguish between functional and structural alterations

within a child's posture. Initially, gradually developing muscular imbalances can result in functional changes which are characterised by a changing body profile that can be actively corrected with conscious effort and corrective exercises. Examples include drooped shoulders, hyperextended knees, and a forward head posture. Over time, in the absence of intervention, these muscular imbalances affect the ligaments, cartilage, bones and joints to such a degree that the faulty posture becomes structural in nature (Mitova, Popova and Gramatikova, 2014; Protic-Gava, Zecak, and Shukova-Stojmanovska, 2014; Cho, 2008). At this stage the poor posture is often accompanied by pain and physical limitations, and requires extensive corrective physical therapy, and in some cases surgical interventions to be corrected. Examples include scoliosis, thoracic hyperkyphosis, lumbar lordosis, pes planus and genu valgum (Mitova, Popova and Gramatikova, 2014; Pocek, Djordjic and Tubic, 2012; Bogdanovik & Marcovic, 2010; Kratenova et al, 2007). This highlights the need for early detection of faulty posture in children, combined with appropriate intervention strategies (Hagner, Bak and Hagner-Derengowska, 2011).

Some of the most common postural deviations experienced by children include: lumbar hyperlordosis (Millardovic, Pausic and Kuzmanic, 2014; Furian et al, 2013; Protic-Gava, Zecak, and Shukova-Stojmanovska, 2014; Aleixo et al, 2012); pes planus (Protic-Gava, Zecak, and Shukova-Stojmanovska, 2014; Aleixo et al, 2012; Evans, 2011); genu varum, genu valgum (Aleixo et al, 2012; Evans, 2011), thoracic hyperkyphosis; sway postures (Smith et al, 2011); cervical hyperlordosis, and winged scapulae (Cho, 2008; Penha et al, 2008). These postural deviations may influence the morphology of bone, disc and other spinal structures, possibly resulting

in back pain and poor spinal health throughout life (Furian et al, 2013; Pocek, Djordjic and Tubic, 2012; Jehle & Kuhnis, 2011; Smith et al, 2011; Cho, 2008).

### 2.3.2. Psychosocial impact of posture on children

Although the physical limitations imposed by faulty posture can affect functionality of children, it is important to keep in mind that poor posture can also affect children on a psychological level. Pocek, Djordjic and Tubic (2012) suggest that posture is most noticeable in a child's physical appearance, which represents the strongest predictor of self-worth in children. Thus, children with faulty posture are at risk for developing anxiety and depression, suicidal thoughts, negative self-perception of physical appearance, and poor communication skills (Pocek, Djordjic and Tubic, 2012). On the other hand, mental state is known to affect posture (Smith et al, 2011). With the established negative psychological effects of obesity, children with higher BMI's may indirectly present with poorer postures as a result of their mood (Smith et al, 2011). It is clear to see that a child's quality of life is considerably decreased by poor posture, particularly if they are experiencing the consequences on a psychosocial level.

### 2.3.3. Posture and ergonomics

In addition to the obesity and physical activity challenges that they face, ergonomics can play a large role in the development of faulty postures in children. Children's sitting, standing and walking postures become challenged when they begin formal schooling which requires prolonged hours of sitting (Prins, Crous and Louw, 2008), as well carrying around heavy school bags (Millardovic, Pausic and Kuzmanic, 2014; Mitova, Popova and Gramatikova, 2014; Hutchful, 2008; Rego & Scartoni, 2008).

Hutchful (2008) refers to the “snail effect” where children carry their lives on their backs as school bags are packed with heavy books, lunch boxes, and stationery. The American Academy of Orthopaedic surgeons have published guidelines suggesting that a child’s school bag should not exceed 10-15% of their body weight (Millardovic, Pausic and Kuzmanic, 2014; Mitova, Popova and Gramatikova, 2014). In a study by De Paula et al (2012) it was found that 71.68% of the participants carried school bags that weighed more than 10% of their body mass. By carrying this excessive load, children’s musculoskeletal systems will modify their movement patterns to allow for increased stability. In addition to the excess mass in school bags, children often don’t wear school bags correctly, which can cause muscular imbalances over time, leading to postural adaptations (Millardovic, Pausic and Kuzmanic, 2014; Rego & Scartoni, 2008). Hutchful (2008) found that only 37% of 6 to 15 year old children wore their bags correctly over both shoulders.

The type of seating used in schools could also be a factor in the development of poor posture (Hutchful, 2008). Computer usage in the home and at school is increasing and will not likely decrease in the near future (Robbins, Johnson and Cunliffe, 2009). This adds to poor postures assumed at home and school while partaking in academic sedentary activities since computers have been introduced in schools with minimal alterations to furniture or attention to proper ergonomics (Robbins, Johnson and Cunliffe, 2009; Rego & Scartoni, 2008). Internationally, data is disturbing, where on a weekly basis, computers are used for schoolwork, communication and fun for over 16 hours per week by American children, 16.9 hours per week by Australian children, and over 18 hours per week by children in Hong Kong (Robbins, Johnson

and Cunliffe, 2009). In South Africa, the Children's World National Report found that during their discretionary time, on average, 69.8% of 10 year olds, and 71.6% of 12 year-olds watched Television or listened to music daily (or almost daily). Additionally, 40% of 10 year-olds and 35.6% of 12 year-olds made use of computers daily (or almost daily). Although this report doesn't provide specific values in terms of time engaged in sedentary behaviour, it is still alarming to see that children in this age group are engaging in these types of sedentary activities daily, or almost daily (Sevahl et al, 2014). As such, if children's workstations and sitting postures are not ergonomically adequate, the development of poor postures and associated musculoskeletal problems is inevitable

### 2.3.4. Assessment of posture

Before faulty posture can be corrected, it must be identified correctly. Dudoniene et al (2013) state that postural analysis is aimed at detecting abnormal deviations from a referenced vertical alignment, in both the frontal and sagittal planes. Postural analysis is not standardised (Cho, 2008; McEvoy & Grimmer, 2005). In clinical practice, therapists use observation to detect musculoskeletal asymmetries and imbalances in one's static posture as well as during functional movements (Shultz, Houglam and Perrin, 2010; Jehle & Kuhnis, 2008; Magee, 2008). Although experienced clinicians can be very good at identifying faulty posture in this way, it remains a subjective evaluation. In order to achieve more objective, quantitative data, a postural grid and plumb line can be used (Cho, 2008; McEvoy & Grimmer, 2005).

Since posture is based on many complex connections between different bodily systems and processes, performing a once-off posture analysis does not always give the level of insight required to suggest appropriate interventions (Jehle & Kuhnis, 2008). In order to achieve objective and reproducible results, technical, time consuming, and expensive methods would work optimally. Unfortunately, within the context of performing research one is often limited in time and financial resources, thus using time-consuming and costly procedures would not be practical (Jehle & Kuhnis, 2008). As such, it is deemed suitable for a qualified clinician to perform postural analyses in the research setting by using their observation skills in the form of the New York Posture Test (Bolton et al, 2013) and using a plumb line and bob to provide an objective reference point (Appendix B).

### 2.4. Interventions

It is clear from the discussion thus far that the three areas of interest within this research overlap. It seems that higher levels of physical activity can play a significant role in preventing (and treating) both faulty posture in children, and childhood obesity. In terms of prevention of these challenges, schools, parents, and government need to recognise the important role that physical activity plays in the healthy development of children on all levels. Programmes should be put in place to encourage greater levels of involvement in sports and extra-curricular physical activities, as well as enhanced awareness regarding the benefits of physical activity and the role it plays in achieving and maintaining health and quality of life. Additionally, the implementation of existing PE policies need to be monitored to ensure that children are participating effectively in this very important component of the curriculum. For children that have been identified with postural or weight-related

problems, interventions must be targeted and outcome-based to ensure any chance of success.

## 2.5. Conclusion

Before targeted interventions can be introduced to help South African children live healthy and balanced lifestyles, research must first be done to determine the nature of the challenges that these children face on a daily basis. Internationally, there is a lot of research done on childhood obesity and posture, especially in America, the United Kingdom, and China. South Africa could benefit from similar research in these areas to help modify public policy and guide interventions aimed at improving the health and quality of life of children.

It is important to understand the complex relationship that exists between physical activity levels, obesity rates, and posture amongst children. Although one can assume that they are related, determining whether each of these areas of focus are independent predictors of health will have significant implications for strategies aimed at encouraging the improvement and maintenance of health in children.

# CHAPTER THREE: METHODS

## 3.1. Study design

This research was a cross-sectional design that was observational and descriptive in nature.

## 3.2. Study participants

Children between the age of 10 and 13 years, of either sex, and of any race formed part of the study sample. The study included both genders so as to be able to draw comparisons between the sexes (despite developmental issues at this age); to be able to compare results to other research findings; and to be able to make gender-specific recommendations.

Inclusion criteria were as follows: signed Assent Form (Appendix C); signed Informed Consent from parent or guardian (Appendix D); participant must have been born between 2002 and 2005. Exclusion criteria included any physical or developmental disability that may prevent the participant from maintaining an upright standing posture; and/or any severe orthopaedic injury (e.g.: broken limb/s) that may give the appearance of a faulty posture where there is none.

Ethical clearance from the University of the Witwatersrand Human Research ethics Committee (HREC) (Appendix E) was obtained and approval from the Gauteng Department of Education (GDE) (Appendix F) was received for this research. Ten Primary schools that fall in Quintile 3 to 5 as well as private schools in the Pretoria East area were approached to participate in the research. This includes government and private schools in Pretoria East, and schools within the informal settlement

areas were excluded. Children from these schools were more likely to participate in similar, and thus comparable, leisure time activities.

A cluster sampling technique was used to sample participants. Under the assumption that 120 pupils from each school approached would voluntarily form part of the study, the population size estimated was 1200. With an expected obesity frequency of 30% (Evans, 2011), and a confidence interval of 95%, the sample size expected was 260 children.

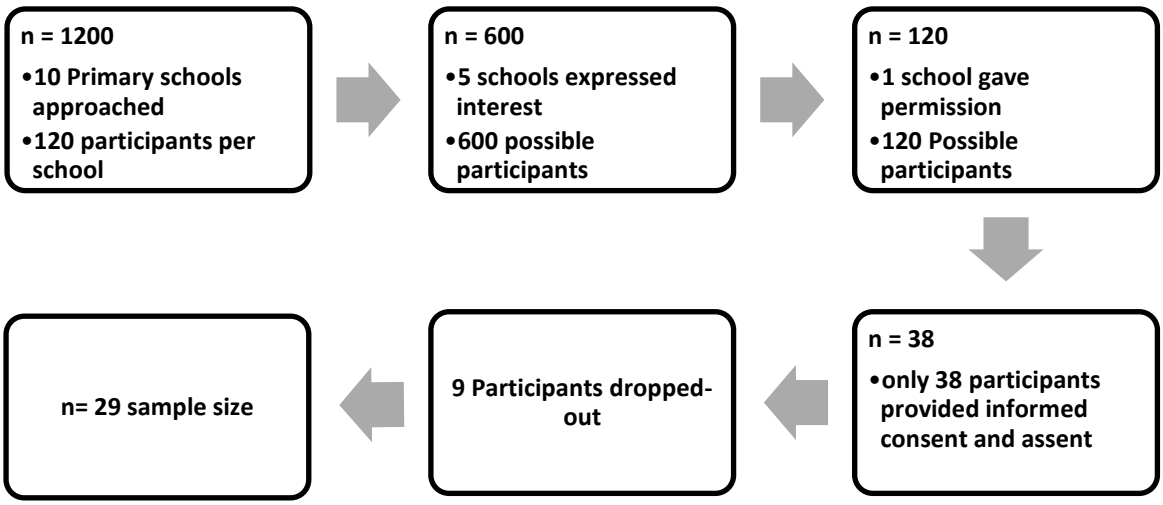


**Figure 3.1. Process of participant recruitment**

Unfortunately, of all the schools approached, only five schools agreed to participate in the research. However, upon initiation of testing procedures, only one school followed through and gave formal permission for the research to continue on school grounds. Reasons given for withdrawal from the study include time constraints and lack of interest from parents. The principal from the participating school signed a

consent form for approval (Appendix G) and sent an information letter out to parents of children in the qualifying age group (10-13 years).

Parents/guardians who voluntarily agreed for their child to participate in the research gave informed consent and their children signed an assent form both guardians and participants knew that they could withdraw from the study at any time without any prejudice. The researcher arranged a suitable time for testing with the head of the Sport Department and it was decided that over a period of two weeks, the testing would be done during the PE periods assigned to the children.

As seen in figure 3.1., 38 Participants provided informed consent and assent, however, 9 of them dropped out of the study. The reasons for these drop outs were as follows: 2 participants were absent from school on the day of testing; 5 participants had been excused from school to initiate their mid-term break holiday before the end of school; and 2 children had prior sporting engagements that meant they had to miss their PE classes on the day of testing.

### 3.3. Measurements

#### 3.3.1. Demographics

Participants were asked to disclose their age, sex, and race as part of the self- report PAQ-C. No names were recorded and participants were allocated a code to protect their identity and maintain confidentiality at all times.

### 3.3.2. Physical activity

To assess levels of physical activity, PAQ-C was used. The PAQ-C is a self-administered, 7-day recall questionnaire. It was used to assess general levels of physical activity during primary school years for children that are 8 to 14 years of age. The PAQ-C can be presented in a classroom setting and provides a total physical activity score which is determined from nine items, each scored on a 5-point scale (Kowalski, Crocker and Faulkner, 1997). The questions are aimed at determining physical activity levels in the past 7 days of a child's life during: 1) their spare time: 2) PE classes; 3) break-time; 4) lunch time; 5) the time right after school; 6) the evenings; 7) their weekends; and 8) in general. Question 9 is aimed at determining which days the children are most active, and providing an overall score out of 5. Using all of these scores out of 5, a composite score is determined for each participant where a score of 1 is considered to be low, and a score of 5 is considered to be high. Question 10 is used to determine if participants experienced any illness or other challenges in the previous week which would have prevented them from pursuing their normal activities.

Chinapaw et al (2010) state that this questionnaire has a positive reliability with an interclass correlation coefficient of 0.75 for girls, and 0.82 boys (Crocker et al, 1997). This questionnaire was also validated by Kowalski, Crocker and Faulkner (1997) who found a convergent validity of r = 0.63 and a construct validity of r = 0.53. This questionnaire is available free from a licence fee.

The researcher presented the questionnaire to groups of participants in an interview style and encouraged the participants to give the correct information since it was not a test. This helped to clear up any confusion or ambiguities, and ensured that all

questions were completed as accurately as possible. Each participant was given a summary score of low (1); low-moderate (2); moderate (3); moderate-high (4); or high (5) physical activity rating based on scoring guidelines as provided by Kowalski, Crocker and Doren (2004).

### 3.3.3. BMI

To assess BMI, a calibrated digital scale (Omron Healthcare Europe BV, Digital personal scale, SN: 201403-03974F, Hoofddorp, The Netherlands) was used to measure mass in kilograms to the nearest 100g. The participants wore their swimming attire and no shoes. A portable stadiometer (Medi-IQ Imports and exports, portable stadiometer SN: 039671, Johannesburg, South Africa ) was used to measure stature in metres to the nearest centimetre.

In order to account for a child's age and sex, children's BMI's are classified using thresholds that vary and are defined in terms of a z-score on a growth reference. (Smith et al, 2011). The WHO Reference (2007) was used to derive age- and gender-specific BMI z-scores and to divide the participants into five BMI categories: severe thinness: (z-score < -3.0), thinness (z-score -3.0 to -2.0), normal-weight (z-score = -2.0 to +1.0), overweight (z-score > +1.0 to < +2.0), and obese (z-score > +2.0) (Dinsdale, Ridler and Ells, 2011; de Onis et al, 2007).

### 3.3.4. Posture

To assess posture, guidelines from Shultz, Houglam and Perrin (2010) were used with a plumbline (Stanley brass plumb bob; 47-973, 70002835; New Britain, USA) as a reference of alignment against a Posture chart (Medi-IQ Imports and exports,

portable posture chart, Johannesburg, South Africa). Appendix H describes the process in detail. The measuring tool that was used is the New York Posture test (Bolton et al, 2013; Kowalski, Crocker and Doren, 2004), and each participant was given an overall score of poor (0-2), poor-fair (2-4), fair (4-6), fair-good (6-8), and good (8-10).

After the assessment, all participants received a generic exercise and stretching pamphlet (Appendix I) containing educational material regarding the correct use of school bags as well as technology based activities. Those participants that were identified with specific postural deviations (e.g.: hyperlordotic lumbar curve) were given certain exercises and stretches to do as well as awareness on how to improve their posture.

### 3.3.5. Data analysis

After data was collected, it was captured in an excel spreadsheet and then exported to SPSS Version 20.0. Descriptive statistics such as frequency distributions, cross tabulations, mean and standard deviations were used to summarise the data.

Pearson's correlation analysis, which is a measure of the strength of a relationship between two variables, was applied. Pearson's correlation coefficients is weak if it is between 0 and 0.29, moderate if between 0.3 and 0.49, and strong if between 0.5 and 1. The Pearson's correlation coefficient was used to assess the relationship between physical activity and BMI, physical activity and posture, and between posture and BMI (Cohen, 1988). To compare differences between genders, the independent sample-t test was used and significance was set at 0.05.

**Table 3.1. Indication of normal distribution of the PAQ-C, Posture, and BMI scores**

| Tests of Normality | | | | | | |
|---|---|---|---|---|---|---|
| | Kolmogorov-Smirnov[a] | | | Shapiro-Wilk | | |
| | Statistic | df | Sig. | Statistic | df | Sig. |
| PAQ-C Score | 0.14 | 29 | 0.18 | 0.97 | 29 | 0.56 |
| Posture Score | 0.13 | 29 | 0.2* | 0.95 | 29 | 0.24 |
| BMI Z-score | 0.19 | 29 | 0.01 | 0.90 | 29 | 0.01 |
| *. This is a lower bound of the true significance. | | | | | | |
| a. Lilliefors Significance Correction | | | | | | |

Both the Kolmogorov-Smirnov test and the Shapiro-Wilk's tests for normality indicated that the PAQ-C Score and the Posture score were normally distributed since the p-values were greater than 0.05. On the other hand the BMI Z-score was not normally distributed since the p-values were less than 0.05.

# CHAPTER FOUR: RESULTS

## 4.1. Demographics

The sample was made up of 29 children with a mean age of 10.7 (±0.9) years. Of the 29 children, 55% were 10 years old (n= 16), 17% were 11 years old (n= 5), 24% were 12 years (n = 7) and the other 4% (n = 1) were 13 years old. (Figure 4.1)

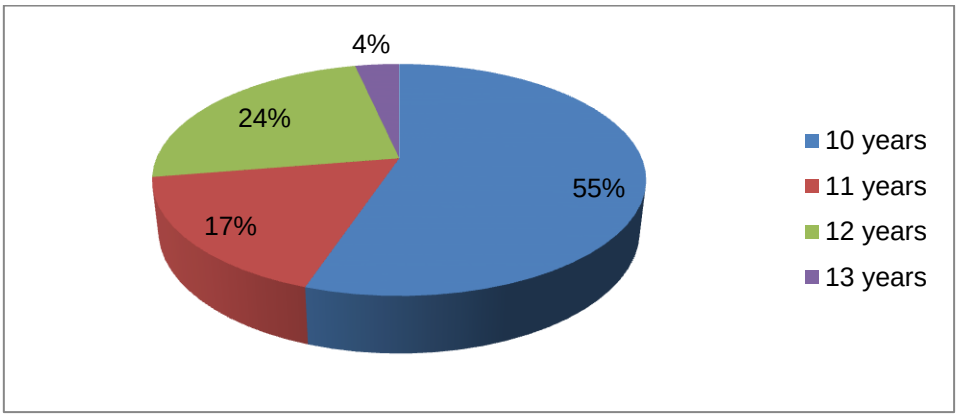


**Figure 4.1: Age of classification for all the participants (n = 29)**

The sample was made up of 55% female (n= 16) and 45% male (n= 13) participants. Most of the participants (62%) were of White origin (n = 18), 35% were of African origin (n = 10) and the other 3% were Coloured (n = 1).

The participants were on average 1.49 m tall, with a weight of 36.48 kg and an average BMI of 16.31kg/m².

**Table 4.1: Descriptive statistics for height, weight, and BMI of all participants (n=29)**

| | **Overall (n=29)** | **Female (n=16)** | **Male (n=13)** | P-value |
|---|---|---|---|---|
| | Mean ± SD | Mean ± SD | Mean ± SD | |
| Height (m) | 1.49 ± 0.09 | 1.50 ± 0.09 | 1.48 ± 0.10 | 0.54 |
| Weight (kg) | 36.48 ± 8.26 | 38.31 ± 8.24 | 34.23 ± 8.03 | 0.19 |
| BMI (kg/m²) | 16.31 ± 2.86 | 16.93 ± 3.10 | 15.53 ± 2.42 | 0.19 |

## 4.2. Physical activity

Each participant was given a summary score of low (1); low-moderate (2); moderate (3); moderate-high (4); or high (5) physical activity rating based on scoring guidelines as provided by Kowalski, Crocker ad Doren (2004). These scores indicate the total time spent being physically active in the most recent 7 days of the participant's life, and do not give an indication of intensity of physical activity pursued.

The results in figure 4.2 show that none of the children aged 10-13 participated in low levels of physical activity. 10% (n = 3) of the children participated in low-to-moderate levels of physical activity, 45% moderate (n = 13), 31% in moderate-to-high (n = 9), while the other 14% (n = 4) participated in high levels of physical activity on a weekly basis.

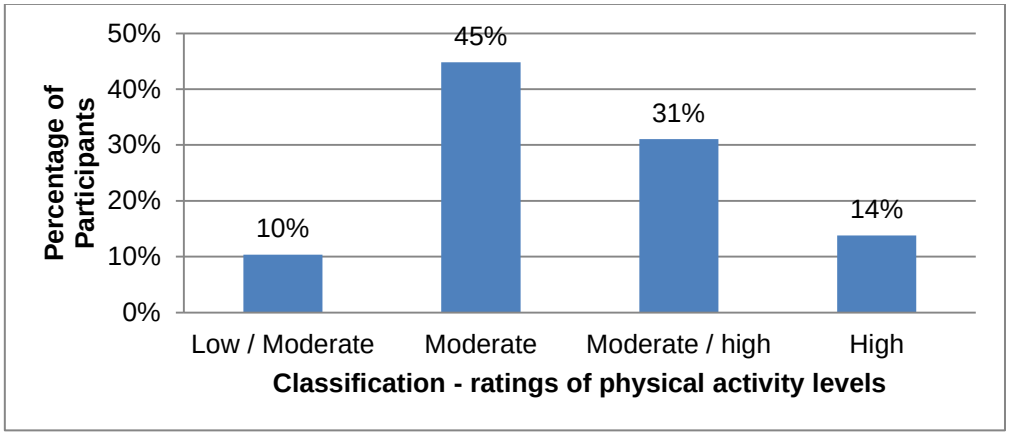


**Figure 4.2: Physical activity scores for all participants (n = 29)**

As indicated by table 4.2, the lowest scores were found in Question 1 (spare time) for both boys and girls. Similarly, Question 2 (PE Class) held the highest scores as well for both genders. This suggests that the participants were least active during their spare time and most active during PE classes. A significant difference is seen in

Question 3 (Break time; p = 0.006), and 4 (Lunch time; p = 0.001) indicating that boys are considerably more active during these periods than girls.

**Table 4.2: Physical activity scores per question and by gender (n = 29)**

| | Overall (n=29) | Female (n=16) | Male (n=13) | P-value |
|---|---|---|---|---|
| | Mean ± SD | Mean ± SD | Mean ± SD | |
| Q1: Spare time | 1.79 ± 0.48 | 1.76 ± 0.49 | 1.82 ± 0.48 | 0.76 |
| Q2: PE class | 4.59 ± 0.98 | 4.63 ± 1.03 | 4.54 ± 0.97 | 0.81 |
| Q3: Break time | 2.86 ± 1.68 | 2.13 ± 1.46 | 3.77 ± 1.54 | ***< 0.01*** |
| Q4:Lunch time | 2.62 ± 1.61 | 1.81 ± 1.17 | 3.62 ± 1.56 | ***< 0.01*** |
| Q5: After school | 4.41 ± 0.87 | 4.25 ± 1.00 | 4.62 ± 0.65 | 0.27 |
| Q6: Evenings | 3.07 ± 1.39 | 3.13 ± 1.31 | 3.00 ± 1.53 | 0.81 |
| Q7: Weekends | 3.59 ± 1.15 | 3.69 ± 1.01 | 3.46 ± 1.33 | 0.60 |
| Q8: General score | 3.59 ± 1.05 | 3.50 ± 1.03 | 3.69 ± 1.11 | 0.63 |

## 4.3. Body mass index (BMI)

It can be noted from figure 4.3 that most of the children (n = 17) had a normal BMI (59%), 14% (n = 4) were thin, while 10% (n = 3) had scores that indicated severe thinness. A proportion of 10% (n = 3) were overweight while another 7% (n = 2) were obese according to WHO 2007 classifications (de Onis et al, 2007).

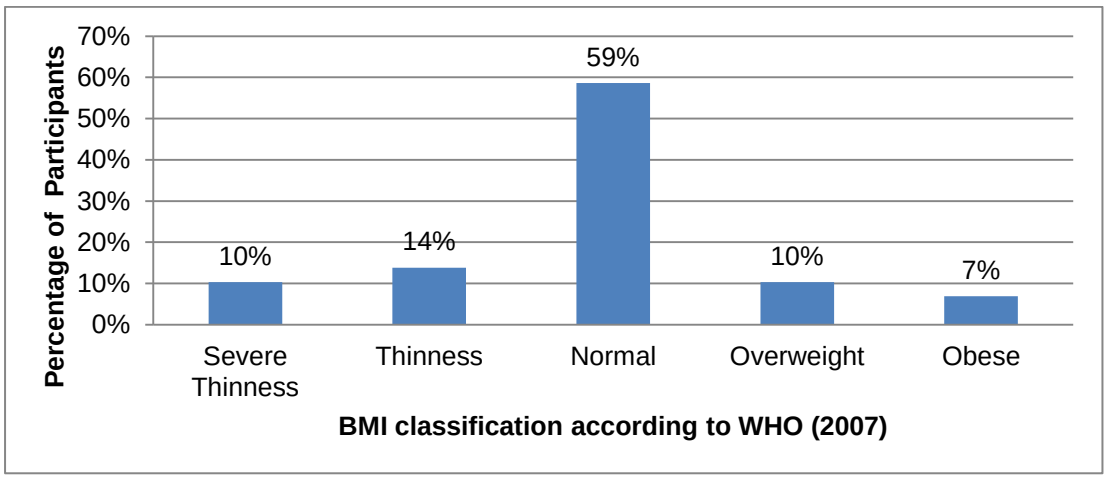


**Figure 4.3: BMI Classification for all participants (n = 29)**

As seen from table 4.1, the average height of all the participants (n = 29) was 1.49m with girls (n = 16) having an average height of 1.50m while boys (n = 13) were on average 1.48m tall. The difference between the mean height for boys and girls was not statistically significant (p = 0.54). The overall average weight was 36.48 kg for the whole sample; girls were on average 38.31 kg while boys were on average 34.23 kg. There is no significant difference in weight by gender (p = 0.19). There is also no significant difference in BMI by gender, the overall mean BMI is 16.31kg/m², while girls expressed a BMI of 16.93kg/m², and boys 15.53kg/m² (p = 0.19).

### 4.4. Posture

As an overall score, most of the participants (n = 19) displayed good posture (66%) and the other 34% had fair-to-good posture (n = 10). However, the researcher observed some form of postural deviation in 93% (n = 27) of the participants. The table below shows postures for different parts of the body.

**Table 4.3: Posture descriptives for all participants (n = 29) by category and by gender**

| | All (n = 29) | Female (n=16) | Male (n=13) | P-value |
|---|---|---|---|---|
| | Mean ± SD | Mean ± SD | Mean ± SD | |
| Spine | 9.66 ± 1.28 | 9.69 ± 1.25 | 9.62 ± 1.38 | 0.88 |
| Hips | 9.66 ± 1.28 | 9.69 ± 1.25 | 9.62 ± 1.38 | 0.88 |
| Upper back | 8.97 ± 2.06 | 9.06 ± 2.01 | 8.85 ± 2.19 | 0.78 |
| Trunk | 8.79 ± 2.17 | 8.75 ± 2.23 | 8.85 ± 2.19 | 0.90 |
| Head | 8.45 ± 2.35 | 8.75 ± 2.23 | 8.08 ± 2.53 | 0.45 |
| Shoulders | 8.45 ± 2.35 | 8.44 ± 2.39 | 8.46 ± 2.40 | 0.97 |
| Ankles | 7.59 ± 2.54 | 8.13 ± 2.50 | 6.92 ± 2.53 | 0.21 |
| Neck | 7.24 ± 2.53 | 6.56 ± 2.39 | 8.08 ± 2.53 | 0.11 |
| Lower back | 6.55 ± 3.30 | 5.63 ± 3.09 | 7.69 ± 3.30 | 0.09 |
| Abdomen | 6.21 ± 3.69 | 5.00 ± 3.65 | 7.69 ± 3.30 | ***0.04*** |
| Total score | **8.16 ± 1.01** | | | |

The average posture score for all participants (n = 29) was highest (indicating good posture) for the spine (9.66) and Hips (9.66), followed by the upper back (8.97). The lowest posture score (indicating poor posture) was for abdomen (6.21). The overall average posture was 8.16 with a standard deviation of 1.01.

Both girls and boys achieved the highest scores for the posture of their spine and hips. Interestingly, the lowest scores observed by boys were found to be in their ankles (indicating pes planus), while girls presented an average good score for this area. On the other hand, girls presented with the lowest scores in the abdomen (indicating a protruding abdomen), while boys presented a fair-to-god score for this area. There was a significant difference (p = 0.04) in scores between boys and girls regarding the abdominal posture.

### 4.5 Correlations

To assess correlation between Physical activity, BMI and posture, the Pearson's Correlation coefficient analysis was conducted, see table 4.4.

**Table 4.4. Correlations between scores for PAQ-C, BMI, and posture for the study sample (n = 29)**

| Correlations | | | | |
|---|---|---|---|---|
| | | PAQ-C Score | Posture Score | BMI Z-score |
| -C Score | Pearson Correlation | | | |
| | Sig. (2-tailed) | | | |
| | N | | | |
| Posture Score | Pearson Correlation | 0.170 | | |
| | Sig. (2-tailed) | 0.378 | | |
| | N | 29 | | |
| BMI Z-score | Pearson Correlation | -0.142 | -0.485 | |
| | Sig. (2-tailed) | 0.463 | 0.008** | |
| | N | 29 | 29 | |
| **. Correlation is significant at the 0.01 level (2-tailed). | | | | |

### 4.5.1. The correlation between physical activity and BMI

The null hypothesis was that there is no association between physical activity and BMI while the alternative hypothesis was that there is an association between posture and BMI. The test was conducted at 5% significance level. Correlation analysis was conducted to uncover whether a statistically significant association exists between BMI and physical activity. As seen in figure 4.4, the result revealed that the correlation between BMI and physical activity is weak and not significant at 5% significance level (r = -0.142; p = 0.463). Thus, there is no association between BMI and physical activity found in the current study.

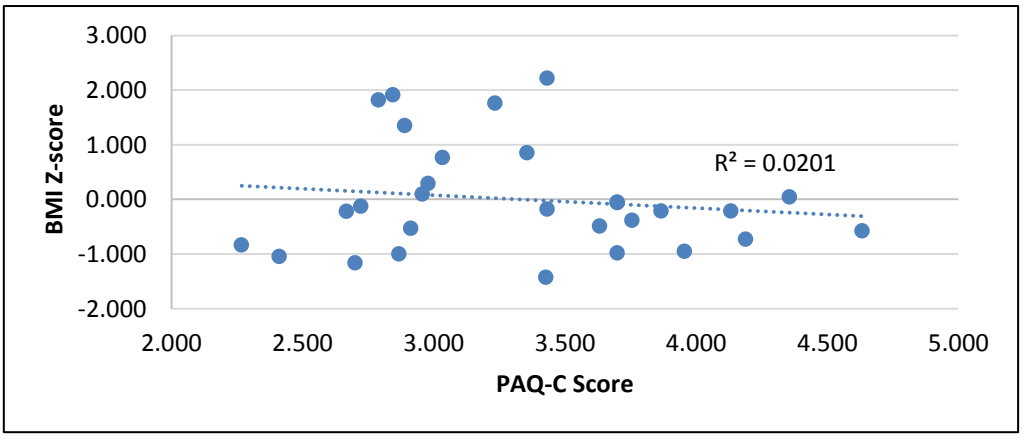


**Figure 4.4. Correlation between physical activity and BMI**

### 4.5.2. The correlation between physical activity and posture

The null hypothesis was that there is no association between posture and physical activity while the alternative hypothesis was that there is an association between posture and physical activity. Correlation analysis was conducted to uncover whether a statistically significant difference association result exists between posture and physical activity. Figure 4.5 shows that the result revealed that the correlation between posture and physical activity is weak and not significant at 5% significance

level (r = 0.170; p = 0.378) since the p-value was greater than 0.05. Thus, there is no association between posture and physical activity.

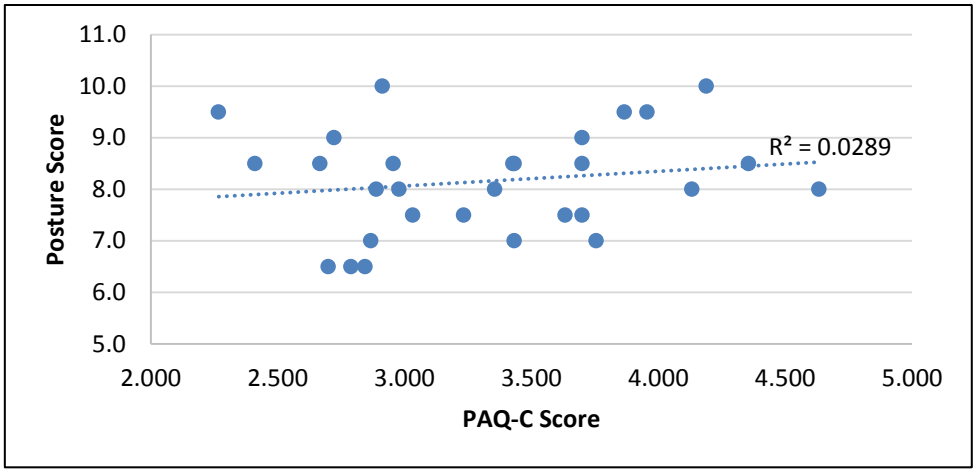


**Figure 4.5. Correlation between physical activity and posture**

### 4.5.3. The correlation between BMI and posture

The null hypothesis was that there is no association between posture and BMI while the alternative hypothesis was that there is an association between posture and BMI. Figure 4.6 indicates that the results reveal that there is a moderate significant negative correlation between posture and BMI (r = -0.485, p = 0.008) since the p-value is less than 0.05 (the significance level) and the correlation coefficient is less than 0. This implies that as the higher the BMI, the poorer the posture and vice versa.

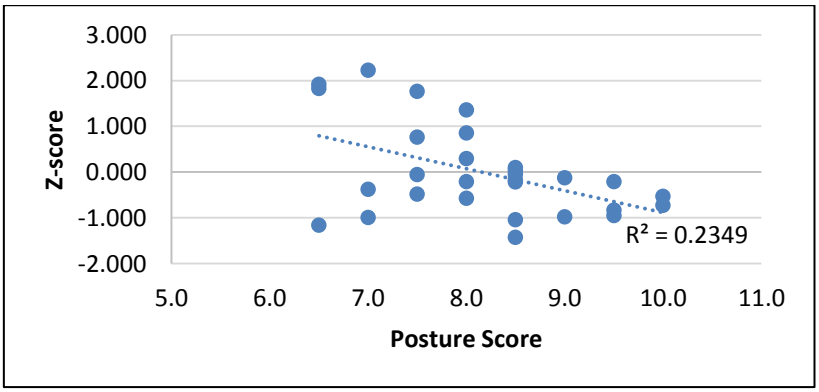


**Figure 4.6. Correlation between BMI and Posture**

# CHAPTER FIVE: DISCUSSION

## 5.1. Physical activity

The literature reveals that children are becoming less physically active than previous generations (Monyeki, 2014). There are multiple reasons for this trend ranging from individual (children's preferences) to interpersonal (parental support), organisational (school opportunities), and environmental (safety or accessibility) (Stroebel et al, 2009b). These barriers can act either in isolation or in collaboration to reduce the general levels of physical activity that children are participant in on a daily basis.

The current study indicated that based on self-report information on an average week, 0% of the children participated in low levels of physical activity, and only 10% of the children participated in low-to-moderate levels of physical activity as measured. Most children (45%) participated in moderate levels of physical activity, 31% moderate-to-high, and 14% participated in high levels of physical activity on a weekly basis.

Results from the Canadian Health Measures Survey indicated that merely 7% of children and adolescents aged 6-19 years participated in the recommended 60 minutes of moderate-to-vigorous intensity physical activity per day (Tremblay et al, 2011), and in China, Shan et al (2010) found that 80% of the participants in their study did not meet the recommendation either. In contrast, the current study revealed that 90% of children did meet, and exceed these guidelines. The reasons for this difference may be due to the opportunities that are available to the sample of children that made up this study. The school that they attend does incorporate PE in the curriculum. Considering that the highest physical activity scores were reported to be during these classes, a comprehensive curriculum which includes PE can go a

long way to improve the general health and wellbeing of children in Primary School (McVeigh & Meiring, 2013). The researcher speculates that additional reasons why the children in this study met and exceeded the physical activity guidelines could be due to the variety of after-school sports on offer a their school, the accessibility to (non-school) sports clubs and gyms, as well as the accessibility to sporting equipment (e.g. balls, bicycles) at home.

Both boys and girls reported that they were least active in their spare time. Similarly, Tremblay et al (2011*b*) report that children spend most of their free time pursuing sedentary activities, and this trend seems to be increasing in children of all ages (Popkin & Gordon-Larsen, 2004). The issue that arises is that regardless of physical activity levels, sedentary behaviour has been identified as an independent risk factor for detrimental health outcomes in children (Herman et al, 2014; Lane, Harrison and Murphy, 2014; Brault et al, 2015; Saunders, Chaput and Tremblay, 2014; Milne, 2013). The proposed mechanism of children's poor health as related to increased sedentary behaviour is the reduction in physical activity levels combined with the consumption of high-calorie foods while engaging in these activities (McVeigh & Meiring, 2014). In a Review of 232 studies, Tremblay et al (*2*011*b)* found that screen-based sedentary behaviour for more than 2 hours per day was associated with increased fat mass and weight gain (Brault et al, 2015; Lane, Harrison and Murphy, 2014; McVeigh & Meiring, 2014), reduced fitness levels, poor posture (Kratenova et al, 2007), low self-esteem, and decreased academic achievement in children (Milne, 2013). This introduces the problem of reducing sedentary time as well as increasing physical activity levels in children to achieve optimal health results with future interventions.

When comparing genders the only significant difference in physical activity levels was found to be during break time ($p = 0.006$) and the lunch period ($p = 0.001$) where boys achieved higher physical activity scores than girls in both questions. Similarly, Lane, Harrison and Murphy (2014) found that boys tend to be generally more active than girls. This may be related to the way in which boys socialise, which is often through physical games and recreational sports. This could possibly mean that even during the times that they get a rest from school work to relax; boys may tend to be more active while girls prefer to sit down and have conversations with their friends.

### 5.2. Childhood Obesity

Internationally and locally, many authors consider childhood obesity to have reached epidemic proportions (Benden et al, 2013; Steinberg et al, 2013; de Paula et al, 2012; Rossouw, Grant and Viljoen, 2012). The morbidities that are associated with childhood obesity are the main cause for concern as these health problems can drain the national health care system on a short- and long-term basis as many of the conditions can continue in to adulthood (Olaya-Contreras, Bastidas and Arvidsson, 2015; Sun, Wang and Wang, 2015; Rankin et al, 2015; Ciubara et al, 2014; Benden et al, 2013; Elizondo-Montemayor et al, 2013; Song-hua et al, 2013; Aleixo et al, 2012; Berntsten et al, 2011; Malkogeorgos et al, 2010; Crothers et al, 2009; Cole et al, 2000).

In the current study 10% of participants were found to be overweight and 7% obese, making the combined overweight obesity prevalence 17%. This is higher than reported by Mchiza and Maunder (2013) where they stated that the South African

National Health and Nutrition examination Survey (NHANES-1) documented a combined overweight and obesity prevalence of 13.5% in South African children. However, when compared to children of similar ages, the results are lower than other low-to-middle income countries which have a combined childhood overweight and obesity prevalence of 22.7 % in Argentina and 41.8% in Mexico (Mchiza & Maunder, 2013). Regarding solely obesity rates, the results of this study (7%) are well below many international prevalence rates, with America at 18%, and China at 10% (Mitchell et al, 2013). The lower rate of obesity found in this study cohort could be attributed to their socioeconomic status of the children. Their parents can afford to send them to a private school which implements PE effectively. They are also able to buy, healthier, more costly food, and pay for access to a wide variety of extra-curricular physical activities.

When comparing gender, 25% of girls in the study were considered to be overweight or obese, while only 7.6% of the boys fell into this category. Similar results are seen by Brault et al (2015) who found that 30% of girls and 12% of boys were already overweight or obese by age ten. In their study, Lane, Harrison and Murphy (2014) found that 27.7% of girls were overweight or obese compared with 21.5% of boys. This may be due to the fact that girls begin to mature and enter puberty before boys do, and the ages examined in this study cohort fall within puberty age-ranges.

The fact that childhood obesity is a risk factor for many cardio-metabolic, pulmonary, gastrointestinal, skeletal, and neurological disorders is well established (Olaya-Contreras, Bastidas and Arvidsson, 2015; Sun, Wang and Wang, 2015; Rankin et al,

2015; Ciubara et al, 2014; Benden et al, 2013; Elizondo-Montemayor et al, 2013; Song-hua et al, 2013; Aleixo et al, 2012; Berntsten et al, 2011; Malkogeorgos et al, 2010; Crothers et al, 2009; Cole et al, 2000). Additionally, the psychosocial impact of childhood obesity only acts to exacerbate the physical challenges already faced by these children and their families. There is also a high risk that obese children may carry their excess weight and associated co-morbidities into adolescence and adulthood. This creates a great burden on the healthcare system for a considerable amount of time, and severely decreases the quality of life of the individual affected, as well as the people that form part of their support system. To help prevent the development of childhood obesity into a life-long disease, children who are at risk should be identified at a young age so that the appropriate interventions may be introduced to help prevent or mange the weight gain problem before it becomes a chronic affliction.

### 5.3. Posture

Due to the combined effect of reduced physical activity rates and prolonged seated postures while at school, watching television, playing computer games or engaging in social media, children's postures are being altered in a negative way. Compared to previous generations, the number of children affected by poor posture is increasing (Millardovic, Pausic and Kuzmanic, 2014; Protic-Gava, Zecak, and Shukova-Stojmanovska, 2014; Furian et al, 2013).

This study found that 66% of participants had good over-all posture, while 34 % presented with fair-to-good posture, and contradicts other research which has

identified a prevalence of poor posture in 30-40% of children (Bendikova, Smida and Rozim, 2014; De Paula et al, 2013; Dudoniene et al, 2013; Jehle & Kuhnis, 2011; Cho 2008; Kratenova et al, 2007). This may be because this study gave over-all posture scores, and not based on only one area of faulty posture. However, in this sample, only 7% of children presented with a perfect posture, and 93% presented with some form of deviation from the norm. Due to the discrepancy in scoring methods throughout the literature, it would be best to compare specific postural abnormalities of this sample with studies performed by other researchers.

In both genders, the body areas which showed the worst postural adaptation were the abdomen and the lumbar spine. There is an accepted association between excessive lumbar lordosis and a protruding abdomen in children, and this study appears to be in line with these findings (Aleixo et al, 2012). Lumbar hyperlordosis and protruding abdomen was found in 58.6% of the participants. 75 % of girls and 38% of boys in this study presented with lumbar hyperlordosis and protruding abdomen. Similarly, in their study, Aleixo et al (2012) found that 61.7% of their participants showed lumbar hyperlordosis, and 64.7% had protruded abdomen. This is an indication of weakness of the entire abdominal muscle group (including pelvic floor muscles) and possibly the hip extensor group. The concomitant over-activity of low back erector spinae, upper internal obliques, and hip flexor muscle groups will result in the observed lumbar hyperlordosis (Kendall, 2010).

When comparing between genders, both girls and boys achieved the highest scores for the posture of their spine and hips, indicating no signs of scoliosis or uneven hips.

Interestingly, 62% of boys received low scores for their ankle posture (indicating pes planus), coinciding with research done by Ilic & Buric (2014) which reported an incidence of 53.3% of pes planus in boys. These researches found pes planus to be the most common postural deviation in girls, where this study found only 37% of girls to be affected with pes planus (Ilic & Buric, 2014). Pes planus is typically seen in children who have minimal longitudinal foot arch with midfoot pronation and heel valgus upon weight-bearing. The over pronation of the midfoot is usually caused by weak tibialis posterior, and long toe flexor muscles, combined with the over-activity of the peroneal and toe extensor muscles groups (Kendall, 2010).

Ilic & Buric (2014) found that the difference between the height of left and right shoulders is more common in the girls 40%, comparing to 20% in the boys. This coincides with the current study in that 6% of the girls presented with uneven shoulders, while none of the boys had this postural deviation. As scoliosis was ruled out with the posterior examination of the spine, the researcher speculates that this could be due to carrying school bags unevenly. It could also be due to normal musculoskeletal development as seen when the dominant side shoulder is usually lightly depressed compared to the non-dominant side (Kendall, 2010).

Another area of concern in both genders was the score for neck posture, indicting a cervical hyperlordosis in 38% of the boys and 69% of the girls. This may be due to prolonged time spent on cell phones or tablets, in front of the computer or television. Children's exposure to information technology is excessive, both throughout the school day, as well as after school during leisure pursuits (Straker, Abbott and Smith, 2013). And while performing these activities, their postures are characterised by a

position which involves rounded shoulders and a forward head. A recent article by Halloren (2015) refers to the overuse syndrome “text neck” which involves strain and pain symptoms of the head, neck, and shoulders. When children hold their heads in a forward and downward position to engage with technology-based devices (such as a phone, video game unit, computer, e-reader, or tablet) on a repetitive basis, or for a prolonged period of time, a large amount of stress is placed on the spine, causing “text neck”. Cervical hyperlordosis is caused by the lengthening of the deep neck flexor muscle group, and the combined over-activity of the neck extensors, upper trapezius, and levator scapula muscles (Kendall, 2010). Unless children are trained to have strong stabilising postural muscles, and reminded to use these devices with proper posture, the development of these imbalances are almost inevitable (Halloren, 2015; Straker, Abbott and Smith, 2013).

### 5.4. Relationship between physical activity and BMI

Stroebel et al (2009) state that low levels of regular physical activity is associated with and increased risk of developing childhood obesity (Janssen et al, 2014), while other researchers found a significant association between increased sport participation and the prevention of overweight and obesity in children between the ages of 6 – 13 years (Mchiza & Maunder, 2013). In contrast, this study found no significant association between physical activity levels and BMI scores of children aged 10 -13 years.

Janssen et al (2014) make an interesting comment on this association when they state that even though physical inactivity and childhood obesity are related, not all physically inactive children are obese, and not all obese children are sedentary. This suggests that further clarification between the association of childhood obesity, physical activity rates and sedentary time is required. Additionally, determining whether sedentary time and obesity are independent predictors of health outcomes in children will influence interventions that are aimed at improving the health status of children.

The children in this study participated in high levels of physical activity and most of them were categorised with normal weight limits. This, as well as the small sample size, could be why the hypothesised association was not found. Another possibility could be that these children come from affluent backgrounds where their parents can afford to buy nutrient dense food that is healthy. In South Africa, healthier food is more costly (Monyeki, 2014; Mchiza & Maunder, 2013), and thus not very accessible to all population groups. In this sample it is likely that even those children who did not present with high physical activity scores would still have a normal BMI score due to the fact that their nutritional habits are healthy.

### 5.5. Relationship between physical activity and posture

The modernised way of life of children living in urban areas leads to a general decrease in physical activity, particularly during their discretionary time. This lack of physical stimulus can lead to a weakening of the child's entire muscular system, possibly resulting in postural abnormalities (Bogdanovic & Marcovic, 2010). Although this leads one to assume that children who perform low levels of physical

activity will reflect as poor posture, this study showed no significant correlation between posture and physical activity levels. This may be because no participant scored low on the level of physical activity performed in a week's time, and similarly, no participant showed an over-all poor score for posture.

In contrast, in a large cross sectional study by Kratenova et al (2007) who examined 3520 children between the ages of 7 and 15 years, 20% of participants performed low levels of physical activity, and all of those children presented with some form of faulty posture. They also noted that children who participated in a team sport expressed the lowest probability of poor posture (Kratenova et al, 2007). In this study, every participant participated in at least one form of sporting activity, possibly explaining the high physical activity scores, as well as the absence of over-all poor posture scores.

A possible link between physical activity and poor posture is postulated by Smith et al (2011) who suggest that childhood obesity is the mechanism responsible for the effect of physical inactivity in posture. They suggest that decreased levels of physical activity could lead to obesity and muscle conditioning, with deconditioning then having a negative influence on posture (Smith et al, 2011). Although this study found no association between physical activity and posture, a negative correlation was found between BMI and posture.

### 5.6. Relationship between BMI and posture

The association between childhood obesity and postural disorders is an under-researched area (Stroebel et al, 2009). The clinical belief is that childhood obesity

places an overload on the musculoskeletal structures of the growing child, adversely affecting the development of their bones, muscles and joints (Song-Huaa, 2012, Smith et al, 2011). This study found a significant correlation with poor posture and BMI scores, that is, the higher the BMI, the poorer the posture scores ($r = -0.485$, $p = 0.008$). Similarly, another South African study by Stroebel et al (2009) found a significant association between BMI and the prevalence of both protruding abdomen, and flat feet. These researchers concluded that children with higher BMI scores showed a significantly higher prevalence rate for these postural deformities. This is in accordance with research done by Aleixo et al (2012) who observed a high number of postural alterations caused by excess body mass in 34 children aged 6 to 12 years. The process whereby obesity and overweight affect posture in children is theorised by Aleixo et al (2012) who state that excess body mass contributes to reduced stability and leads to a need to seek postural adaptation mechanisms in the form of biomechanical changes in the spine and both upper and lower quarters.

In contrast, Stroebel et al (2009) discuss research done on Polish rural girls aged 7 to 19 years which found that participants with a higher BMI had better posture scores than those with lower BMI ratings. Similarly, Kratenova et al (2007) found the highest prevalence of poor posture to be in the children classified as underweight, while the lowest prevalence of poor posture was found in those considered to be overweight and obese. The rationale is that having excess body mass can 1) hide underlying postural disorders, and 2) aid in providing spinal stability, thus improving over-all posture scores (Stroebel et al, 2009).

The association between obesity and poor posture found in this study requires further investigation, and understanding. As childhood obesity rates around the world increase (Sun, Wang and Wang, 2015; Protic-Gava, Zecak, and Shukova-Stojmanovska, 2014; Elizondo-Montemayor et al, 2013; Song-hua et al, 2013; Pau, Kim and Nussbaum 2012; Popkin & Gordon-Larsen, 2004), the likelihood is that the incidence of poor postures among children will follow the same pattern. The concern is that some postural deviations are not “out-grown” with development and children carry these into adolescence and adulthood. As a result, many of the consequences of poor posture such as back and neck pain will affect a larger quantity of both adolescents and adults, causing them to be dependent on chronic medical treatment for these pain conditions (Ilic & Buric, 2014; Smith et al, 2011; Stroebel et al, 2009; Kratenova et al, 2007). This could all be avoided if both obesity and poor posture were identified and corrected during childhood, before one or the other can possibly cause irreparable damage to the children’s bodies and psychological status.

The other main finding that causes alarm is that children are most sedentary in their discretionary time. Parents should put rules in place that encourage higher levels of physical activity and fewer sedentary pursuits during this time. The fact that 93% of the children in this study presented with some form of postural deviation from the norm is also cause for concern. Parents should be made more aware of these sorts of problems and the long term effects they can have if allowed to develop into structural problems.

### 5.7 Strengths, limitations, and further research

Previous research in South Africa has examined both obesity rates and postural deformities in children (Rossouw, Grant and Viljoen, 2012; Stroebel et al, 2009*b*). This is the first South African research to also examine physical activity and how it relates to obesity and posture in children. Unfortunately, all participants were localised to one school, and therefore this sample is not representative of other South African populations. More participants, from many schools, will be needed in future studies to extrapolate findings beyond a single school. While the sample size was small (n = 29), this study provides useful information on which further research can be based.

As mentioned by Jehle & Kuhnis (2011), static posture analyses are considered to be a snap-reading method of screening, and they have their limitations. To conduct objective and reproducible measurements, time-consuming, costly and technical methods are required. As Rossouw, Grant and Viljoen (2012) discuss, there is a lack of comparable research analysing the broad spectrum of postural deviations. As such, the researcher would also argue that a standardised tool for screening posture in research settings should be developed so that research on this topic can be more easily compared and discussed.

This study revealed a high prevalence of postural deviations, where 93% of participants displayed some form of faulty posture. The literature reveals that weakness of the back, chest, abdominal, pelvic floor and lower quarter muscles are the main causes of postural abnormalities in children (Pocek, Djordjic and Tubic, 2012; Smith et al, 2011; Bogdanovic & Marcovic, 2010; Shultz, Houglam and Perrin,

2010; Hutchful, 2008; Kratenova et al, 2007). Determining the cause of poor posture in children did not form part of the scope of this research, and as such was not investigated. This could however, be a useful topic to be covered in future research.

It has been established that childhood obesity is a multifactorial disease (Crothers et al, 2009), and as such a limiting factor in this study is that no consideration was given to children who had metabolic issues or were on prescription medications that could influence their weight. This is an important matter that needs to be considered when performing research on this area in the future.

The high physical activity scores found in this study could be due to the fact that it was a self-report questionnaire whereby children might exaggerate their activity levels to create a certain impression. Sallis & Saelens (2000) confirm this justification by stating that social-desirability bias can lead to an over-reporting of physical activity levels when using self-report measures. Additionally, Prince et al (2008) state that there is a need for more valid, accurate and reliable measures of physical activity in research settings. To address this problem, Tremblay et al (2011) suggest that future research should utilise a combination of direct (i.e., accelerometers) and indirect (i.e., questionnaires) methods of determining physical activity behaviour. This will aid in gaining insightful and accurate quantitative and qualitative information regarding physical activity levels as well as sedentary time activities in children (Chaput et al, 2013).

# CHAPTER SIX: RECOMMENDATIONS AND CONCLUSION

## 6.1. Physical activity

Currently, public health interventions have mainly focused on physical activity, and neglected to focus on increasing sedentary behaviour rates. The literature shows that regardless of physical activity levels, sedentary behaviour is related to a higher risk of developing cardio-metabolic disease, and a variety of physiological and psychological problems in children (Tremblay et al, 2011). In this study, children were most sedentary during their spare time, a cause for concern since it means they choose this type of behaviour over activities that are physical in nature. Therefore, in order to resolve the inactivity crisis in children, interventions should attempt to concomitantly increase intentional physical activity and decrease sedentary behaviours (Arundell et al, 2015; Tremblay et al, 2011).

Specifically, the WHO (2010) recommends that children should participate in at least 60 minutes of moderate-to-vigorous physical activity per day, and should pursue vigorous intensity activities at least 3 days per week (Arundell et al, 2015; Stroebel et al, 2009b; Longmuir et al, 2014; McVeigh & Meiring, 2014; Monyeki, 2014). In addition, children should limit recreational screen time, such as watching television, computer use, playing video games, etc. to less than 2 hours per day (Arundell et al, 2015; McVeigh & Meiring, 2014; Tremblay et al, 2011; Stroebel et al, 2009b). This could be achieved if parents restrict children's recreational screen time as shown by Pate et al (2011.

Social support in the form of parental guidance and peer motivation also tends to increase levels of participation in physical activity (Longmuir et al, 2014). As such, educators and parents should set the scene for a generally more physically active lifestyle and encourage social activities that do not revolve around sedentary behaviour such as playing computer games or watching television.

As seen from the results of the current study, an easy way to increase physical activity levels in children is by incorporating a PE into the Primary School curriculum in an effective manner. Due to the way that the current OBE curriculum is set out, the focus on physical activity has decreased and children are not receiving the adequate physical stimulus to be healthy and meet WHO (2010) guidelines. The issue in this case does not seem to be the policies that are in place, but rather the effective *implementation* of the Physical Education classes. In response to this the Department of Basic Education (DBE) in collaboration with the Physical Education Institute of South Africa (PEISA) held a Physical Education Symposium in Cape Town in April 2015. The main goal of this Symposium was to improve the instruction and implementation of Curriculum-Orientated PE and encourage the promotion of physical activity in all schools (Sport and dev.org, 2016). The conclusions derived from this symposium were that the DBE, PEISA and other delegates resolved to provide practical solutions to improve the current state of PE in South African Schools. This is a step in the right to direction towards improving the physical activity profiles of South African children and enhancing their health, wellbeing and longevity.

Ultimately, resolving the problem of inactivity requires a transformation in children's individual daily activity and sedentary habits that is sustainable. If the both the physical activity and sedentary behaviour guidelines as set by WHO (2010) are maintained over the long term, children will benefit from improved body composition, enhanced cardiorespiratory and musculoskeletal fitness, greater academic achievement, improved self-esteem, and more satisfactory social behaviours (Tremblay et al, 2011).

### 6.2. Childhood obesity

Elizondo-Montemayor et al (2013) suggest a strategy of combined dietary intervention and physical activity to achieve the weight loss necessary to decrease the prevalence of overweight and obese children, and their associated medical conditions (Lane, Harrison and Murphy, 2014). Some researchers speculate that this is not enough to achieve significant weight loss, and that the modernised lifestyle shoulder be challenged by decreasing sedentary time as well. Possible approaches can be to limit social time on mobile phones; remove televisions from bedrooms, and encourage family-based physical activities (Lane, Harrison and Murphy, 2014). Additionally, the presence and participation of parents or guardians in the weight-loss intervention helps to achieve more successful outcomes (Elizondo-Montemayor et al, 2013; Krebs et al, 2007). This study found a prevalence rate of 17% for combined overweight and obesity, making intervention strategies necessary for this vulnerable population group.

Clinically one sees that encouraging children to lose weight and adopt healthy lifestyles after years of developing bad habits is very challenging. Thus, similar to the

postural challenges that children face, the literature suggests that preventing childhood obesity (rather than trying to challenge it) is a more efficient tactic to achieve the improved health status of our youths (Brault et al, 2015; Janssen et al, 2014).

### 6.3. Posture

Karaleic, Savic and Milenkovic (2014) confirm that the application of corrective exercise can repair bad posture, mainly through the mechanisms of strengthening weak muscles (Niksic & Rasidagic, 2014; Protic-Gava, Zecak, and Shukova-Stojmanovska, 2014). The ideal age-range during which these posture-correction interventions should be applied is between 7 and 14 years, when maturation of the processes that control posture occurs, and improvement in deficiencies is more likely (De Paula, 2013; Torlakovik, Muftic and Kovac, 2013; Penha et al, 2008). Children who make a sincere effort to improve their postures through habitual physical activity or corrective therapy interventions tend to achieve promising results if the deviations are recognised early and managed adequately (Hagner, Bak and Hagner-Derengowska, 2011; Stroebel et al, 2009; Jehle & Kuhnis, 2008).

Unfortunately, in clinical practice it is seen that many children in this age range rarely apply the corrective techniques in a consistent manner so as to bring about significant improvements. This suggests that the focus should shift to prevention, rather than correction. Ilic & Buric (2014) support this view point by stating that postural problems in children are very often noticed too late. As discussed before, functional changes may evolve into structural deformities, resulting in temporary and

permanent limitations that may continue into adulthood, highlighting the need for interventions that are preventative in nature.

In addition to corrective and preventative physical activity, proper ergonomics must also be considered when trying to prevent or improve children's faulty postures (Mitova, Popova and Gramatikova, 2014). Parents and educators must consistently remind children to apply correct posture techniques whilst sitting and standing (Stroebel et al, 2009). Based on the literature, the guidelines for the correct use of children's school bags is indicated in the table below (Mitova, Popova and Gramatikova, 2014; Hutchful, 2008).

**Table 6.1. Guidelines for proper use of school bags for Primary school learners**

| Do's of schoolbag use | Don'ts of schoolbag use |
|---|---|
| Encourage children to use rucksacks for school and carry them on both shoulders | Weight should not exceed 10% of the child's body weight |
| Bags should have adjustable belt and shoulder straps to ensure adequate fit and prevent free movement | Bag must not be wider than the shoulders or protrude above, or fall below the waist of the child |
| The bag must have multiple pockets for even weight distribution | Plan in advance – do not pack a week's worth of contents for one day. Every day the schoolbag should be packed for that day |
| The schoolbag must retain its shape when lifted | |

It is recommended that Primary schools enlist clinical professionals to perform posture screenings on an annual basis. The responsible clinician will be able to advise whether the deviations are developmental in nature (the child will out-grow them) or if the child requires a clinical intervention. In this way postural abnormalities can be identified and possibly corrected at an early age. These assessments will also provide an opportunity to educate children, parents and teachers about good posture and the dangers of poor posture. This self-awareness will help children take

responsibility for their bodies and help bring down the prevalence of poor posture in children.

### 6.4. Summary of recommendations

- Physical activity interventions aimed at increasing physical activity rates should also incorporate strategies on how to decrease sedentary behaviour
    - Children should participate in at least 60 minutes of moderate to vigorous intensity physical activity every day, and vigorous intensity activities 3 times per week
    - Recreational screen time or sedentary activities should be limited to no more than 2 hours per day
- Parents and guardians should apply stricter rules at home and limit recreational screen time
- Parents, guardians and teachers should behave as role models by exhibiting a physically active lifestyle and promoting the value of regular physical activity
- The DBE should ensure that PE programs are effectively implemented in Primary Schools and not neglected
- Parents, guardians and schools should increase children's awareness of the negative health consequences of childhood obesity
- Parents and guardians should strive for the attainment and maintenance of a healthy weight so as to set a good example for their children
- When applying strategies for weight loss, the interventions should focus on a combination of dietary challenges, physical and sedentary activities, and behavioural factors in order to help children achieve goals and results that are sustainable

- Parents, guardians and teachers should consistently encourage children to adopt good postural habits during all activities, including academic time and recreational screen-time
- Parents, guardians and teachers should encourage the proper use of school bags
- Schools should use clinical professionals to perform postural screenings on an annual basis to help identify postural deviations before they advance into structural disorders.
    - These annual screenings can also be used to help enhance children's awareness and understanding of the effects of poor posture and how to maintain a good posture

### 6.5. Conclusion

The study sample showed a combined overweight and obesity prevalence of 17%, which is lower than what has been documented in other low-to-middle income countries, but still an alarming statistic. As childhood obesity rates continue to rise locally (Draper et al, 2014; Monyeki, 2014; Rossouw, Grant and Viljoen, 2012), these weight issues must be addressed before South African children present with similar statistics to other low-to-middle income countries such as Argentina and Mexico with a combined overweight and obesity prevalence of 22.7% and 41.8% respectively.

Although overall posture scores in this study were good, the fact that 93% of the participants displayed some form of faulty postural adaptation is alarming and these issues must be addressed.

This study found an association between obesity and poor posture in children. As such, the researcher recommends that interventions be aimed at reducing overweight and obesity prevalence in children that are of primary school age to prevent both poor posture and obesity from affecting these children as they develop into adolescents, and later adults. In addition, the researcher recommends the implementation of interventions at Primary School level that will help prevent the development of poor posture and weight gain in children. Throughout the processes of prevention, detection, or rehabilitation of postural and weight disorders, it is essential to have cooperation between parents, teachers, physical educators, and healthcare practitioners (Ilic & Buric, 2014; Mitova, Popova and Gramatikova, 2014; Protic-Gava, Zecak, and Shukova-Stojmanovska, 2014; Hutchful, 2008; Kratenova et al, 2007). It is the responsibility of these role players to have the knowledge to be able to implement programmes that are preventative in nature. They should also be able to identify existing postural and weight problems and suggest the most appropriate course of action for rehabilitation (Protic-Gava, Zecak, and Shukova-Stojmanovska, 2014).

Most of the participants in this study (90%) met physical activity guidelines as set out by WHO (2010), possibly due to the incorporation of compulsory PE classes in the curriculum of their school. The researcher feels the need to emphasise the fact that based on the results of the self-report questionnaire, the children in this study were most physically active during these classes. This is a prime example of how the effective implementation of PE in schools can help children to meet their physical activity goals. Taking into consideration the insight gained into the physical activity patterns, obesity rates and postural status of the children that formed part of this

study, this research demonstrates the need for a multidisciplinary intervention strategy to address emerging health issues such as low physical activity rates, childhood obesity and poor posture in the youth of South Africa.

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# APPENDICES

## Appendix A: Physical Activity Questionnaire for older children (PAQ-C)

Participant reference Code: _____ Age_____ Gender_____

Race_____

We are trying to find out about your level of physical activity form ***the last 7 days*** (in the last week). This includes sports or any activities that make you sweat or make your legs feel tired, or games that make you breathe hard, like tag, skipping, running, climbing and others.

**Remember:**

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

---

1. Physical activity in your spare time: Have you done any of the following activities in the past 7 days (last week)? If yes, how many times? (mark only one block per row)

| Activity | No | 1-2 | 3-4 | 5-6 | 7 times or more |
|---|---|---|---|---|---|
| Skipping | | | | | |
| Rowing / canoeing | | | | | |
| Tag | | | | | |
| Walking for exercise | | | | | |
| Bicycling | | | | | |
| Jogging or Running | | | | | |
| Aerobics | | | | | |
| Swimming | | | | | |
| Baseball / softball | | | | | |
| Dancing | | | | | |
| Skateboarding | | | | | |
| Soccer | | | | | |
| Hockey | | | | | |
| Basketball | | | | | |
| Rugby | | | | | |
| Netball | | | | | |
| Tennis | | | | | |
| Water polo | | | | | |
| Cricket | | | | | |
| Diving | | | | | |
| Gymnastics | | | | | |
| Squash | | | | | |
| Golf | | | | | |
| Other_____ | | | | | |
| Other_____ | | | | | |

2. In the last 7 days, during your physical education (PE) classes, how often were you very active (playing hard, running, jumping, throwing)? Tick only one option.

   I don't do PE ..... O
   Hardly ever ..... O
   Sometimes ..... O
   Quite often ..... O
   Always ..... O

3. In the last 7 days, what did you do most of the time at *break?* Tick only one option.

   Sat down (talking, reading, doing schoolwork)..... O
   Stood around or walked around ..... O
   Ran or played a little bit ..... O
   Ran around and played quite a bit ..... O
   Ran around and played hard most of the time ..... O

4. In the last 7 days, what did you normally do at *lunch* (besides eating lunch)? Tick only one option.

   Sat down (talking, reading, doing schoolwork)..... O
   Stood around or walked around ..... O
   Ran or played a little bit ..... O
   Ran around and played quite a bit ..... O
   Ran around and played hard most of the time ..... O

5. In the last 7 days, on how many days *right after school,* did you do sports, dance, or play games in which you were very active? Tick only one option.

   None ..... O
   1 time last week ..... O
   2 or 3 times last week ..... O
   4 times last week ..... O
   5 times last week ..... O

6. In the last 7 days, on how many *evenings* did you do sports, dance or play games in which you were very active? Tick only one option.

   None ..... O
   1 time last week ..... O
   2 or 3 times last week ..... O
   4 times last week ..... O
   5 times last week ..... O

7. On the *last weekend,* how many times did you do sports, dance or play games in which you were very active? Tick only one option.

   None …….. O
   1 time …….. O
   2 - 3 times …….. O
   4 - 5 times …….. O
   6 or more times …….. O

8. Which *one* of the following describes you best for the last 7 days? Read *all five* statements before deciding on the *one* answer that describes you.

   A. All or most of my free time was spent doing things that involve little physical effort
   B. I sometimes (1- 2 times last week) did physical things in my free time (e.g. played sports, went running, swimming, bike riding, did aerobics)
   C. I often (3 – 4 times last week)did physical things in my free time
   D. I quite often (5 – 6 times last week) did physical things in my free time
   E. I very often (7 or more times last week) did physical things in my free time

9. Mark how often you did physical activity (like plying sports, games, doing dance, or any other physical activity) for each day last week.

| Day of the week | None | Little bit | Medium | Often | Very often |
|---|---|---|---|---|---|
| Monday | | | | | |
| Tuesday | | | | | |
| Wednesday | | | | | |
| Thursday | | | | | |
| Friday | | | | | |
| Saturday | | | | | |
| Sunday | | | | | |

10. Were you sick last week, or did anything prevent you from doing your normal physical activities? Tick only one option.

    Yes …….. O

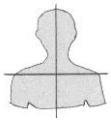
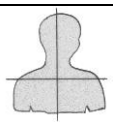
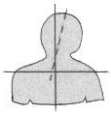
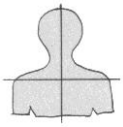
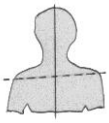
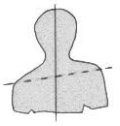
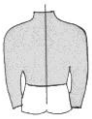
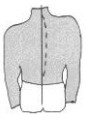
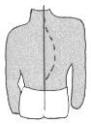
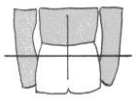
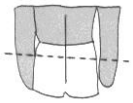
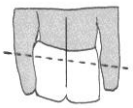
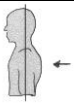
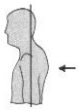
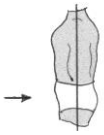
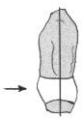
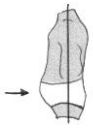
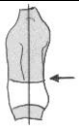
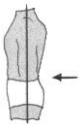
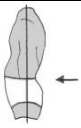
    No …….. O

    If yes, what prevented you? _____

## Appendix B: Posture Scoring Sheet (New York Posture test) Bolton et al, 2013

**Participant reference code:**_____

**Height (m):**_____ **Weight: (Kg)**_____ **BMI (Kg/m²):**_____

| | Good – 10 | Fair – 5 | Poor – 0 | |
|---|---|---|---|---|
| Head |  Head erect, gravity line passes through center |  Head twisted or turned slightly to one side |  Head twisted or turned markedly to one side | |
| Shoulders |  Shoulders level (horizontally) |  One shoulder slightly higher |  One shoulder markedly higher | |
| Spine |  Spine Straight |  Spine slightly curved laterally |  Spine markedly curved laterally | |
| Hips |  Hips level (horizontally) |  One hip slightly higher |  One hip markedly higher | |
| Ankles |  Feet pointed straight ahead |  Feet pointed out |  Feet pointed out markedly, ankles sag in pronation | |
| Neck |  Neck erect, chin in, head directly above shoulders |  Neck slightly forward, chin slightly out |  Neck markedly forward, chin markedly out | |
| Upper Back |  Upper back normally rounded |  Upper back slightly more rounded |  Upper back markedly rounded | |
| Trunk |  Trunk erect |  Trunk inclined slightly to rear |  Trunk inclined markedly to rear | |
| Abdomen |  Abdomen flat |  Abdomen protruding |  Abdomen protruding and sagging | |
| Lower Back |  Lower back normally curved |  Lower back slightly hollow |  Lower back markedly hollow | |
| | | | Final Score ≡ | |

## Appendix C: Assent form for Child to participate in Research study.

**Title of research:** "Relationship between posture, obesity and physical activity levels in children aged 10 – 13"

**Researcher:** Miss M Lombard – registered Bokineticist

Cell: 082 301 5256 / e-mail: marilie_lombard@hotmail.com

**Research Supervisor:** Mrs Estelle Watson

Tel: 011 7173227 /e-mail: Estelle.watson@wits.ac.za)

### A. Procedures

If you agree to take part in this research study, the following will take place:

1. You will be asked to fill out a "Physical activity Questionnaire for older children". A nice lady that is also a Biokineticist will help you to fill it in.
2. One day after school, you will be asked to do the assessment. This assessment will take about 15 minutes to finish. You will be alone with the tester (Biokineticist) in a separate room during your assessment to make sure you have some privacy.

   This is what will happen during the assessment:
   a. A study of your posture. Here I will ask you to wear a small amount of clothing (shorts for boys / shorts and tank top for girls) so that all the findings can be as true and correct as possible. You will be asked to stand still, in the most comfortable position possible. I will then look at your posture from the front, the back, and both sides.
   b. A Body Mass Index (BMI) Analysis. BMI is used to see if you are in the right weight range for your height. Here we will weigh you and measure how tall you are.

It is important for you to know that any test results or information that we find about you in this research will be extremely private and will not be shared with anyone else. I will not use your name in any of my reports or discussions.

### B. Consent

I have been given a copy of this assent form to keep. I can decide if I want to take part in this study and I am free to choose to not take part in this research study. I may pull out or stop the tests at any point without anything bad happening to me.

I understand that:

- The tests that are going to be performed for this study have been explained.
- I can pull out or stop the tests at any time without anything bad happening to me.
- My information and test results will remain private.

In writing, I agree to let the researcher carry on with the set of tests which form part of the study as explained in this form.

I, _____ agree to take part in the research study entitled "Relationship between posture, obesity and physical activity levels in children aged 10 – 13"

I am a minor and I am _____ years old _____ (name)

_____ (signature) _____ (date)

## Appendix D: Information sheet and consent form

Parent / Guardian information sheet and Consent form for Child to participate in Research study.

**Title of research:** "Relationship between posture, obesity and physical activity levels in children aged 10 – 13".

**Purpose and background**

Good day, my name is Marilie Lombard and I am a Biokineticist with specific interest in working with children. My research study is aimed at identifying the most prevalent postural deviations in children and to see if there is a relationship between the postures of children, their weight and height profiles, as well as their levels of physical activity.

Under the supervision of Estelle Watson, I will be conducting research on the profiles of posture, obesity and physical activity levels of children aged 10 -13 years. The purpose of this research is to shed some light on the postural status of children in South Africa. Knowing more about their postures as well the correlations between obesity and physical activity will enable Biokineticists and other health care practitioners to rehabilitate childhood injuries and conditions more efficiently.

**C. Procedures**

If you agree for your child to participate in this research study, the following will occur:

3. Your child will be asked to fill out a "Physical activity Questionnaire for older children". This questionnaire is used to gauge the levels of physical activity that your child participates in on a regular basis. You may assist your child with filling in this questionnaire.
4. On the scheduled day and time (to be determined), your child will be asked to attend the assessment after school. This assessment will take approximately 15 minutes to complete. Each assessment will be performed in a separate room to ensure the privacy of your child and confidentiality of their measurements.

The assessment will consist of:

**A postural analysis**. Here the child will be asked to wear minimal clothing (shorts for boys / shorts and tank top for girls) in order to make it possible to identify specific anatomical landmarks. The child will be asked to stand still, in the most comfortable

manner possible. The researcher will then observe the child's posture from the front, the back, and both sides.

**Body Mass Index (BMI) Analysis.** BMI is used to assess weight relative to height and is calculated by dividing body weight in Kilograms by height in metres squared. An increased risk of high blood pressure, high cholesterol, coronary disease and mortality are associated with a BMI greater than 30kg/m². Your child will be weighed and their height will be measured in order to determine their BMI

**D. Risks**

There are no risks involved with participation in this research study.

**E. Confidentiality**

The information gathered in this study will be kept confidential and only shared with research participants if they wish to know their values. Your child will be allocated a code and their real name will not be used in the report or any discussions regarding the research study. All files and data will be kept by the researcher, and only the supervisor will have access to them. Your child's name will not be used and any identifying personal information will be avoided.

**D. Benefits**

There are no direct benefits to partaking in this research. However, the indirect benefits include you and your child being made aware of:

- Your child's physical activity levels;
- Your child's posture;
- The relationship between your child's height and weight; and where improvements could be made in all these areas to enhance your child's quality of life.

For those children that wish to improve in any of the above areas, the researcher is willing to help them with advice and guidelines in that regard.

**E. Alternatives**

Your child is free to choose not to participate in this research study. They are also able to withdraw from the study at any stage

**F. Costs**

There will be no costs to you or your child if your child participates in this research study

**G. Questions**

Please feel free to contact the researcher at any time regarding your questions and queries:

Marilie Lombard
Cel: 082 301 5256 e-mail: mlombard@hotmail.com

You can also contact of the chair of the Ethics committee, Professor Peter Cleaton-Jones at 011 717 2301 or send an e-mail to peter.cleaton-jones@wits.ac.za

**H. Consent**

I have been given a copy of this consent form to keep. Participation in this research study is voluntary. My child is free to decline to participate in this research study, or I may withdraw their participation at any point without adverse consequences.

I hereby declare that:

- I have read and understood the Information sheet.
- The testing procedures have been explained.
- I understand that my daughter/son can withdraw or stop the testing procedure at any time without prejudice.
- I understand that my daughter's/son's information and her test results will remain confidential.

I give my written consent to the researcher to proceed with the battery of tests which form part of the above mentioned study.

My child _____ has consent to participate in the research study entitled "Relationship between posture, obesity and physical activity levels in children aged 10 – 13"

My child is a minor aged _____

Parent / Guardian _____ (name)

_____ (signature)

Date _____

## Appendix E: Ethical clearance



**HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)**

**CLEARANCE CERTIFICATE NO. M130902**

| | |
|---|---|
| **NAME: (Principal Investigator)** | Ms Marilie Lombard |
| **DEPARTMENT:** | Centre for Exercise Science and Sports Medicine |
| **PROJECT TITLE:** | "Relationship between Posture, Obesity and Physical Activity Levels in Children Aged 10-13 Years" |
| **DATE CONSIDERED:** | 27/09/2013 |
| **DECISION:** | Approved unconditionally |
| **CONDITIONS:** | |
| **SUPERVISOR:** | Mrs Estelle Watson |
| **APPROVED BY:** | Professor PE Cleaton-Jones, Chairperson, HREC (Medical) |

**DATE OF APPROVAL:** 29/11/2013

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

**DECLARATION OF INVESTIGATORS**

To be completed in duplicate and **ONE COPY** returned to the Secretary in Room 10004, 10th floor, Senate House, University.

I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**.

Principal Investigator Signature M130902Date

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

## Appendix F: GDE Approval

GAUTENG PROVINCE
Department: Education
REPUBLIC OF SOUTH AFRICA

For administrative use:
Reference no: D2014/266

# GDE RESEARCH APPROVAL LETTER

| | |
|---|---|
| Date: | 18 November 2013 |
| Validity of Research Approval: | 10 February to 3 October 2014 |
| Name of Researcher: | Lombard M. |
| Address of Researcher: | 49 Ambassador Crescent |
| | Monument park |
| | 0181 |
| Telephone Number: | 082 801 5256 |
| Email address: | marilie_lombard@hotmail.com<br>mlombard@eohhealth.co.za |
| Research Topic: | Relationships between posture, obesity and physical activity levels in children aged 10 - 13 years |
| Number and type of schools: | TEN Primary schools |
| District/s/HO | Tshwane South |

***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.

**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:**

2013/11/19





**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

## Appendix G: Information letter and consent for Research in School

**Title of research:** "Relationship between posture, obesity and physical activity levels in children aged 10 – 13".

**Purpose and background**

Good day, my name is Marilie Lombard and I am a Biokineticist with specific interest in working with children. My research study is aimed at identifying the most prevalent postural deviations in children and to see if there is a relationship between the postures of children, their weight and height profiles, as well as their levels of physical activity. Under the supervision of Estelle Watson, I will be conducting research on the profiles of posture, obesity and physical activity levels of children aged 10 -13 years. The purpose of this research is to shed some light on the postural status of children in South Africa. Knowing more about their postures as well the correlations between obesity and physical activity will enable Biokineticists and other health care practitioners to prevent and rehabilitate childhood injuries and conditions more efficiently.

**Procedures**

If you agree for your school to participate in this research study, the following will occur:

1. Children's assent and Parent / Guardian informed consent will be obtained from pupils and their parents.
2. Pupils will fill out a "Physical activity Questionnaire for older children". This questionnaire is used to gauge the levels of physical activity that children participate in on a regular basis.
3. On the scheduled day and time (to be determined for your convenience), research participants will be asked to attend the assessment after school, on school grounds. This assessment will take approximately 15 minutes to complete. Each assessment will be performed in a separate room to ensure the privacy of all participants and confidentiality of their measurements.

The assessment will consist of:

A postural analysis. Here the child will be asked to wear minimal clothing (shorts for boys / shorts and tank top for girls) in order to make it possible to identify specific anatomical

landmarks. The child will be asked to stand still, in the most comfortable manner possible. The researcher will then observe the child's posture from the front, the back, and both sides.

Body Mass Index (BMI) Analysis. BMI is used to assess weight relative to height and is calculated by dividing body weight in Kilograms by height in metres squared. An increased risk of high blood pressure, high cholesterol, coronary disease and mortality are associated with a BMI greater than 30kg/m². Your child will be weighed and their height will be measured in order to determine their BMI

**Risks**

There are no risks involved with participation in this research study. Please note that the researcher has received permission from the Gauteng Department of Education, as well as the Human Research Ethics Council to perform this research study.

**Confidentiality**

The information gathered in this study will be kept confidential and only shared with research participants if they wish to know their values. All files and data will be kept by the researcher, and only the supervisor will have access to them. Your School's name, as well as participants' names will not be used in any part of the research discussion.

**Alternatives**

You are free to choose not to participate in this research study. You are also able to withdraw your school from the study at any stage

**Costs**

There will be no costs to you, your school, or research participants if you choose to participate in this research study.

**Questions**

Please feel free to contact the researcher at any time regarding your questions and queries:

Marilie Lombard
Cell: 082 301 5256
e-mail: marilie_lombard@hotmail.com or marilie.lombard@eoh.co.za

You can also contact of the chair of the Ethics committee, Professor Peter Cleaton-Jones at 011 717 2301 or send an e-mail to peter.cleaton-jones@wits.ac.za

I _____ _Headmaster / Headmistress /

Principal of _____ hereby grant permission to Marilie Lombard to conduct her research study “Relationship between Posture, Obesity and Physical activity in children aged 10 – 13 years at my school.

I understand all aspects of the research and where I have uncertainties, I have cleared them with the researcher. I understand the scope of the research and that there will be questionnaire and physical assessment done on school property.

I support this research on the condition that assent and informed consent is received from research participants and their parents/ guardians, respectively.

Signed_____

Name_____

Date_____

**Appendix H: Process for posture examination (Shultz et al, 2010; Magee et al, 2008)**

Examine posture with the patient in a static position and in as few clothes as possible to allow for an unobstructed view of all postural elements (boys = shorts, girls = shorts and tank tops).

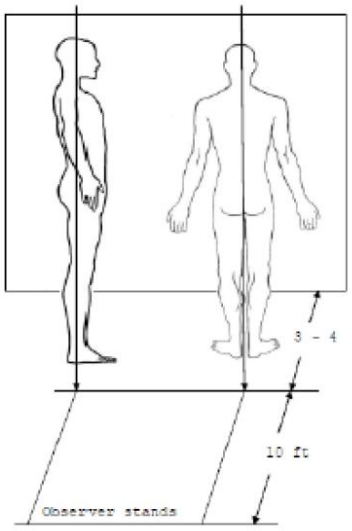
A plumb line is often used as a reference of alignment for the body when examining posture. A plumb line is a string suspended overhead with a small weight, or plumb bob, attached at the end near floor.

The plumb line will be hung 1.2m (4 feet) in front of a posture grid. Perpendicular to the grid, a line of masking tape will be placed on the floor directly beneath the plumb line. The masking tape will be extended by 3m (10 feet) towards the researcher. The participant will stand between the plumb line and the posture grid and will be asked to rotate their standing position so that they may be examined from an anterior view, lateral view and a posterior view. The participant will be positioned behind the line so that the researcher will be able to see the body bisected by the plumbb line.

**Anterior posture check list:**

Start so that the plumbb line runs between the eyes and the centre of the nose, mouth, and chin.Then proceed with the analysis and check for the folowing:

- Left and right halves of body are mirror images of each other
- Arms rest at the sides of body
- Hands along the sides of the hips
- Patella face anteriorly
- Knees straight and equidisant from plumb line
- Toes pointed either forward or slightly lateral
- Ear lobes are level
- Acromian process are even
- Axillary folds are even
- Lower rib margins are level
- Iliac crest are level
- Patellae are same height
- Tibial tuberosities are level
- Medial malleoli are level
- Muscle definition is symmetrical throughout.



**Lateral Posture check list:**

Observe the lateral view from both the left and right sides so you can see any imbalances between the two.

Start so that the plumbb line runs through the middle of the ear's auditory meatus. Then proceed with the analysis and check for the folowing:

- Plumb line runs slightly posterior to the patella and anterior to the lateral malleolus
- Anterior superior iliac spine (ASIS) and posterior superior iliac (PSIS) are close to level with each other.
- Legs are perpendicular to the feet
- Hands are slightly forward of the elbow and beside the thigh
- Chin is parallel to the floor

**Posterior posture check list:**

The view includes some of the same items observed in the anterior view but should not be eliminated since it also reveals other factors such as foot arch position, knee fossa alignment, scoliosis, and scapula height.

Start so that the plumb line bisects the head. Then proceed with the analysis and check for the folowing:

- Left and right halves are mirror images of each other
- Ear lobes are level
- Shoulder heights are level (dominant may be slightly lower)
- Axillary folds are even
- Inferior angles of the scapulae are level
- Vertebral scapular borders are equidistant and 5cm from the spine
- Scapula rest on ribs between T2 and T7
- Iliac crest are even
- Popliteal fossa are same height
- Arms rest comfortably at the sides with hands along sides of thighs
- Medial malleoli are level
- Two toes are visible laterally to each leg
- Muscle definition is symmetrical throughout.

## Appendix I: Posture correction exercises, stretches and ergonomic tips for children

### Exercises: Only do those exercises that have been ticked

**Chin tuck**



- Sit or stand, looking forward, with good posture.
- Tuck chin in.
- Return to start position.

Special Instructions:

To progress, place finger on chin, apply backwards pressure.

**Perform 3 sets of 20 Repetitions, once a day.**

Rest 1 Minute between sets.
Perform 1 repetition every 4 Seconds.

**Knee push up**



- Begin by lying on floor face down.
- Push up, keeping knees on floor, straightening elbows.
- Maintain a straight back.
- Lower to floor and repeat.

**Perform 3 sets of 10 Repetitions, once a day.**

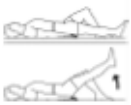
**Crunch**



- Lie on back with knees bent, and hands clasped behind neck.
- Raise shoulders up until they clear the floor and return to start position for one set.
- For the other two sets,
- Raise left shoulder toward right knee, return to floor.
- Lift right shoulder toward left knee, return to floor.

**Perform 3 sets of 20 Repetitions, once a day.**

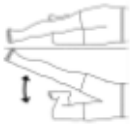
**Straight leg raise**



- Lie on back with one knee bent as shown.
- Raise straight leg to thigh level of bent leg.
- Return to starting position.
- Repeat on other leg.

**Perform 3 sets of 10 Repetition, once a day.**

**Side leg raise**



- Lie on uninvolved side, with lower knee bent for stability.
- Keep knee straight on involved leg, lifting leg upward.
- Return to start position and repeat.

Special Instructions:

Do not roll trunk forward or backward.

**Perform 3 sets of 20 Repetitions, once a day.**

**Kneeling mule kick**



- Begin in four point kneeling.
- Lift one leg up, keeping knee bent.
- Lower and repeat.

**Perform 3 sets of 20 Repetitions, once a day.**

### Stretches: Only do those stretches that have been ticked

**Forward neck stretch**



- Sit comfortably in your chair.
- Place hand on back of head.
- Gently push chin to chest until stretch is felt at back of neck.

**Perform 1 set, twice a day.**

Hold exercise for 20 Seconds.

**Butterfly Pec stretch**



- Sit or stand up straight.
- Hook fingers behind neck elbows out to side.
- Move neck and shoulders backward until a stretch is felt on front of neck and chest.

**Perform 1 set, twice a day.**

Hold exercise for 20 Seconds.

**Sitting back stretch**



- Sit in chair with knees apart.
- Slowly bend forward and reach between legs until a stretch is felt in lower back.

**Perform 1 set, twice a day.**

Hold exercise for 20 Seconds.

**Sidelying Quad stretch**



- Lie on side, bottom leg bent for support.
- Reach back and grasp ankle of top leg.
- Relax leg and gently pull ankle towards buttocks until a stretch is felt in the front of the leg or hip.
- Repeat on other side.

**Perform 1 set, twice a day.**

Hold exercise for 20 Seconds.

**Standing hamstring stretch**



- Stand with heel propped on low table, knee straight, as shown.
- Gently and slowly lean forward at waist until stretch is felt behind the leg.
- Repeat with other leg.

Special Instructions:

Keep the knee straight.

**Perform 1 set, twice a day.**

Hold exercise for 20 Seconds.

**Single knee to chest hooklying**



- Lie on back with knees bent.
- Bring one knee to chest, then other knee to chest.
- Keep hands under knees.

**Perform 1 set, once a day.**

Hold exercise for 20 Seconds.

## School bag tips

**your bag must:**

- ✓ have padded shoulder straps
- ✓ have a waist belt
- ✓ not weigh more than 15 % of your body weight
- ✓ contain the heaviest items closest to your back
- ✓ fit snugly against your back

## Computer tips:

- ✓ Do not sit too close to the monitor
- ✓ Take breaks often to rest your eyes
- ✓ Stand up and stretch every 30 minutes
- ✓ Sit up straight at all times

## Television tips:

- ✓ Sit up straight, don't slouch forward or lie on your side
- ✓ Don't mindlessly snack
- ✓ Don't sit too close to the TV
- ✓ No more than 2 hours of TV a day

**For any questions or concerns please feel free to contact me on 082 301 5256**

**Appendix J: Turnitin report**

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