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Relation between physical activity patterns and body composition among primary schoolchildren in marginalized neighbourhoods of Port Elizabeth, South Africa

Masterarbeit

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Abstract

Background

The burden of child obesity in developing countries is increasingly dramatic. A sedentary lifestyle is gaining popularity and along with it risks for non-communicable diseases rise. With less movement, abdominal fat is expanding, which in turn leads to cardiovascular risks. The aim of this master thesis is to provide an overview of physical activity patterns of schoolchildren, and to identify the effect on body composition, such as abdominal fat.

Methods

Cross-sectional data were collected from 739 primary schoolchildren living in disadvantaged neighbourhoods in Porth Elizabeth, South Africa, within the framework of the KaziBantu study. The cross-sectional survey was conducted from February to March 2019. The data include physical activity levels, measured with an wGT3X-BT accelerometer device. It also contains the body compositions such as waist- and hip-circumference as well as total body- and trunk-fat-percentage measured with a Tanita scale MC-580. The schoolchildren were between 8 - 13 years old.

Results

It was found that boys, on average, spend more time in all levels of physical activities, while girls devote more of their time to sedentary activities. With increasing age, children spend more time in sedentary activity, usually at the expense of time spent on light physical activity. Moderate and vigorous activity levels stay constant throughout the studied age buckets. Especially vigorous activity showed a strong and statistically significant effect on different body compositions.

Conclusion

Boys already spend a large part of their time with physical activity, especially when they are younger. Therefore, girls should be in the focus of physical activity interventions, if the aim is to avoid overweight from this study population. Also, an effective intervention would be to increase vigorous activity, as this showed the largest influence on body composition.

Zusammenfassung

Hintergrund

Die Belastung durch Fettleibigkeit bei Kindern in Entwicklungsländern nimmt dramatisch zu. Ein sitzender Lebensstil wird immer beliebter und dementsprechend steigen die Risikofaktoren für nicht übertragbare Krankheiten. Mit weniger Bewegung expandiert das Viszeralfett, was wiederum mit kardiovaskulären Risiken verbunden ist. Ziel dieser Masterarbeit ist es, einen Überblick über die Bewegungsmuster von Schulkindern in marginalisierten Gemeinden in Port Elizabeth, Südafrika, zu geben und die Auswirkungen auf die Körperzusammensetzung wie Viszeralfett zu identifizieren.

Methode

Im Rahmen der *KaziBantu*-Studie wurden Querschnittsdaten von 739 Grundschülern in benachteiligten Stadtteilen in Port Elizabeth, Südafrika, erhoben. Die Querschnittserhebung wurde im Februar – März 2019 durchgeführt. Die Daten umfassen die körperliche Aktivität, die mit einem wGT3X-BT-Beschleunigungsmesser gemessen wurde. Die Körperzusammensetzung wie Taillen- und Hüftumfang sowie den Gesamtkörper- und Rumpffettanteil wurde mit der Tanita-Skala MC-580 gemessen. Die Schulkinder waren zwischen 8 und 13 Jahre alt.

Ergebnisse

Es wurde festgestellt, dass Knaben im Durchschnitt mehr Zeit für körperliche Aktivitäten auf allen Intensitätslevels aufwenden, während Mädchen mehr Zeit für sitzende Aktivitäten verwenden. Mit zunehmendem Alter verbringen Kinder mehr Zeit mit sitzender Aktivität, in der Regel oftmals auf Kosten von leichter körperlicher Aktivität. Moderate und kräftige Aktivitätsniveaus bleiben während des untersuchten Alters konstant. Besonders intensive körperliche Aktivität zeigte einen starken Effekt auf den Taillen- und Hüftumfang sowie den Gesamtkörper- und Rumpffettanteil.

Schlussfolgerungen

Knaben verbringen bereits einen grossen Teil ihrer Zeit mit körperlicher Aktivität in jungem Alter. Daher sollten Mädchen im Fokus von Aktivitätsinterventionen stehen, um Übergewicht bei Jugendlichen aus dieser Studienpopulation zu vermeiden. Eine wirksame Massnahme wäre auch die Verlängerung des intensiven Aktivitätslevels, welches den grössten Einfluss auf die Körperzusammensetzung gezeigt hat.

Opsomming

Agtergrond

Die las van vetsug by kinders in ontwikkelende lande neem dramaties toe. 'N sittende leefstyl word al hoe gewilder en die risikofaktore vir nie-oordraagbare siektes neem dienooreenkomstig toe. Met minder oefening brei die maagvet uit, wat weer verband hou met kardiovaskulêre risiko's. Die doel van hierdie magistertesis is om 'n oorsig te gee van die bewegingspatrone van skoolkinders in gemarginaliseerde gemeenskappe in Port Elizabeth, Suid-Afrika, en om die effekte op liggaamsamestelling soos buikvet te identifiseer.

Metode

Die *KaziBantu*-studie het deursnee-gegewens versamel van 739 laerskoolleerlinge in ontneemde woonbuurte in Port Elizabeth, Suid-Afrika. Die deursnee-opname is in Februarie - Maart 2019 gedoen. Data bevat fisiese aktiwiteit gemeet met 'n wGT3X-BT-versnellingsmeter. Die liggaamsamestelling soos middellyf en heupomtrek en die totale vet- en liggaamsvetinhoud is gemeet met die Tanita-skaal MC-580. Die skoolkinders was tussen 8 en 13 jaar oud.

Resultate

Seuns bestee gemiddeld meer tyd aan fisieke aktiwiteite op alle vlakke, terwyl meisies meer tyd spandeer. Namate kinders ouer word, spandeer hulle meer tyd aan sit, wat gewoonlik minder tyd vir ligte fisieke aktiwiteit duur. Matige en kragtige aktiwiteitsvlakke bly konstant gedurende die bestudeerde ouderdom. 'N Besondere sterk aktiwiteit het 'n sterk en statisties beduidende effek op die verskillende liggaamsamestelling getoon.

Gevolgtrekkings

Seuns spandeer op 'n jong ouderdom 'n groot deel van hul tyd aan fisieke aktiwiteite en word gewoonlik minder geraak deur vetsug. Daarom moet meisies die fokus wees van ingrypings in fisieke aktiwiteit om oorgewig by adolessente uit hierdie studiepopulasie te vermy. 'N Effektiewe maatreël is ook die toename in intensiewe aktiwiteit, aangesien dit die grootste invloed op liggaamsamestelling getoon het.

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List of abbreviations

AIDS	Acquired Immune Deficiency Syndrome
BIA	Body Impedance Analysis
BMI	Body Mass Index
CVD	Cardiovascular Disease
FATP	Body Fat Percentage
HC	Hip Circumference
HIV	Human Immunodeficiency Virus
LMCs	Low-Middle-income Countries
LPA	Light Physical Activity
MET	Metabolic Equivalent of Task
MVPA	Moderate to Vigorous Physical Activity
MPA	Moderate Physical Activity
NCD	Non-Communicable Diseases
TRFATP	Visceral Fat Percentage
WC	Waist Circumference
VPA	Vigorous Physical Activity
WHO	World Health Organization
WHR	Waist-to-Hip Ratio

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1 Introduction

The environment in which a child grows up has relevant impacts on the child's health and weight status. Until recently, obesity during childhood was uncommon in Europe and there was no evidence, that childhood obesity had implications for long-term health and longevity (Livingstone, 2001). However, today it is acknowledged to be a matter of growing concern for a healthy development during childhood (De Onis & Blössner, 2000). Obesity has become epidemic in many parts of the world, especially in developing countries (Armstrong, Lambert, Sharwood, & Lambert, 2006), with serious public health problems (Livingstone, 2001). Being overweight in early life can also increase the likelihood of being overweight in adulthood (Wang & Lobstein, 2006). South Africa is in a state of transition and suffers from the burden of an increased sedentary lifestyle and decreased physical activity (Tathiah, Moodley, Mubaiwa, Denny, & Taylor, 2013). Physical activity is an important factor for a healthy development during childhood (Ross & Katzmarzyk, 2003). As obesity is a growing health problem, the World Health Organization (WHO) has emphasised the importance of monitoring the prevalence of overweight and obesity in different populations (Toriola, Moselakgomo, & Shaw, 2012).

The first study in the South African school context was a study called *DASH* "*Disease, Activity and Schoolchildren`s Health*" in 2015. The goal was to give a snapshot of the status of intestinal parasite infections and risk factors for diabetes and hypertension. The impact on the children's physical fitness, nutrition status, cognitive performance and psychosocial health were gathered and evaluated in eight disadvantaged primary schools in Port Elizabeth. They found that an infection had a small but significant effect on the physical fitness of children and their anthropometric indicators. The *KaziBantu* project (2019): "Effects of a school-based health intervention programme in marginalised communities of Port Elizabeth, South Africa", is the successor study of DASH (2015). The *KaziBantu* project has the aim to improve and promote a healthy and active lifestyle for schoolchildren and their teachers, with the help of a developed intervention package supported by knowledge gained in DASH. Furthermore, the project assesses the impact of the intervention package on risk factors for non-communicable diseases (NCD), health behaviours and psychosocial health (Müller et al., 2019). This master thesis is a part of the baseline assessment of the *KaziBantu* study. In the theoretical framework, this master thesis describes the current worldwide situation of overweight and obesity during childhood. Furthermore, reasons for the decreasing physical activity and the resulting health risks will be discussed. The health situation of South Africa and its specific challenges in the implementation of physical activity are evaluated. In the method part, the *KaziBantu* project will be described in depth with the corresponding study setting, sample as well as the study design. The measurement devices and the statistical analysis applied on the collected data will also be explained. The goal of this master thesis is to give a first overview of physical activity patterns and body compositions from the baseline assessment in the *KaziBantu* study. It will show, whether the primary school children in Port Elizabeth reach the recommended physical activity guideline or not. Furthermore, the relationship of the body composition to physical activity will be described.

2 Theoretical framework and current state of research

> Changes in the world food economy have contributed to shifting dietary patterns, for example, increased consumption of energy-dense diets high in fat, particularly saturated fat, and low in unrefined carbohydrates. These patterns are combined with a decline in energy expenditure that is associated with a sedentary lifestyle - motorized transport, labour-saving devices at home, the phasing out of physically demanding manual tasks in the workplace, and leisure time that is preponderantly devoted to physically undemanding pastimes (WHO Technical Report, 2003, pp. 1–2).

This section summarises the global changes that are a driving force behind the increasing prevalence of obesity and overweight among adults and children worldwide. In the following sections, further details focusing specifically on the body composition of children will be shown. Additionally, physical activity in accordance with the WHO guideline are explained and the resulting health risk factors are evaluated. The relationship between physical activity and body composition will be discussed with the current literature. Also, an overview of the situation in South Africa will be provided and the used measurements for the research will be discussed.

2.1 International burden of overweight and obesity

Overweight and obesity are becoming a major problem of our modern world (Tathiah et al., 2013). They are on the rise globally, but especially economically developed regions suffer from a significant intensification of this problem (Kruger, Kruger, & Macintyre, 2006).

In 1997 the WHO recognized the global effect of the obesity epidemic and since than evidence of the increased global prevalence has been summed up. The obesity epidemic began over 40 years ago in the USA. As of 2010, 36% of men and women in the USA have been recorded as obese (Malik, Willett, & Hu, 2013). In 2014 the worldwide obesity rate of adults aged 18 and above is at 39% (38% of men and 40% of women). In the time period between 1980 and 2014 the worldwide prevalence of obesity has nearly doubled with approximately half a billion adults classified as obese (WHO, 2016). In 2002 the WHO recorded 2.6 million deaths as a result of being overweight or obese (Waxman, 2004). Later in 2012, 1.5 million deaths were reported as a direct cause of diabetes (WHO, 2016). In addition, globally 44% of diabetes burdens, 23% of cardiovascular disease (CVD) burdens, and 7% to 41% of specific cancer burdens are due to overweight and obesity. In 2012, obesity costs the world economy 2 billion dollars, including health care costs, lost productivity, and other costs to reduce the impact of the problem. The total value was 3% of global gross domestic production. These costs put a financial burden on the countries and present a challenge to the healthcare system (Yusefzadeh, Rashidi, & Rahimi, 2019).

Even children are not protected from the burden of overweight and obesity (WHO, 2017). Childhood obesity is worsening in many countries at a dramatic rate (Lobstein, Bauer, & Uauy, 2004) and is one of the most serious public-health challenges (Malik et al., 2013). The worldwide prevalence of childhood overweight and obesity increased from 4% in 1990 to 6% in 2010 and is projected to rise to 9% by 2020. This amounts to approximately 60 million overweight and obese children globally by 2020 (Toriola et al., 2012). The highest rates of increase of overweight were observed in Africa and Asia (WHO, 2016). The appropriate measurement and definition of overweight children is intensely discussed in the current literature. Because of natural age-related physiological variation in body composition of children, it is less standardised than for adults. The body mass index (BMI) classified by the WHO (2016), is often used to determine underweight (BMI ≤ 18.5), normal weight (BMI ≥ 24.9), overweight (BMI ≥ 25) and obesity (BMI ≥ 30) for adults. The use of the BMI has some limitations as will be discussed in section 2.5. For the screening of overweight and obesity, anthropometric measures such as height, weight, skinfold thickness, waist (WC) and hip circumference (HC), total body fat, and visceral fat can be used to determine the body composition. In this study, body composition is defined and measured with WC and HC, body fat and visceral fat.

According to the World Obesity Federation (2018), Figure 1 displays the worldwide prevalence of childhood obesity, where a high prevalence is marked using a dark red colour. As shown, few parts of the world are still marked with a light colour.

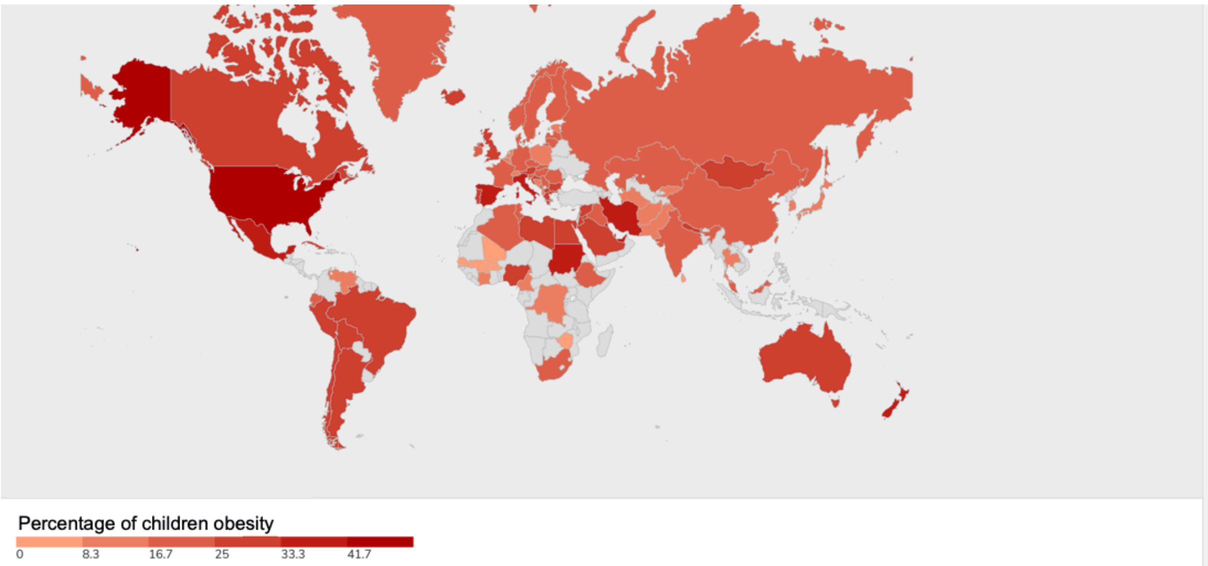

Figure 1. Map for overweight and obesity prevalence in childhood. Source: World Obesity Federation (2018).

Besides the increase in developed countries, a high rate of prevalence has been reported in developing regions (Armstrong et al., 2006). The largest expected proportional increase in overweight adults will occur in low- and low-middle-income countries (LMCs) (Malik et al., 2013). In LMCs, NCD deaths are the reason for almost half of premature deaths (WHO, 2017). However, underweight is in some populations still a major concern and must be taken seriously. Besides obesity related chronic diseases, some countries are dealing with underweight and undernutrition, and must therefore manage a dual burden (Malik et al., 2013).

There is limited research on African countries in regard to childhood overweight, as most health-related efforts are focused on malnutrition and food safety problems (Lobstein et al., 2004). As mentioned previously, Africa has one of the fastest growing overweight and obesity rates for children (Rossouw, Grant, & Viljoen, 2012). Reasons for this trend will be evaluated in the section 2.4. In 2010 there was a childhood overweight and obesity prevalence of 9% in

Africa. This figure is expected to reach 13% in 2020 (Toriola et al., 2012), with variations in age, gender and ethnic group (Rossouw et al., 2012).

The consequences for the health industry cannot be estimated yet. Also, the main health problems will only be seen in the next generation of adults, when the present childhood obesity epidemic passes through to adulthood. The rising trend of excess weight in children and adolescents are already alarming for health professionals and the health service industry. Especially in developing countries, the health services industry cannot easily bear the costs of life-long treatments which could lead to significant decrease in life expectancy for patients and their families (Lobstein et al., 2004). In order to know further details about overweight and obesity during childhood, the changes in physical activity will be evaluated in the next chapter.

2.2 Changes in physical activity

According to the WHO, physical inactivity leads to 1.9 million deaths worldwide every year (Waxman, 2004). Regular physical activity plays an important role in improving and maintaining health and is necessary for a healthy development during childhood and adolescence. The body composition of physically active individuals is better and they have, in principal, less health problems (Nebahat, 2018). It can be assumed that higher amounts or intensities of physical activity have greater benefit on cardiorespiratory and metabolic risk profile (WHO, 2018). Physical inactivity has been identified as the main public health concern across all age groups, although the exact amount of physical activity for optimal health is uncertain (Dobbins, Husson, DeCorby, & LaRocca, 2013). A small to moderate association between moderate to vigorous physical activity (MVPA) and the time spent in sedentary activity is already known (Ekelund et al., 2012). A better understanding between sedentary time and physical activity in the relation to CVD factors for children should be further evaluated. Therefore, the WHO formulated physical activity guideline for children and adolescent aged 5 to 17 years old, with the recommendation to spend at least 60 minutes per day in MVPA (WHO, 2010). The intensity can be categorised in light (LPA), moderate (MPA), MVPA and vigorous physical activity (VPA); these activities can be divided according to the energy expenditure. Evidence was found that VPA have potent effects on CVD risks, but exact recommendation of the WHO for VPA are still limited (Füssenich et al., 2015).

Physical activity exists in various forms and changes with age. Children spend their time more in playing or invent active ways that involve physical activity. Older children play more organized sports in clubs or informally in parks or playgrounds. These types of motions provide a large amount of activity and reach a wide range of muscle groups, leading to energy expenditure. Especially for girls in their mid-teens, the amount of physical activity decline (Boreham & Riddoch, 2001). In the study of Boyle, Marshall and Robeson (2003), the observation was, that boys spend more time during school breaks in higher intensities and longer duration than girls. In addition to that, their games were more competitive. In comparison to the boys, girls were more often seen in social activities like walk and talk (Boyle et al., 2003). In different studies, boys are reported as active than girls, but when comparing only in MPA, the discrepancy in gender decreases (Livingstone, 2001). Physical activity of children is related to several influential factors, such as season, time spent outside, parental interactions, time spent in sedentary behaviour, characteristics of the school and outside environment (Timmons, Naylor, & Pfeiffer, 2007).

According to the "International Health Behaviour in School-aged Children study", approximately two-thirds of all young people do not meet the current guideline of 60 minutes or more active play per day. In the youth risk behaviour study, 43% of all children participated in sufficient vigorous activity, while 29% did enough moderate activity. In total, 42% performed insufficient physical activity to improve their health and one in three students watched more than 3 hours television per day (Shilubane et al., 2013). Activities in the leisure time are more often sedentary and shifted from outdoor to indoor, such as viewing television, internet use and computer gaming (Malik et al., 2013). As children become older, Timmons et al. (2007) found an increase in time spent watching television. The connection between time spent watching television and weight gain is well known. It has also been shown that reducing sedentary behaviour has a positive impact on weight, regardless of exercise (Malik et al., 2013).

Because of the relationship between education level, socioeconomic status and obesity prevalence, it has been discovered that obesity is becoming increasingly a feature of the poor. The poverty and lower education in turn reflects the bigger enjoyment of watching television, because sedentary activities are less expensive and require less initiative (James, 2004).

The lack of physical activity can have its origin in various causes such as a change in way of transport, increased use of technology and urbanization. Additional obstacles to be physically more active are unsafe access, affordability, access to appropriate programs and places. In most countries, these limitations are especially high for girls, women, older adults and underprivileged groups. For children and adolescents, it is important to find strategies to increase the activity level during school hours (Menschik, Ahmed, Alexander, & Blum, 2008). A suitable option is to integrate the physical activity into the daily settings where one lives, works or plays. Supportive school environments and qualitative high physical education can help to develop a healthy and active lifestyle (WHO, 2018).

2.3 Physical health consequences

Overweight and obesity are associated with a low physical activity status and lead to various risk factors for CVD, NCD like insulin resistance, type 2 diabetes mellitus and metabolic disorders (Moses et al., 2007). The aforementioned diseases must not necessarily be seen during childhood or adolescence. Most of the major risks detected are high systolic and diastolic blood pressure, dyslipidaemia, abnormal vascular endothelial function, abnormal left ventricular function and atherosclerotic lesions. Overweight and obesity with increased fat shares during childhood and adolescence raise the risk for disability pension, premature mortality and morbidity during adulthood, as well as ischaemic heart disease, different cancers and strokes (Rossouw et al., 2012). There are very few organic systems that are not negatively affected by obesity (Lobstein et al., 2004). Table 1 below shows the main health consequences of childhood and adolescent obesity.

The need for medical treatment may last throughout the entire lifetime (Lobstein et al., 2004). For adults, it is well documented that especially the accumulation of abdominal fat leads to a high risk of developing diabetes type 2 and cardiovascular problems. There are indicators that the same applies to children as well (Rossouw et al., 2012). In the study of Fernandez et al. (2004) it has been shown that at the young age of 13 years, US children exceeded risk threshold value of adults for obesity-related diseases.

Table 1

Physical consequences of childhood and adolescent obesity

Pulmonary	**Gastroenterological**
Sleep apnoea	Cholelithiasis
Asthma	Liver steatosis / non-alcoholic fatty liver
Pickwickian syndrome	Gastroesophageal reflux
Orthopaedic	**Endocrine**
Slipped capital epiphyses	Insulin resistance/impaired glucose tolerance
Blount’s disease (tibia vara)	Type 2 diabetes
Tibial torsion	Menstrual abnormalities
Flat feet	Polycystic ovary syndrome
Ankle sprains	Hypercorticism
Increased risk of fractures	
Cardiovascular	**Neurological**
Hypertension	Idiopathic intracranial hypertension
Dyslipidaemia	(e.g. pseudotumor cerebri)
Fatty streaks	
Left ventricular hypertrophy	
Other	
Systemic inflammation/raised C-reactive protein	

Annotation. Source: Lobstein et al. (2004).

Next to the CVD, neurological and endocrine consequences of overweight, the respiratory tract can be affected as well. Known pulmonary consequences are sleeping-associated breathing disorders with conditions like increased resistance of the flow of oxygen through the upper respiratory tract, heavy snoring, reduction of flow of oxygen and cessation of breathing (Lobstein et al., 2004). A study found abnormal sleeping patterns in 94% of obese children, with oxygen saturation below 90% (Silvestri et al., 1993). Asthma is a further health impact during childhood overweight with a negative influence on the physical activity level (Lobstein et al., 2004). It has been shown that overweight impedes schoolchildren from performing physical activity, which further increases the weight problem (Rossouw et al., 2012).

Next to the physical changes, overweight has a negative impact on the psychological well-being, characterized by a low self-esteem. Despite childhood obesity becoming more common, the social reaction to obese children does not soften (Lobstein et al., 2004). Additionally, it has a significant influence on school performance, physical self-image and social acceptance (Rossouw et al., 2012). The treatment of adult obesity is difficult and has mostly poor results (Kruger et al., 2006). Furthermore, obesity is difficult to reverse once established (Butler, Derraik, Taylor, & Cutfield, 2018). Therefore, studies suggest to better identify children with high overweight or obesity risks to address and prevent the public health problem at an early stage (Kruger et al., 2006). In order to gain a protective effect on a later adult weight status, physical activity interventions were shown to be more successful in normal weight adolescent rather than for excess-weight loss (Menschik et al., 2008). Also, Lobstein et al. (2004) identifies the overweight prevention in young age as the best option and as an essential strategy for all affected countries.

2.3.1 Relationship between body composition and physical activity level

As already mentioned, there are many possibilities to determine the overweight or risk factors for CVD of a child. One possibility is to measure the body composition. In this study, body compositions are defined as total body (FATP) and visceral fat percentage (TRFATP), measured with body impedance analysis (BIA) and WC and HC.

Abdominal fat, mainly visceral or internal abdominal fat depositions, is more related to cardiovascular and diabetes risk factors then whole-body fat in adults and similarly in children (Saelens, Seeley, Van Schaick, Donnelly, & O'Brien, 2007). Adults with a higher fitness lever have lower visceral fat, compared to less fit adults with approximately the same BMI. It is known that physical activity is a critical influencing factor of visceral fat in adults (Ross & Katzmarzyk, 2003). Large increases in training intensity helps best to increase the fitness level, but it may not be enough to reduce or prevent visceral fat accumulation. It has been shown that moderately intense physical activity, such as walking, decreases visceral fat in adults. Even without an additional weight loss, physical activity leads to a reduction in visceral fat (Saelens et al., 2007). But little is known about what influences the accumulation of visceral fat in children has (Suliga, 2009). Ferrari et al. (2015) showed that VPA had greater potential influence on children's body composition than MPA. Additionally, McGregor, Palarea-Albaladejo, Dall, Stamatakis and Chastin (2018) found that the role of LPA is ambivalent and has a positive effect on the health when replacing sedentary activity with LPA, but negatively when replacing with the time spent in MVPA. The study of Saelens et al. (2007) showed that greater physical activity of children is associated with lower fat accumulation in the visceral fat depot. Furthermore, leaner adolescents had a higher physical activity level then their obese counterparts. The negative relation between physical activity of children with high total body and visceral fat has been shown by using objective measures of activity (accelerometer). However, self-reported measures by children did not reflect this relation. The accelerometer measuring lower physical activity in early childhood, was shown to lead to greater body fat in later childhood (Moore et al., 2003). Body composition is dependent on ethnicity, gender and age (Fernández, Redden, Pietrobelli, & Allison, 2004; Saelens et al., 2007). The next chapter will provide an overview of the health situation in the study country of South Africa.

2.4 Physical health of South Africa

South Africa is the home to 57.7 million people with different main ethnicities like Black African (81%), Coloured (9%), Indian/ Asian (3%), and White (8%). The population consists of 30% below 15 years old and 9% older than 60 years. Approximately 29.5 million (51%) are women with a life expectancy at birth for 2018 of 67.3 years and for men 61.1 years (Statistics South Africa, 2019).

South Africa is a middle-income country and faces the burden of poverty-related illnesses such as infectious diseases like Human Immunodeficiency Virus (HIV), Acquired Immune Deficiency Syndrome (AIDS) and tuberculosis, as well as NCD, such as undernutrition, overnutrition, diabetes, hypertension and cancer (Tathiah, 2013). Major causes of premature deaths and disability are, next to violence and injuries, HIV and AIDS; they account for 31% of total disability-adjusted life years of the South African population. There is still a big difference between disease and mortality rates among ethnic groups. A limiting factor for change is the remarkable large income gap between the various groups in South Africa, which severely limits the economic growth opportunities of the majority of the African population (Christopher, 2001). For black people, the HIV prevalence is about seven times higher than for White or Asians. Also, life expectancy is 50% lower for black women, compared to white women (Coovadia, Jewkes, Barron, Sanders, & McIntyre, 2009). The combination of the concurrent epidemics out of poverty-related illnesses, can be found only in the Southern African development community region (Coovadia et al., 2009). The youth of South Africa is exposed to a variety of influential factors, which places them at risk for violence, misuse of substance, unhealthy eating habits, risky sexual behaviours and physical inactivity (Shilubane et al., 2013). As a middle-income country, South Africas health consequences are worse than in many lower income countries. The mortality rate of the country with 69 deaths under the age of 5 per 100 000 life births is higher than in Peru, Nepal, Morocco and Egypt and reflects the health conditions (Coovadia et al., 2009).

Between provinces as well within provinces, there are substantial inequalities in the state of health. Compared to the other provinces of South Africa, the Eastern Cape, where the schools of this master’s thesis were located (Port Elizabeth), is among the three worst conditions for most of the risk categories in Figure 2. For example, the Eastern Cape has one of the highest rates for people living below the poverty line. This rate was only higher in Limpopo and KwaZulu-Natal (Coovadia et al., 2009).

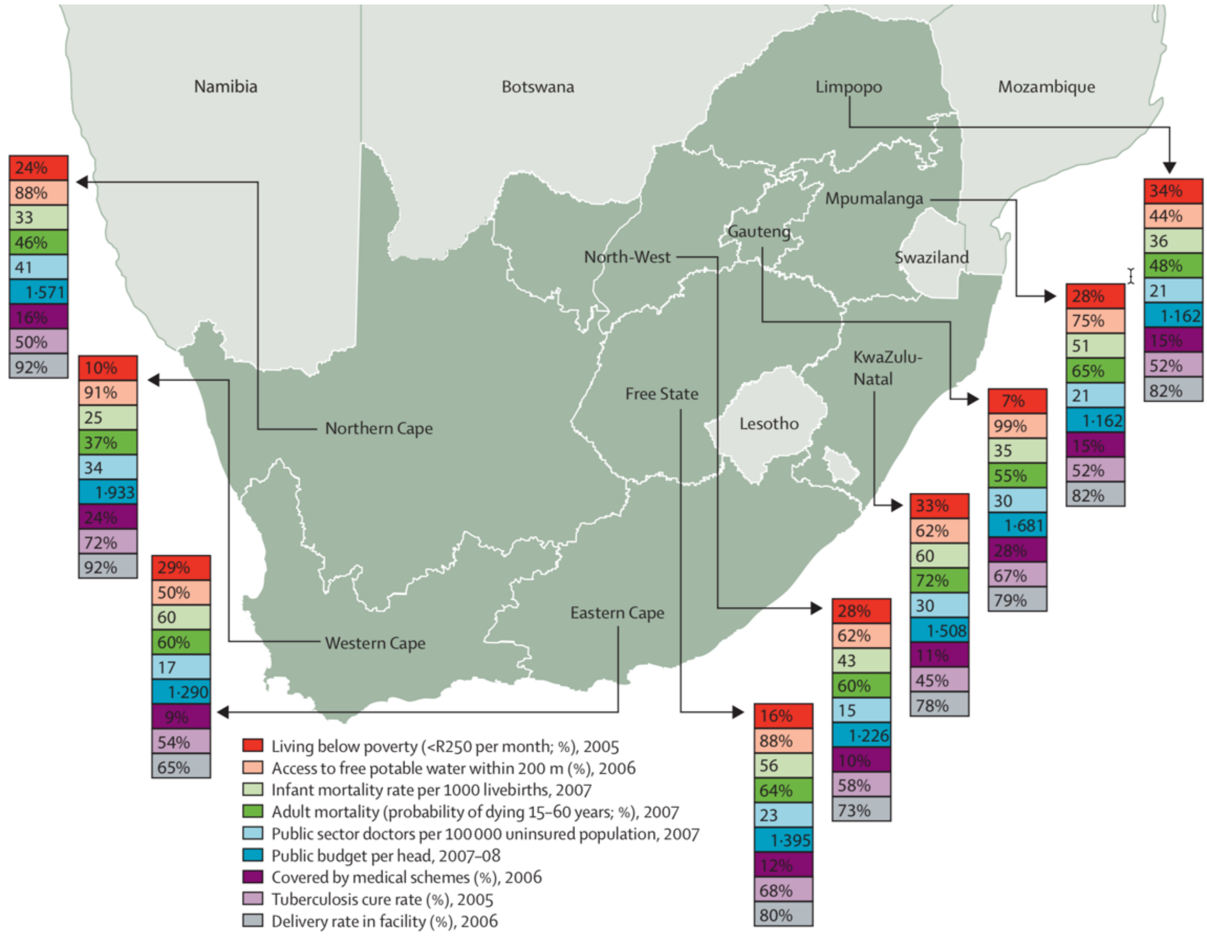

Figure 2. Indicators for health and development in South Africa's provinces, 2008. Source: Coovadia et al. (2009).

In South Africa, a transition from a rural lifestyle to an adoption of the urban way of life is taking place. The changes include the reduction of physical activity, an increased sedentary lifestyle, more time spent watching television, the change in food consumption habits, and high sugar, salt and trans-fat diet. Additionally, the access and affordability of technologies such as smart phones is getting easier and could lead to a further increase of screen time (Draper et al., 2018). In South Africa, 28% of the burden of diseases is attributed to diet related NCD (Tathiah, 2013). The nutritional change, from staple foods to an energy dense diet, follows along a rapid economic and urban transition in LMCs and is a major force behind the increased level of overweight and obesity. Undernutrition, overweight and obesity related diseases are often due to the prevalence of other diseases in the society (Kimani-Murage, 2013). Tathiah (2013) found an indication for undernutrition in 35% of rural school children in South African households. Besides the quality and the diversity of the available food in the rural population, the presence of HIV and AIDS affect the ability to provide for basic needs. As of today, not much is known about the co-existence of undernutrition and obesity in the same geographical setting. It remains an open question to be answered (Tathiah, 2013).

To reflect the situation of overweight and obesity prevalence in South African school children (grades 8 to 11) in the age of 13 to 19, the South African National Youth Risk Behaviour (SANYRB) surveys collected data in 2002 and 2008. In 2002 the study showed that 17% of the children were overweight and 4% obese. Later in 2008 the overweight adolescents had increased to 20%, with the highest prevalence of overweight youths in the province KwaZulu-Natal (26%) (Reddy et al., 2010). Overnutrition was found to be correlated with a low birth weight, a maternal age over 50 years, lower education level household head's (less than secondary certificate), food security, and socio-economic status. The probability of being overweight or obese during later childhood and adolescence is dramatically increased when the parents themselves are overweight or obese (Li et al., 2007). This highlights a great problem, as the age-standardized BMI for South African women is increasing from 25.8 kg/m2 in 1980 to 28 kg/m2 in 2008 (Finucane et al., 2011). In South Africa, especially black girls are affected from overweight and obesity. In the sample (N=2'422) of Armstrong et al. (2006), the appearance of overweight and obesity in black girls increased by 83% from 12% at 6 years to 22% at 13 years of age. Toriola et al. (2012) found similar results, showing that overweight and obesity peaks at the age of 12. Contrary, the study of Kimani-Murage (2013) showed an opposite trend. That found that the risk of overweight, obesity and metabolic diseases increased with age, are higher among girls (Figure 3) and are highly associated with pubertal development.

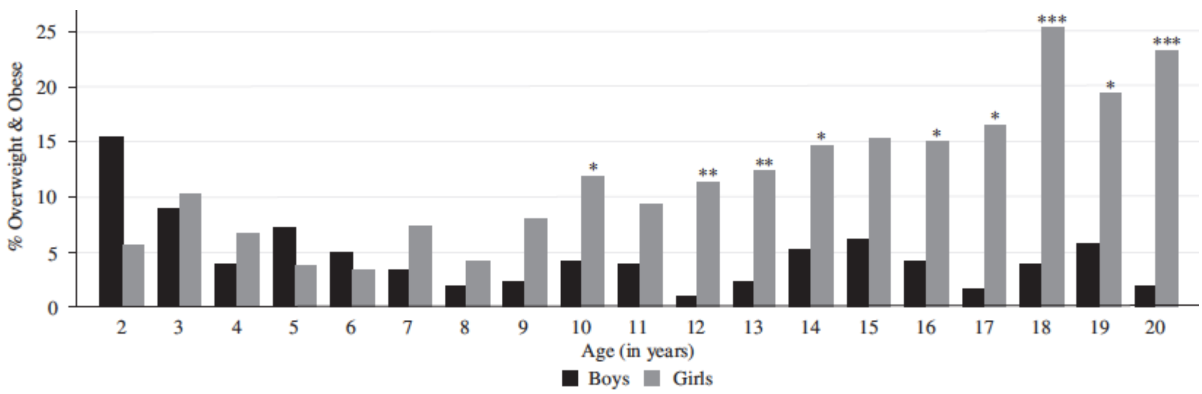

Figure 3. Prevalence of combined overweight and obesity for children aged 2-20 years (n=3,358), Agincourt sub-district, South Africa, 2007. Significant difference by sex: *p-value=.05, **p-value=.01, ***p-value=.001. Source: Kimani-Murage (2013).

These findings reflect factors like increased sedentary behaviours and decreased physical activity in pubertal girls. Van Biljon, McKune, DuBose, Kolanisi and Semple (2018) found the association between the decrease in physical activity and age in pubertal development as well. Another component in the South African setting is the missing physical education in schools. In 2002, less than one-third of all black children in Africa were offered physical education (Armstrong et al., 2006). In the South Africa's Report Card on Physical Activity 2014, less than 50% of the children achieved the WHO physical activity guideline with the recommended amount of 60 min of MVPA per day (Draper, Basset, De Villiers, & Lambert, 2014). One of the reasons is the insufficient security of the child, to be able to practice physical activity or move safely in the environment. 61% of the parents are uncomfortable with their child walking alone to school, but most of them are unable to afford another save mode of transportation (Draper et al., 2018). Young children in families with limited resources are often unsupervised in South Africa. Such communities, parents or caregivers have often a high unemployment and poverty rate, which may be cause by financial difficulties, health problems and challenging living conditions. This may contribute to lower level of supervision (Simons, Koekemoer, Niekerk, & Govender, 2018).

Additionally, the female participation in intense physical activity is often not encouraged by society. This can be seen more often in provincial communities, where cultural values have a larger presence. In a province where the benefits of physical activity are known, there are more opportunities to be active (Van Biljon et al., 2018). The 2018 Report Card on physical activity for children in South African mentions that the country has made insufficient progress in regard to the promotion of save and accessible physical activity opportunities (Draper et al., 2018).

2.5 Measurement of physical activity and body composition

The accuracy of the measurement of physical activity and body composition depends on the chosen measurement by itself and on the precision of the measurer. In the following section, physical activity and body composition measurements and its applicability will be described and discussed.

In the past physical activity has been measured with self-reported questionnaires. A major problem is to recall activities and classify these activities in the performed intensity, especially in studies with children (Crouter, Horton, & Bassett, 2013). Furthermore, self-reported physical activity measurements have shown to lead to over reporting. (Sallis & Saelens, 2000). Therefore, accelerometers with a higher accuracy have become the most preferred measurement device in studies to monitor physical activity during childhood (Crouter et al., 2013).

Especially when measuring overweight and obesity in children and adolescents, the use of different methods and settings are common. However, the quantity of fat is a key determinant for the risk of capturing a disease, regardless of absolute body weight. Therefore, a standardized determination of the body composition is important in everyday practice (Gerber, Goerres, Uebelhart, & Suter, 2007).

The BMI is, despite some limitations, the measurement traditionally used for body volume in epidemiological studies (Huxley, Mendis, Zheleznyakov, Reddy, & Chan, 2010). However, alternative measurements such as the BIA (Fuller, Fewtrell, Dewit, Elia, & Wells, 2002), the WC and the waist-to-hip ratio (WHR) (Huxley et al., 2010), reflect central adiposity and are suggested to be superior to the BMI in predicting the risk for CVD. Studies have shown that the BMI can deceive with normal values but hides a large WC, which predicts ectopic body fat. This can lead to several unhealthy effects such as a range of metabolic abnormalities, decreased glucose tolerance, reduced insulin sensitivity and negative lipid profiles (Huxley et al., 2010). WC is an indicative measurement of central adiposity and is strongly correlated with the risk for CVD in adults. WC percentile charts have been created but unfortunately no cut-off points for the definition of the risk factor have been identified (Lobstein et al., 2014). Savva et al. (2000) found that children who exceed the 75th percentile for WC have significantly higher values for all cardiovascular risk factors. It is recommended to primarily use WC to characterize a population in terms of abdominal fat distribution and determine the prevalence of risk factors (Lobstein et al., 2014).

In order to determine body fat, Power, Lake and Colie (1997) suggest that the measurement device should be accurate, precise, with small measurement errors, accessible, easy to use for the person and the measurer. They also highlighted, that no existing measurement fulfills all the criteria. A device that fulfills many criterions is the BIA. Furthermore, the BIA is used in several studies and especially for children it is a popular measurement instrument. The BIA is a non-invasive, safe, inexpensive method with portable equipment to measure body compositions (Barbosa-Silvia & Barros, 2005), therefore especially suitable for field use (Sluyter, Schaaf, Scragg, & Plank, 2009). Additionally, it has a high inter- and intra-observer reliability. The accuracy may vary with hydration and ethnic status (Lobstein et al., 2004).

2.6 Purpose of the study and research question

As discussed in section 2.4, overweight and obesity among South African schoolchildren is a cause for increasing concern and is a result of a complicated transition of the country into modern time, as well as the lack of physical education. It has a negative influence on various areas of a healthy development and can cause lasting effects for the whole life. The collection and monitoring of anthropometric data from children are important to identify health risk factors and to develop prevention strategies. The main goal of this thesis is to investigate, if higher physical activity patterns are associated with lower FATP, TRFATP and WC and HC. A second goal of this study is to provide an overview of activity patterns, body compositions among South African primary schoolchildren and locate risk factors for NCD. Last but not least, getting a deeper understanding about the relation between physical activity patterns to determine appropriate decision-making for health-related questions and local policy makers.

This master thesis wants to answer two main questions:

1 Do primary schoolchildren in marginalized neighbourhoods of Port Elizabeth, South Africa reach the current physical activity guideline of 60 minutes in moderate to vigorous intensity?

2 How do physical activity patterns affect the body composition of primary schoolchildren in marginalized neighbourhoods of Port Elizabeth, South Africa?

2.6.1 Hypothesis

In the framework of this study, five hypotheses are formulated, which will be tested empirically:

1 On average, boys spend more time with physical activities than girls. Furthermore, they spend more time with intense physical activities.

2 Age correlates negatively with different physical activity patterns.

3 Age and gender have a significant influence on the time spent between different intensities of physical activity.

4 Body fat percentage, visceral fat percentage, waist circumference and hip circumference have a negative relation on the time spent with more intense physical activity.

5 The body compositions (WC, HC, FATP; TRFATP) and the time spent with sedentary activity influences the achievement of the WHO’s physical activity guideline.

3 Methods

In the following section the methods of the master thesis and the *KaziBantu* project will be described. Furthermore, a short overview of the procedure will be provided, in addition to a more thorough explanation of the physical activity and body composition measurements.

3.1 Study setting and sample

The master thesis occurs within the framework of the study: „ Effects of a school-based health intervention program in marginalised communities of Port Elizabeth, South Africa: The *KaziBantu* project " (Müller et al., 2019).

Public schools in South Africa are divided into five quintiles, depending on the schools financial resources. Quintile one represents the poorest, while quintile five accommodates the richest. According to the national poverty distribution table in 2008, 35% of the children are in quintile one, 32% in quintile two, 20% in quintile three, 8% in quintile four and 6% in quintile five schools (Hall & Giese, 2009). The *KaziBantu* project will be carried out in quintile three schools.

In total approximately 1000 children aged 8 to 13 years and in the grades four to six participated in the baseline assessment of the study. Out of 64 interested schools in the Nelson Mandela Bay municipality, only eight passed the study criteria and have been included in the study. Among the criteria not met by other schools are the following: Geographical location in the township area with predominantly black African people or in a northern area with mostly coloured people. It also requires that either IsiXhosa, Afrikaans or English is spoken, and the school principal has to support the project actively. Of the eight included schools four are located in the northern area (Schauderville, Bethelsdorp, Windvogel and Booysens Park) and four in the townships (Motherwell, Zwide, Kwazakhele and New Brighton). The township areas and the northern areas are mostly inhabited by black Africans and coloured people. The main ethnicity of the children partaking in the study are black and coloured. For simplicity the few mixed, Asian/ Indian children and those with unknown ethnicity will be combined into one ethnicity group, labelled as mixed in this thesis. All primary schools are situated in disadvantaged neighbourhoods of Port Elizabeth.

The teachers, children and parents or guardians are informed about the study beforehand. All teachers inform the children that the study is voluntary, and they can stop participating at any time without consequences. The children had to be willing to take part, while also not being in another clinical trial study during the same time and not suffering from any medical conditions. Furthermore, the parents or guardian must sign a consent form to agree with the study conditions (Müller et al., 2019).

3.2 Study design

The *KaziBantu* Project is a randomized controlled trial with an intervention and control group. The baseline measurements of the assessment takes place from February to March 2019, where the data for this master thesis was collected.

In Figure 4 a graphical overview of the study design can be seen. The assessment battery includes different stations, where the children are measured for the CVD markers, including anthropometry (height, weight, WHR and BIA) and cardiovascular markers (blood pressure, blood glucose and blood lipid). After the stations have been completed, the 20m shuttle run test will take place by class. At the end of the sampling epoch accelerometers will be distributed to all children to measure their physical activity. After seven days the accelerometers are recollected and the data is evaluated. The data collection takes place in the field, in a school setting or in a room provided by the school.

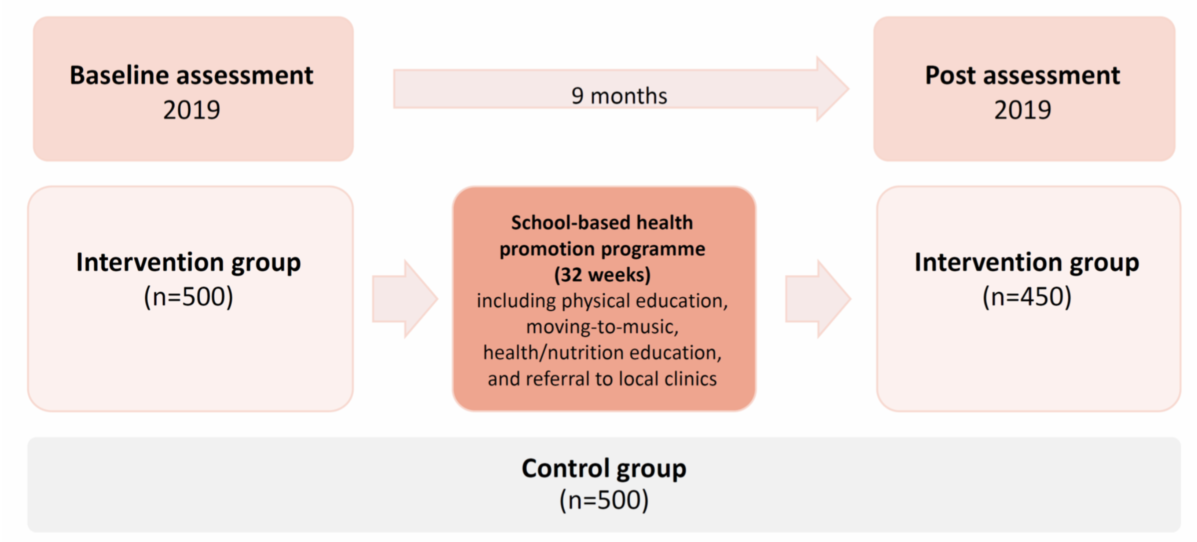

Figure 4. Overview *KaziBantu study* design 2019. Source: Müller et al. (2019).

Following the baseline assessment, is a 9-month intervention period with *KaziKidz,* a school-based health promotion program. This includes the *KaziKidz Teaching Material* with physical education, moving-to-music lessons and health, hygiene and nutrition education. The intervention schools receive one 40 min physical education and one moving-to-music lesson per week, three health educations and three nutrition lessons of 40 min. The control schools document their physical education and sports in school. A computer program randomly selects the different treatments for each study school (Figure 5) and one class per grade 4, 5 and 6.

The *KaziHealth* is a 6-month workplace intervention for the teachers. The goal is to evaluate the individual health risks and to educate and improve their health behaviours. To support the school staff, it follows a face-to-face lifestyle coaching with self-monitoring and the *KaziHealth* mobile application.

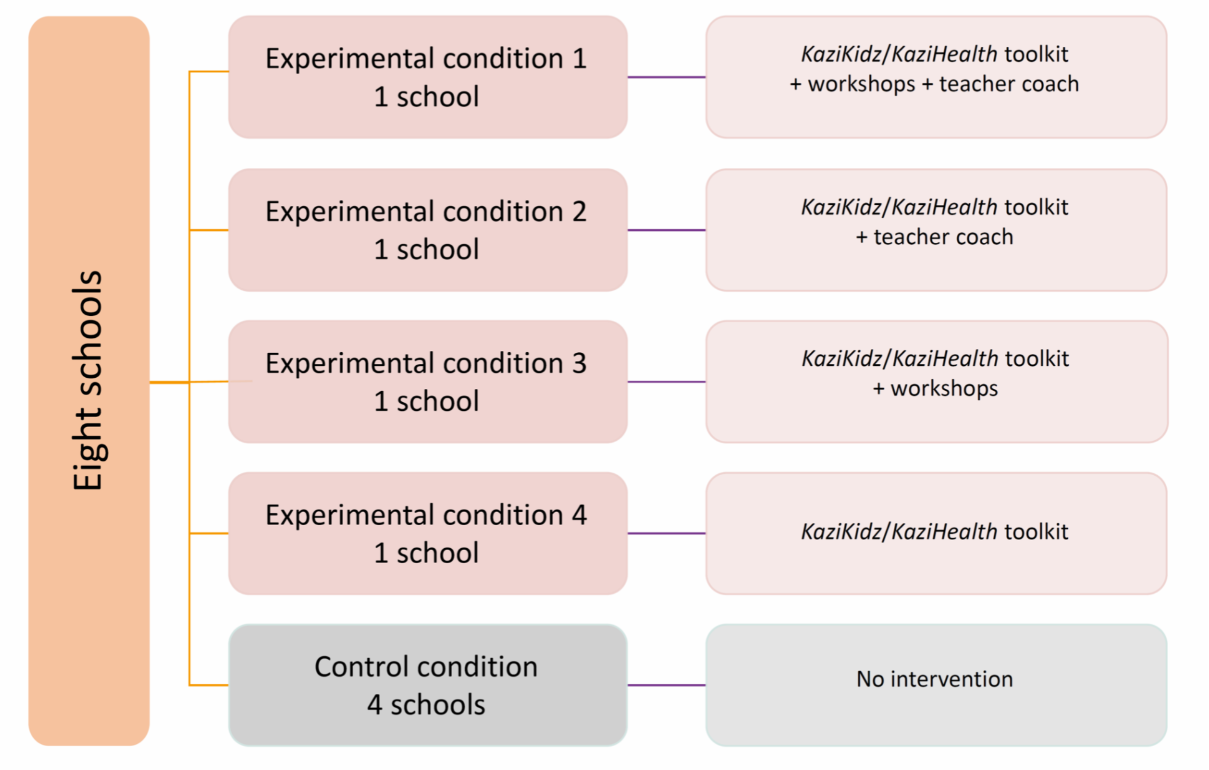

Figure 5. *KaziBantu* study design and its conditions. Source: Müller et al. (2019).

From September to October 2019 the post assessment takes place. For more information, see the description of the study protocol of the *KaziBantu* project (Müller et al., 2019).

3.3 Measurement devices

Body composition includes anthropometric measurements like height, weight, WC, HC, and BIA. A trained international South African and Swiss team from the Nelson Mandela University and University of Basel were responsible for the measurements. The children can wear the school uniform for all measurements, excluding shoes, socks, vest, and jersey. Furthermore, in the clinical examination the children's self-reported health status will be captured (see Appendix 3).

3.3.1 Anthropometric measurement

Body composition, body weight and body height. Total body fat percentage (FATP), trunk fat percentage (TRFATP) and body weight are measured by using a single-frequency, 8-electrode bio impedance analyser system (Tanita MC-580; Tanita Corp., Tokyo, Japan). The device has been validated in the study of Pietrobelli, Rubiano, St-Onge, and Heymsfield (2004) who presented a high correlation in FATP to the reference method called dual energy x-ray absorptiometry. The participants are instructed to fast three hours prior to the measurement. The participants will be guided by the research assistant to stand with optimal contact according to manufacturer's instruction on the machine. At the same time the weight is measured to the nearest 0.1 kg.The height is measured with a stadiometer where a sensitivity level of 0.1 cm is applied.

Waist and hip circumferences. To measure the WC a flexible steel tape around the natural waist (halfway between the ribcage and the iliac crest) is used. To prevent measurement mistakes each documentation contains two assistant helper, one that measures the circumferences and one that writes the results down (NHANES, 2011). For the HC, the same system will be used but at the maximal circumference of the buttocks. The measurement is taken in standing position and legs together.

3.3.2 Physical activity measurement

To get information about the physical behaviour, all children receive an accelerometer device (ActiGraph wGT3x-BT, Shalimar, FL, USA) to wear around the hip. The physical activity is measured for seven days, five school and two weekend days with a data-sampling epoch of 30 seconds (Rowlands, 2007).

The usage of accelerometers to measure physical activity in children has been validated in several studies (Crouter et al., 2013); (Hänggi, Phillips, & Rowlands, 2013). The data created by the accelerometer and the ActiLife® computer software is categorized into sedentary activity, LPA, MPA and VPA. The categorization is done based on the research of Freedson, Melanson, and Sirard (1998) who define sedentary activity as less than 1.5 metabolic equivalent of task (MET). LPA is between 1.5 and 2.9 MET, MPA between 3 and 5.9 MET, and finally VPA is defined as larger than 6 MET. To compare the activity patterns of the children, a cut-off level will be defined. It will be differentiated between children who reach the recommended level of physical activity (≥ 60 min MVPA per day) and children who don't (Benitez-Porres, Alvero-Cruz, Sardinha, Lopez-Fernandez, & Carnero, 2016).

3.4 Statistical analysis

Statistical analyses are performed with SPSS® version 26 (IBM Corporation; Armonk, United States). For all analyses, an alpha level of .05 is used to indicate statistical significance. Descriptive statistics is displayed as mean (*M*) and standard deviation (*SD*). The main part of the statistical analyses is descriptive to visualize the data in tables and graphs. In all of the parameters, t-tests are applied to validate the differences ($p < .05$). To analyse the relation between physical activity patterns and body composition the Pearson correlation and multiple linear regressions are applied. All regression coefficients are adjusted for respondent's age, sex and ethnicity. A binomial logistic regression is used to analyse whether children reach the WHO physical activity threshold and what the main drivers for reaching them are.

3.4.1 Data cleaning

As shown in Figure 6 out of the approximately 1000 children eligible to participate in the study, 985 observation have been collected.

To clean up the data, the following structure was applied. Gender was measured at three independent places during the assessment with varying degrees of completeness. Therefore, the gender of the master file was taken as base and in a first step, the missing genders where filled with the Tanita measurements, as they were the most similar to the base. As a last source the questionnaire was used. For 5 children the gender cannot be identified even using all the variables at hand.

Participants below 8 and above 13 years old have been removed as they violate the study criteria. Additionally, 19 children with missing age data were excluded. Afterwards, children with no consent form, which left school, moved to a higher grade out of the study criteria or where absent during the measuring time, where removed as well. This step decreases the sample to 948 children. To reduce bias only the actigraphy data with the total measured time over 6000 minutes was included. Therefore 123 children with a lower time where removed.

For the last aspect of the data cleaning, participants with missing body composition (height, weight, WC, HC, FATP, TRFATP) were removed. Subsequently, the dataset contains 749 participants with valid data. Unfortunately, the dataset contains 4 duplicates of ID with different measurements. All subsequent analysis concerns the 739 children with no missing data in all the variables.

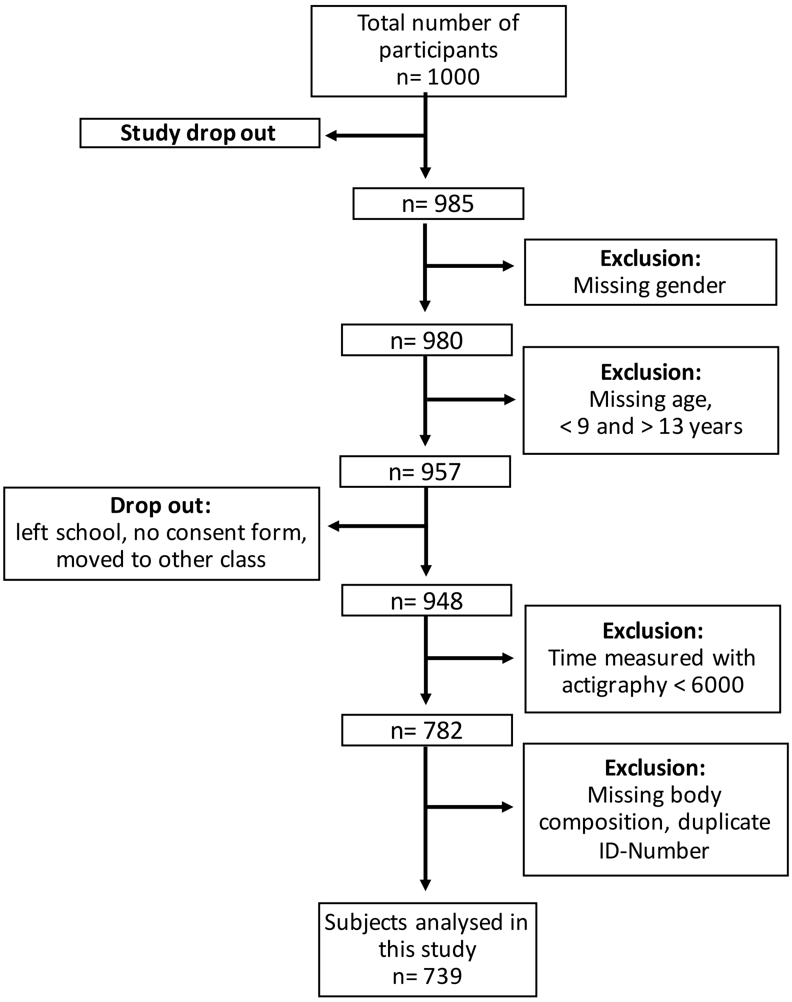

Figure 6. Graphical overview of the data cleaning. Source: Own figure.

4 Results

The records include a first data extract of the baseline assessment of the study „Effects of a school-based health intervention program in marginalised communities of Port Elizabeth, South Africa: The *KaziBantu* project“ (Müller et al., 2019) and tries to answer the two main questions:

Do primary schoolchildren in marginalized neighbourhoods of Port Elizabeth, South Africa reach the current physical activity guideline of 60 minutes in moderate to vigorous intensity?

How do physical activity patterns affect the body composition of primary schoolchildren in marginalized neighbourhoods of Port Elizabeth, South Africa?

4.1 Descriptive statistics

Table 2 shows the distribution of the anthropometric measurement for boys and girls. The 739 observations contain 51% girls and 49% boys. The study sample contains 464 black children, 176 coloured children, 61 mixed children and 38 with unknown ethnicity, which are combined into the ethnicity mixed. Furthermore, the health status of the children was recorded. In 166 cases sicknesses like headache (n = 38), stomach-ache (n = 41), fever (n = 37), injured legs or arms (n = 12) and others (38) were found. The highest appearance of reported sicknesses was found among black children with 117 cases, followed by coloured children with 29 and 14 cases among mixed children.

Table 2

Distribution of the anthropometric measurements with mean and standard deviation (SD) separated by gender

	Gender					
	Female (n=379)		Male (n=360)		Total (n=739)	
	Mean	SD	Mean	SD	Mean	SD
Age (years)	10.68	1.04	10.94	1.15	10.81	1.10
Weight (kg)	36.87	11.13	34.13	9.09	35.54	10.27
Height (cm)	140.28	8.85	139.05	8.30	139.68	8.60
WC (cm)	58.96	8.45	57.87	7.74	58.43	8.13
HC (cm)	76.04	10.47	72.53	8.81	74.33	9.84
FATP (%)	26.43	6.36	21.00	6.62	23.78	7.03
TRFATP (%)	20.91	6.85	16.94	6.50	18.98	6.97

Annotation. Waist Circumference (WC), Hip Circumference (HC), Fat Range (FATP), Trunk Fat Range (TRFATP).

The average participant was 10.81 years old (*SD* = 1.10), while the youngest was 8 and the oldest 13. The majority consists of 10-years old (31%) while 13-years old are the smallest minority (3%).

On average the girls (M = 36.87 kg, M = 140.28 cm) were 2.74 kg heavier and 1.23 cm taller than the boys (M = 34.13 kg, M = 139.05 cm). They also had a 1.09 cm wider WC and a 3.51

cm wider HC, as well as 5% more FATP and 4% more TRFATP. In all the parameters black and mixed children have a higher value than coloured children.

An overview of the physical activity pattern per day, separated by gender is given in Table 3.

Table 3

Distribution of the physical activity per day in minutes with mean and standard deviation (SD) separated by gender

	Gender					
	Female (n=379)		Male (n=360)		Total (n=739)	
	Mean	SD	Mean	SD	Mean	SD
Sedentary Day	581.41	55.56	562.28	57.23	572.10	57.15
Light Day	254.27	36.58	261.77	36.83	257.92	36.87
Moderate Day	38.07	12.55	50.73	14.46	44.24	14.91
Vigorous Day	15.37	7.80	24.89	11.94	20.01	11.10
MVPA per Day	53.44	19.23	75.62	24.66	64.25	24.67
TotalPA per Day	307.71	48.57	337.39	51.51	322.17	52.15

Annotation. All physical activities are per day and minute. MVPA per Day: Average moderate to vigorous physical activity per day, TotalPA per Day: summarize light, moderate and vigorous physical activity per day.

Participants spent most of the day with sedentary activities (*M* = 572.10 min, *SD* = 57.15) and LPA (*M* = 257.92 min, *SD* = 36.97). The biggest gap in the time spent in an activity is between LPA and MPA, independent of gender.

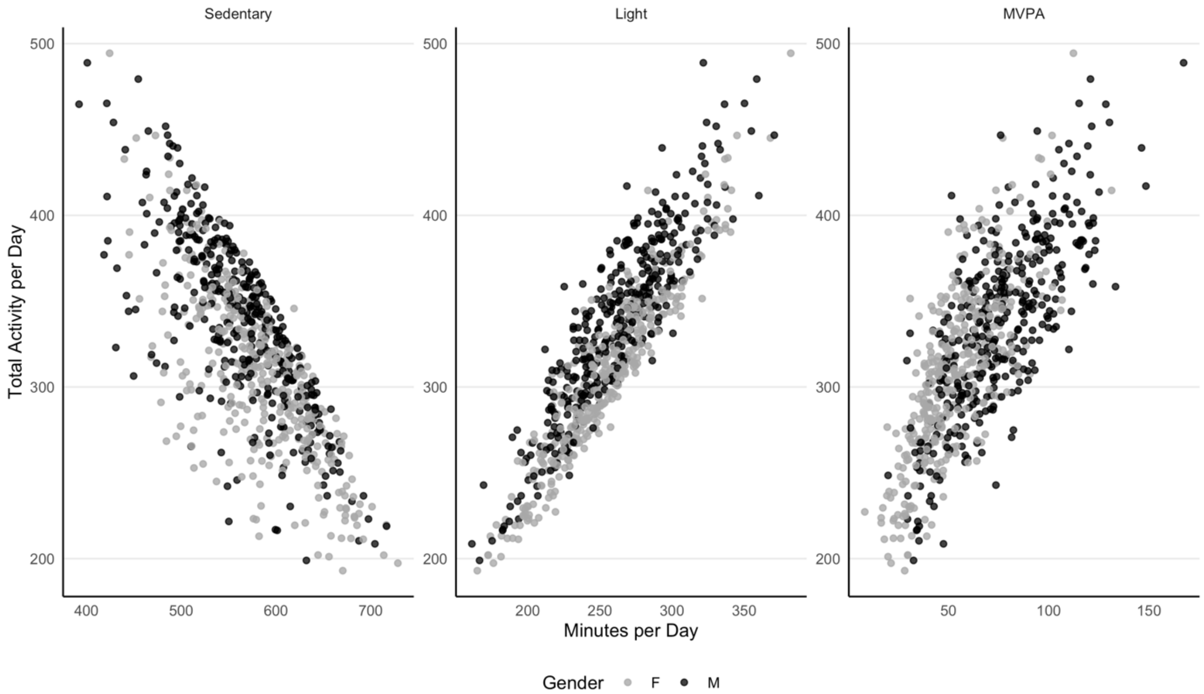

Figure 7. Scatterplot of total physical activity with sedentary activity, light physical activity and moderate to vigorous physical activity separated by gender. Source: Own figure.

In Figure 7 on the left side the total physical activity compared to the time spent with sedentary activity shows a negative relation. There is a large variance in daily sedentary activity, ranging from 400 minutes to 700 minutes per day. On average girls spend more time with sedentary activity than boys. In the middle of Figure 7 the distribution of the time spent with LPA shows a positive relationship to the total physical activity, with the smallest variation. On the right side the distribution of the total physical activity compared to the MVPA can be seen for both genders. Generally, there is a positive relation between total physical activity and MVPA per day. Furthermore, the activity pattern among boys have a higher mean MVPA, compared to girls.

4.2 Results of the hypothesis

In the following section the results of the 5 hypotheses will be shown.

Hypotheses 1

On average, boys spend more time with physical activities than girls. Furthermore, they spend more time with intense physical activities.

Result

An independent-sample t-test was run to determine if there are differences in physical activity patterns between boys and girls (Table 4). There were no outliers in the data as assessed by inspection of a boxplot. Levene's Test for Equality showed that the variances of MPA (p = .003) and VPA (p < .001) are not homogenous.

Table 4

Results of the independent-sample T-Test for physical activity pattern in minutes and gender

Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Sedentary Day	F	379	581.414	55.558	2.854
	M	360	562.285	57.231	3.016
Light Day	F	379	254.270	36.579	1.879
	M	360	261.765	36.827	1.941
Moderate Day	F	379	38.071	12.547	0.645
	M	360	50.733	14.457	0.762
Vigorous Day	F	379	15.368	7.798	0.401
	M	360	24.890	11.939	0.629

Independent Samples Test

	t-test for Equality of Means						
	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95%-KI Lower	95%-KI Upper
Sedentary Day	4.607	732	0.000	19.130	4.152	10.978	27.282
Light Day	-2.775	735	0.006	-7.495	2.701	-12.799	-2.192
Moderate Day	-12.687	711	0.000	-12.661	0.998	-14.621	-10.702
Vigorous Day	-12.765	613	0.000	-9.522	0.746	-10.987	-8.057

Annotation. In the independent sample T-Test, male is used as reference gender, Physical activity pattern per day and in minutes.

It has been shown that the average time spent with sedentary activities was lower among boys (M = 562.28, SD = 57.23) than girls (M = 581.41, SD = 55.56). The difference between gender was statistically significant $t(732) = 4.61$, $p < .001$. On the other hand, boys spend more with all other activities from LPA $t(735) = - 2.78$, $p = .006$, MPA $t(711) = - 12.69$, $p < .001$ and VPA $t(613) = - 12.77$, $p < .001$.

In addition, an independent-samples t-test was run for MVPA $t(678) = - 13.59$, $p < .001$ and total physical activity $t(728) = - 8.05$, $p < .001$. In comparison to girls, boys spend on average 22.18 min more time with MVPA and 29.69 min more time with total physical activity per day.

As expected, girls spend more time with sedentary activities than boys. Additionally, it has been shown, that boys spend more time with intense physical activities.

Hypotheses 2

Age correlates negatively with different physical activity patterns.

Results

A Pearson correlation was calculated to assess the relationship between age and daily time spent in different physical intensities in 8 to 13 year old children. Preliminary analysis showed the realtionship to be linear with normally distributed variables. In Table 5 the Pearson correlations can be seen. There was a small statistically significant positive correlation between age and the daily time spent with sedentary activities $r(737) = .190$, $p < .001$. Furthermore, the daily time spent with LPA had a small negative correlation with age $r(737) = - .177$, $p < .001$. There was no statistically significant correlation between age and the daily time spent with MPA and VPA ($p > .05$).

Table 5

Pearson correlation of age and physical activity pattern

Correlations

		Sedentary Day	Light Day	Moderate Day	Vigorous Day
Age	Pearson Correlation	,190**	-,177**	,017	-,002
	Sig. (2-tailed)	,000	,000	,636	,962
	N	739	739	739	739

**. Correlation is significant at the 0.01 level (2-tailed).

Annotation. Physical activity pattern per day and in minutes, Age: from 8 to 13-year olds.

In conclusion, LPA per day is statistically significant and negatively correlated with age. Contrarily, the time spent with sedentary activities had a significant positive correlation with age.

Hypotheses 3

Age and gender have a significant influence on the time spent between different intensities of physical activity.

Results

Figure 8 shows a graphical overview of the different physical intensities per day over age, separated by gender. As seen before, girls spend more time in sedentary activities than boys. The older the children get, the more time they spend in sedentary activities. In all other intensities the time spent in physical activities decreases, the older the children get. The decrease in age appears, as seen in hypothesis 2, only with LPA. Furthermore, the time spent in physical activities mainly with MPA and VPA is higher among boys.

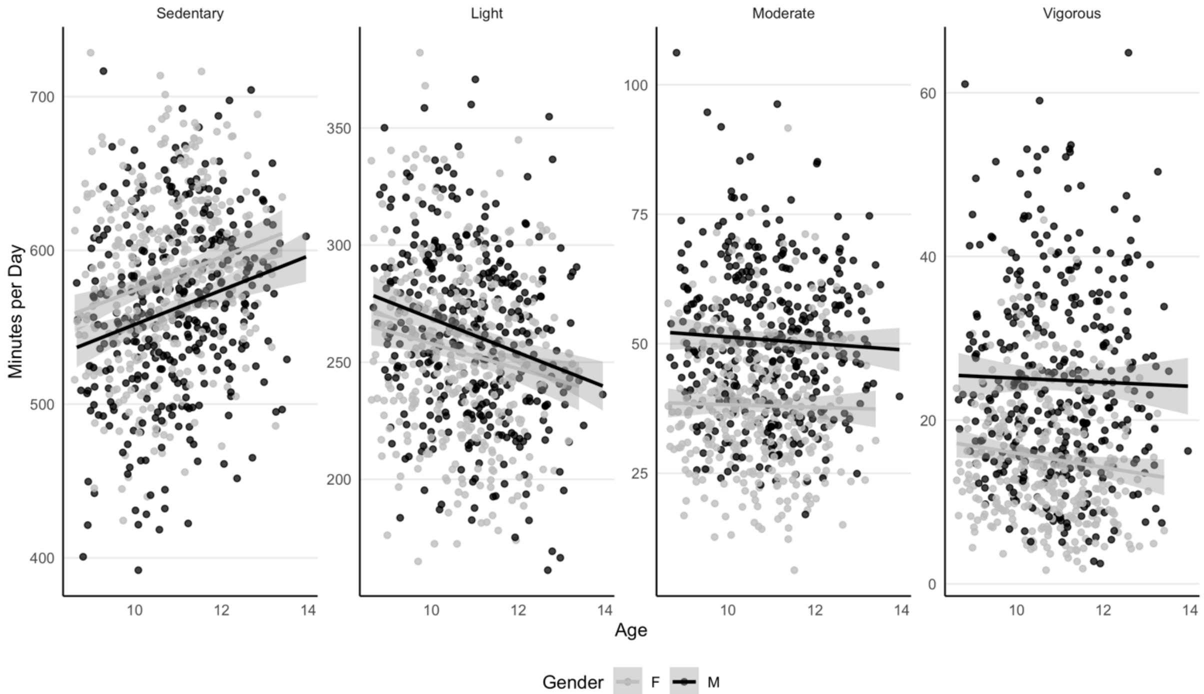

Figure 8. Graphical overview of relationship between movement, age and gender. Attention, the scales for the y axes are different per plot. Source: Own figure.

Separate multiple regressions were used to explain the time spent in sedentary activities, LPA, MPA, and VPA from age, gender, reported sick, and ethnicity. The variance is homoscedastic as assessed by visual inspection of a plot of standardized residuals versus unstandardized predicted values. Furthermore, the assumption of normality was met, as assessed by a Q-Q Plot. In the appendix 1, the tables for LPA (Table 1), MPA (Table 2) and VPA (Table 3) can be found.

Table 6

Results of the multiple regression analysis for the daily time spent in sedentary activities

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.277[a]	0.077	0.071	55.092

a. Predictors: (Constant), Ethnicity Colored, Age, Reported Sick, Female, Ethnicity Black

b. Dependent Variable: Sedentary Day

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	185459.613	5	37091.923	12.221	0.000[b]
	Residual	2224726.678	733	3035.098		
	Total	2410186.292	738			

a. Dependent Variable: Sedentary Day

b. Predictors: (Constant), Ethnicity Colored, Age, Reported Sick, Female, Ethnicity Black

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	439.450	21.178		20.750	0.000	397.872	481.028
	Age	11.086	1.853	0.214	5.982	0.000	7.448	14.725
	Female	22.104	4.096	0.193	5.397	0.000	14.063	30.145
	Reported Sick	1.753	4.901	0.013	0.358	0.721	-7.869	11.375
	Ethnicity Black	-1.167	6.104	-0.010	-0.191	0.848	-13.150	10.817
	Ethnicity Colored	7.642	6.924	0.057	1.104	0.270	-5.951	21.236

a. Dependent Variable: Sedentary Day

Annotation. Sedentary time in minutes and per day, Age: from 8 to 13-year olds, Gender: as reference category male. Ethnicity: as reference category mixed. Reported sick: headache, cough, stomach pain, fever.

The following results have been found for sedentary activities (Table 6). Ethnicity, gender, reported sick, and age are jointly statistically significant predictors for the daily time spent with sedentary activities $F(5,733) = 12.221$, $p < .001$. The R^2 for the overall model was 7.7% with an adjusted R^2 of 7.1%. Even when controlling for ethnicity, gender and the reported sick, age is still a statistically significant factor to spend more time with sedentary activities (β = 11.024, 95% CI: 7.392; 14.565, $p < .001$). Furthermore, there is a strong evidence that girls spend more time with sedentary activities than boys (β = 22.104, 95% CI: 14.063; 30.145, $p < .001$), independent of the other factors.

The multiple regression explaining LPA is jointly significant ($F(5,733) = 8.288$, $p < .001$, adj. $R^2 = .047$), where age (β = - 6.379, 95% CI: - 8.755; - 4.002, $p < .001$) and gender (β = - 9.424, 95% CI: - 14.677; - 4.171, $p < .001$) are significant predictors while controlling for ethnicity and reported sick.

In more intense physical activity levels, only gender was a statistically significant predictor. Girls spend 12.70 min less time per day with MPA (β = - 12.703, 95% CI: - 14.676; - 10.731,

$p < .001$) and 9.64 min less with VPA (β = - 9.640, 95% CI: - 11.105; - 8.175, $p < .001$) than their peers, holding all other variables constant. Both models for MPA ($F(5,733) = 33.141$, $p < 0.001$, adj. $R^2 = .179$) and VPA ($F(5,733) = 33.839$, $p < 0.001$, adj. $R^2 = .182$) are jointly statistically significant. Reported sick and ethnicity have not been significant in any of the multiple regressions ($p > .05$).

As seen age and gender both have a statistically significant influence on sedentary activity and LPA. In more intense levels only gender is still statistically significant.

Hypotheses 4

Body fat percentage, visceral fat percentage, waist circumference and hip circumference have a negative relation on the time spent with more intense physical activity.

Results

Again, multiple regressions were applied to explain the body composition. All models were jointly statistically significant as can be seen in the following overview.

WC ($F(9,729) = 14.205$, $p < .001$, adj. $R^2 = .139$),

HC ($F(9,729) = 20.765$, $p < .001$, adj. $R^2 = .194$),

FATP ($F(9,729) = 29.373$, $p < .001$, adj. $R^2 = .257$),

TRFATP ($F(9,729) = 20.484$, $p < .001$, adj. $R^2 = .192$).

Table 7 shows the results for the multiple regression analysis of the WC. Further tables are outlined in the appendix 2 for HC (Table 1), FATP (Table 2) and TRFATP (Table 3).

Of all the physical activity patterns, only the time spent with LPA and VPA are statistically significant factors for all body compositions. An extra minute of daily time spent with LPA leads to a 0.026 cm (β = 0.026, 95% CI: - 0.006; 0.047, $p = .012$) increase of WC, a 0.024 cm (β = 0.024, 95% CI: 0.001; 0.048, $p = .045$) increase of HC, a 0.018%-point (β = - 0.018, 95% CI: - 0.002; 0.035, $p = .002$) decrease of FATP and a 0.019%-point (β = 0.019, 95% CI: 0.002; 0.036, $p = .029$) increase of TRFATP, holding of all other factors constant. However, this does not work, as the minute more in LPA has to come either from sedentary, moderate or vigorous time. Therefore, an extra minute in LPA originating from VPA increases WC by $1*0.026+(-1) * (-0.195) = 0.221$ cm. Sedentary activity and MPA are not significant and nothing can be said about these effects.

The most significantly negative relation between physical activity and body composition was found in the time spent with VPA per day. Even after controlling for the independent variables, the time spent with VPA was still a statistically significant factor for WC (β = - 0.195, 95% CI: - 0.280; - 0.111, $p < .001$), HC (β = - 0.266, 95% CI: - 0.365; - 0.167, $p < .001$), FATP (β = - 0.224, 95% CI: - 0.292; - 0.156, $p < .001$) and TRFATP (β = - 0.227, 95% CI: - 0.297; - 0.157, $p < .001$). Not only LPA and VPA were significant factors, sedentary activities showed a negative influence for FATP as well (β = - 0.013, 95% CI: - 0.02; - 0.001, $p < .001$).

Table 7

Results of the regression analysis for waist circumference

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.386[a]	0.149	0.139	7.541

a. Predictors: (Constant), Vigorous Day, Age, Ethnicity Black, Reported Sick, Light Day, Female, Ethnicity Colored, Sedentary Day, Moderate Day

b. Dependent Variable: WC

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7270.994	9	807.888	14.205	0.000[b]
	Residual	41459.611	729	56.872		
	Total	48730.606	738			

a. Dependent Variable: WC

b. Predictors: (Constant), Vigorous Day, Age, Ethnicity Black, Reported Sick, Light Day, Female, Ethnicity Colored, Sedentary Day, Moderate Day

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	44.208	6.964		6.348	0.000	30.536	57.881
	Age	1.900	0.263	0.258	7.215	0.000	1.383	2.417
	Female	-0.234	0.633	-0.014	-0.370	0.711	-1.476	1.008
	Reported Sick	0.050	0.672	0.003	0.074	0.941	-1.269	1.368
	Ethnicity Black	0.425	0.837	0.025	0.507	0.612	-1.219	2.069
	Ethnicity Colored	-2.408	0.954	-0.126	-2.524	0.012	-4.281	-0.535
	Sedentary Day	-0.013	0.008	-0.093	-1.734	0.083	-0.028	0.002
	Light Day	0.026	0.010	0.119	2.508	0.012	0.006	0.047
	Moderate Day	-0.027	0.036	-0.049	-0.745	0.457	-0.098	0.044
	Vigorous Day	-0.195	0.043	-0.267	-4.552	0.000	-0.280	-0.111

a. Dependent Variable: WC

Annotation. Physical activity in minutes and per day, Age: from 8 to 13-year olds, Gender: as reference category female. Ethnicity: as reference category mixed. Reported sick: headache, cough, stomach pain, fever.

Next to the physical activity patterns independent variables such as age, gender, reported sick, and ethnicity were added to the multiple regression model to control for their influence. Age has a positive influence on WC and HC ($p < .001$). Furthermore, the girls had statistically significant higher values in HC, FATP and TRFATP ($p < .05$). The body composition of coloured children showed statistically significant lower values than mixed children ($p < .05$). The reported sickness, the ethnicity of black children, as well as the MPA had no significant influence on the body composition ($p > .05$) (the coefficient for WC can be found in Table 7 above and for HC; FATP and TRFATP in the appendix 2). There was no significant interaction to be found between age and gender on body composition.

In conclusion the time spent with sedentary activities only had a statistically significant negative influence on FATP. The time spent with LPA influences WC, HC, TRFATP positively and FATP negatively. MPA was the only intensity that did not have an influence on any body composition. In contrast, the daily time spent with VPA was the only variable, which had statistically significant negative influence on all body compositions. Again, the final effect will depend on from which activity the time is taken.

Hypotheses 5

The body compositions (WC, HC, FATP; TRFATP) and the time spent with sedentary activity influences the achievement of the WHOs physical activity guideline.

Results

First of all, 47% of the study participants did not achieve the WHO physical activity guideline. Children who did not reach this guideline spent on an average day 52.61 min more with sedentary activities, 23.22 min less with LPA, 23.20 min less with MPA and 15.95 min less with VPA compared to those who reached the guidelines. In contrast to the boys (29%), 65% of the girls did not fulfil the recommendation (Figure 9).

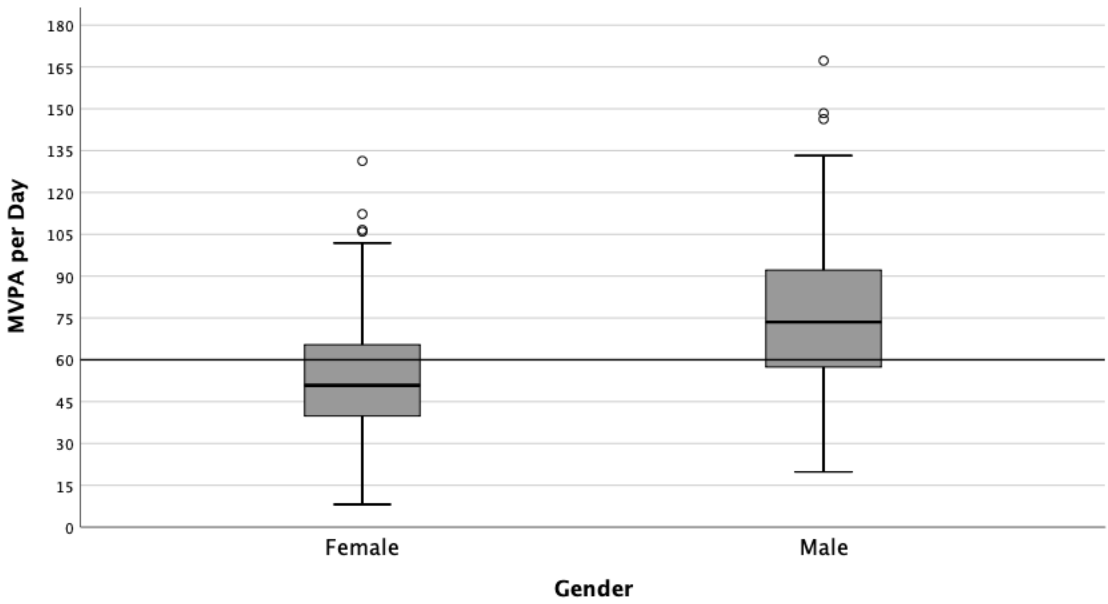

Figure 9. Boxplot for average moderate to vigorous physical activity (MVPA) per day separated by gender and with reference line, set to 60 min. Source: Own figure.

A binominal logistic regression was performed to ascertain the effects of gender, age, ethnicity, reported sick, weight, body compositions and sedentary activity on the probability to achieve the WHO physical activity guideline (Table 8).

Table 8

Results of the binominal logistic regression on the probability to achieve the WHO physical activity guideline

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	323.906	11	0.000
	Block	323.906	11	0.000
	Model	323.906	11	0.000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	698,712[a]	0.355	0.474

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than ,001.

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	Female(1)	-0.831	0.318	6.822	1	0.009	0.436	0.233	0.813
	Age	0.051	0.120	0.180	1	0.671	1.052	0.832	1.330
	Ethnicity Black(1)	-0.085	0.284	0.089	1	0.765	0.919	0.526	1.603
	Ethnicity Colored(1)	-0.405	0.324	1.560	1	0.212	0.667	0.354	1.259
	Reported Sick(1)	0.216	0.228	0.897	1	0.344	1.241	0.794	1.938
	Weight	0.010	0.031	0.114	1	0.735	1.011	0.951	1.074
	WC	0.028	0.032	0.793	1	0.373	1.028	0.967	1.094
	HC	0.002	0.025	0.005	1	0.942	1.002	0.954	1.052
	FATP	-0.220	0.146	2.290	1	0.130	0.802	0.603	1.067
	TRFATP	0.066	0.129	0.259	1	0.611	1.068	0.830	1.374
	Sedentary Day	-0.024	0.002	116.459	1	0.000	0.976	0.972	0.981
	Constant	15.802	2.397	43.461	1	0.000	7290223.67		

a. Variables entered on step 1: Female, Age, Ethnicity Black, and Colored, Reported Sick, Weight, WC, HC, FATP, TRFATP, Sedentary Day.

Annotation. Gender: as reference category male, Age: from 8 to 13-year olds, Reported Sick: reference category is no reported sickness, Body compositions: Waist Circumference (WC), Hip Circumference (HC), Fat Range (FATP), Trunk Fat Range (TRFATP), Sedentary activity: in minutes and per day.

The logistic regression model was statistically significant, $\chi 2(11) = 323.906$, $p < .001$. The model explains 47.4% (Nagelkerke R^2) of the variance. Of the eleven predictor variables, only two are statistically significant: gender and daily time spent in sedentary activities (Table 8). Girls have only 0.44 times the odds of reaching the guideline compared to boys. In other words, girls reach the guideline with a probability of 30.5%. Decreased time spent with sedentary activities was associated with an increased probability to achieve the WHO guideline.

In conclusion only the gender and the daily time spent in sedentary activities have been detected to be significant predictors to reach the WHO guideline.

5 Discussion

Hypotheses 1

On average, boys spend more time with physical activities than girls. Furthermore, they spend more time with intense physical activities.

As expected, girls spend more time per day with sedentary activities than boys. Boys on the other hand, spend more time with all other intensities like LPA, MPA and VPA. The same considerable differences between the genders have been found in the study of Boreham and Riddoch (2001). Girls spent approximately 30 minutes less with total physical activity per day than boys. Livingstone (2001) discussed that in studies, boy are often reported to be more active than girls; but this gender-discrepancy is reduced, when comparing moderate activity only. This finding of Livingstone (2001) is partially contrary to the results of this study. As mentioned, the time spend with sedentary activity was higher among girls, but the time spend with VPA was higher among boys. The main difference between genders, apart from sedentary activity, was found in MPA. In addition, it was found that the discrepancy between girls and boys rises in intense physical activity as well.

Only a few studies discuss the reasons for these gender specific differences. One possible explanation in the school setting was found in the study of Boreham and Riddoch (2001). In school settings, boys spend more time with physical activities during school break such as active play, whereas girls spend a large share of their time with social activities on the playground. Furthermore, it has been observed that the intensity and duration of the activity in the school playground is higher among boys (Boyle et al., 2003). Due to the behaviour on the playground and the general increase with sedentary activities during leisure time, the focus on physical activity intervention should therefore be on the school setting (Menschik et al., 2008).

In addition, reasons for the decreased physical activity especially among girls were found in the South Africa 2018 Report Card. It was highlighted that 61% of the parents were uncomfortable with their child walking to school without an adult, depending on gender and age of the child. The report also showed that parental interaction has an influence on the physical activity of the child. Simons et al. (2018) emphasized that in families with limited resources and other problems, such as a high rate of unemployment, a lower level of supervision of the children can be found. Girls face even further barriers when joining physical activities in unsafe environments, such as the townships and the northern areas, as shown by the studies of Menschik et al. (2008) and Draper et al. (2018). The safety factors should be an additional factor to be taken into account in future studies (Timmons et al., 2007). Therefore, a supportive school environment with focus on the girls and qualitatively high physical education lessons can further help to develop a healthy lifestyle (WHO, 2018). Schools can be beneficial, especially for children of different risk groups, particularly children with no access to playgrounds and especially girls. However, schools cannot solve the problems of inactivity alone but they can become a key element in a community to ensure their students spend the recommended time with physical activities. It is still not known exactly what the most effective strategy is to promote healthy behaviours (Dobbins et al., 2013). Further research is required to identify the cause of gender specific differences in disadvantaged primary school children in the South African population to implement setting specific interventions.

Hypotheses 2

Age correlates negatively with different physical activity patterns.

This thesis showed earlier, that age has a significant effect on the time spent with sedentary activity and LPA. Older children spend less time with LPA per day but more with sedentary activities compared to their younger peers. These findings are in line with the results of several studies (Li et al., 2007; Armstrong et al., 2006; Kimani-Murage, 2013), where sedentary behaviour increased with age. No effect was found between age and higher levels of physical activity. Within the population of this study and in comparison between genders, the age factor seems to be a negligible factor when it comes to time spent with intense physical activity. However, the data was able to show that the main shift takes place from less time spent with LPA towards more time spent with sedentary activities with older children. For a better health outcome, the sedentary time should decrease while increasing time spend with LPA or better with VPA (McGregor et al., 2018). Therefore, the increased time spent with sedentary activities should be replaced with more physical education lessons or interventions during school as suggested by Menschik et al. (2008).

While getting older, the increased time spent with sedentary activities is alarming. This trend has several consequences: Firstly, it can lead to a high risk related behaviour with a larger chance for chronic diseases and CVD. Secondly, the reduced physical activity can lead to psychosocial health problems and finally carry over the conditions from childhood into adulthood. It is not exactly known at what age the decline begins (Dobbins et al., 2013). The resulting costs are difficult to handle, especially in developing countries, and can lead to a significant fall of life expectancy for children and their families (Lobstein et al., 2004). The tendency for the decrease of physical activity with growing age has been explained by the biological maturation in relation to the start of puberty (Van Biljon et al., 2018). Several studies (Toriola at al., 2012; Armstrong et al., 2006) found a further relation, showing that overweight increases as well with pubertal development and can reflect factors such as increased sedentary activity and decreased physical activity (Van Biljon et al., 2018). In a further step, pubertal development can be included in the analysis to determine its influence.

Furthermore, different reasons for the interaction of age and physical activity are discussed in the literature. Increasing age also aligns with more time spent watching television (Timmons et al., 2007). This is also the case in the South African setting, as access and affordability of technology products is getting easier, leading to more screen time during childhood (Draper et al., 2018). The increase in sedentary time in this study might as well be associated with increased leisure time in front of the television (Malik et al., 2013). A link was found between the enjoyment of sedentary activities and the socioeconomic status on one hand, and the education level of children and their parents on the other hand (James, 2004). Additionally, the transition from less time of free play to more organised sports during increasing age has to be considered (Boreham & Riddoch, 2001), as well as the general shift from outdoor to indoor activities (Malik et al., 2013). Future studies trying to explain the increased sedentary behaviour and decreased LPA with growing age can include specific leisure time behaviour such as time spent watching television and participation in sport programs.

Hypotheses 3

Age and gender have a significant influence on the time spent between different intensities of physical activity.

As already mentioned in hypotheses 1 and 2 girls spend more time with sedentary activities than boys. The daily time spent with sedentary activities increases at a higher age. Furthermore, LPA decreases at growing age and is slightly higher among boys.

Age and gender were the only significant predictors in the multiple regression for the time spent with sedentary activities and LPA. For each year a child ages it spends 11.09 min more with sedentary activities and 6.38 min less with LPA per day. On average girls spend 22.10 min more with sedentary activities and 9.42 min less with LPA than boys. In moderate and vigorous activity, only gender was significant. Over the course of age, the time spent with MPA and VPA was more or less stable with a slight decrease. Per day girls spend 12.70 min less with MPA and 9.74 min less with VPA than boys. There was no interaction found between age and gender.

In conclusion, the two main findings are firstly the increasing time spent with sedentary activity and decreasing time spent with LPA with growing age. The second finding is the large difference between genders in all physical activity intensities. Several reasons for this trend have been discussed in hypotheses 1 and 2. Problems like missing physical activity opportunities with appropriate and safe sport programs, might explain the lack of physical activity. With the value of physical activity in the communities, gender specific differences especially in intense physical activity can be explained. It is reflected in the available sport opportunities in the environment and in the encouragement to participate in intense physical activity (Van Biljon et al., 2018). Especially for girls, cultural consent to participate in intense physical activity is important. Missing reassurance can lead to gender specific differences (Draper et al., 2018). Furthermore, the natural shift while aging from less time of free play to more organized sport can decrease further due to missing financial resources (Van Biljon et al., 2018). James (2004) found that especially poor families spend more time in sedentary activities because they are usually less expensive than sport activities. Due to missing time resources the socio-economic status was not considered in this study.

Hypotheses 4

Body fat percentage, visceral fat percentage, waist circumference and hip circumference have a negative relation on the time spent with more intense physical activity.

The time spend with sedentary activity only had an influence on the FATP of the children. Against intuition, the FATP decreased by 0.013%-points for more time spent with sedentary activities per day. It has to be taken in account that children who move more during the day need to take breaks in sedentary time as well and this could influence each other. Therefore, it is difficult to make a conclusion out of one intensity without considering the others. For all parameter of the body composition, time spent with LPA and VPA per day had a significant relation. More time spent with LPA was associated with a higher value in WC, HC and TRFATP. Only the FATP decreases on average by 0.018%-points for each minute per day more spent with LPA. It seems that the intensity of LPA is already enough to have a positive effect on the FATP. The study of McGregor et al. (2018) showed an additional interesting fact to consider in the interpretation. The role of LPA implied to be ambivalent for the health when it replaced the sedentary activity and not the time spent in MVPA. In a further step this association could be taken into account. Saelens et al., (2007) found contrary to this results that MPA already had a positive influence on the visceral fat, which was measured with WC and magnetic resonance imaging. The different measurement methods used for abdominal fat might have led to these opposite results.

As expected, VPA was an overall significant negative factor, which influenced the circumferences and the fat percentages. Per minute per day more time spent with VPA the WC decreases on average by 0.12cm, the HC by 0.27cm, the FATP by 0.22%-points and the TRFATP by 0.23%-points. Children who are more involved with intense physical activities have smaller circumferences and fat percentages. These results support the findings of Ferrari et al. (2015) who found that VPA in comparison to MPA have a larger influence on body composition. This negative relation between physical activity and body fat, as well as visceral fat, was shown by using objective measures of activity (Moore et al., 2003). The WHO (2018) emphasized that higher volumes or intensities of physical activity have greater benefits on the cardiorespiratory and metabolic risk factors. Furthermore, Nebahat (2018) showed that the body composition of physically active children is better and that these children suffer from less health problems. This thesis showed that high VPA goes hand in hand with good body composition. The accumulation of abdominal fat leads to high risks for the development of diabetes type 2 and CVD (Rossouw et al., 2012). The results showed that the indicator variables for abdominal fat (TRFATP and WC) can be improved by more time spent in VPA. MPA in contrast had no significant influence on any body composition. These findings are contrary to the results of Saelens et al. (2007), where the abdominal fat of adults already decreased with higher MPA. However, Suliga (2009) emphasized that little is known about the accumulation of abdominal fat in children and further research is needed. This thesis showed that coloured children have significantly lower body composition values compared to mixed children. The body of black children seems to be more similar to mixed children. Differences in body compositions between ethnicity must be further evaluated, but South African data are still limited.

Hypotheses 5

The body compositions (WC, HC, FATP; TRFATP) and the time spent with sedentary activity influences the achievement of the WHOs physical activity guideline.

Only 35% of the girls achieved the physical activity guideline of 60 min MVPA per day. 71% of the boys spent at least the recommended daily time in MPVA. The results of the South Africa’s Report Card on Physical Activity 2014 showed that less than 50% and in the study of Shilubane et al. (2013) 42% of the children reached the WHO guideline. This study supports those findings, where 53% achieved the target. Further studies in different provinces in South

Africa found, that the achievement of the guideline was between 33% to 78% but mostly under 50% (Biljon et al., 2018). It has been found that 60 min with MVPA is not enough to reduce CVD risk factors and Füssenich et al. (2015) recommended an amount of 77 min in MVPA. Despite in many studies in the South African setting only a small rate of the schoolchildren could reach the WHO physical activity guideline, the dose-response cannot be answered conclusively. Further investigation should be made to answer this open question for an optimal health outcome. Additionally, different measurement methods could have influenced the finding. Some studies used self-reported questionnaires which can lead to an over reporting (Sallis & Saelens, 2000).

The significant discrepancies between gender have also been detected by the binominal logistic regression model. The gender and the daily time spent with sedentary activities are the sole significant predictors for achieving the WHO guideline. Surprisingly, the body composition did not show an influence on the achievement of the guideline. In contrast the study of Saelens et al. (2007) showed that leaner adolescent had a higher physical activity level. This in turn, may be linked to an increased likelihood to reach the WHO guideline. As seen in the results of Hypotheses four, more time spent with VPA do improve the body compositions, but better body compositions did not increase the probability of reaching the guideline significantly. A clear dose-respond is not exactly known. The causes remain to be further investigated. In an additional model with the same variables excluding the sedentary activity, the WC was found to be a statistically significant factor. With increased WC the chance to reach the WHO guideline was smaller.

The ethnicity groups are not significant predictors for the physical activity guideline. Black, mixed and coloured children have a similar probability to achieve the 60 min of MVPA per day. The study of Armstrong et al. (2006) found a higher overweight and obesity rate in black children, which is similar to these results, where higher body compositions were found among black and mixed children. Significant differences in the time spent in physical activity between ethnicities of the children (white & black) in different provinces in South Africa were found in the study of Biljon et al. (2018).

Kruger et al. (2006) emphasized the importance to identify children on a higher overweight risk at an early stage. To reduce the overweight risk, sedentary time has to be reduced, especially among girls who seem to be a high-risk group.

Key findings

Do primary schoolchildren reach the current physical activity guideline of 60 min in moderate to vigorous intensity?

53% of the primary schoolchildren spend 60 min with MVPA per day. The WHO guideline could not be achieved by 29% (n = 360) of the boys and 65% (n = 379) of the girls. Girls spend more time with sedentary activities while boys spend more time with higher intensities. Further results have shown that with increasing age, children spend more time with sedentary activity, usually at the expense of less time spent on light physical activity. Therefore, it can be assumed that older children, especially girls, spend more time with sedentary activities. Only the gender had a considerable influence on spending more time with higher physical activity. Similar results have been found in the logistic regression model. Only gender and time spent with sedentary activities where significant predictors whether a child reaches the WHO physical activity guideline. Variables, like body compositions, ethnicity, reported sick, and age did not influence the likelihood to reach the guideline.

How do physical activity patterns affect body composition among primary schoolchildren in marginalized neighbourhoods of Port Elizabeth, South Africa?

Contrary to expectation the daily time spent with sedentary activity improved the FATP. Per minute per day more spent with sedentary activities the FATP decreases by 0.013%-points. Furthermore, it has been shown that the daily time spend with LPA impaired the WC, HC and TRFATP. Only FATP improved by more time spent with LPA per day. It seems that LPA has a positive influence on FATP, but not on the other body compositions. The greatest impact on the body composition arises from VPA. Each minute per day spent with intense physical activity showed a 0.12 cm decrease in WC, a 0.27 cm decrease in HC, a 0.22%-point decrease in FATP and a 0.23%-point decrease in TRFATP, holding all the other variables constant.

6 Study limitations and strengths

The interpretation of the results has to be done carefully and with some additional information. This study is not representative for the whole of South Africa as it only contains results out of eight schools around Port Elizabeth in the Easter Cape. Furthermore, it is a cross-sectional study, which does not indicate causality. Also, it is important to keep in mind that these numbers of the result are not to be used for extrapolation outside of the given data range in the study.

The findings of this study have to be seen in light of some limitations. The primary limitation is that the accelerometer was worn over the hip which limits the ability to capture activities with little displacement of the body, such as cycling or weight training. Furthermore, the device must be removed for contact sports or swimming and therefore tend to underestimate the activity of the children. For an accurate output it would be important to know what the children did during their day. Therefore, an activity diary would help to gain valuable information about children's activity pattern. On the behavioural side, the study setting could be an additional motivational factor for the child to move more frequently during the measuring period and falsify the results. A second limitation is that the intensities of physical activity must be considered together with each other. The third limitation factor of the study is the comparable body composition values between children. For reliable values it is important to stand sober on the Tanita device. This factor is difficult to verify in the study setting, except of asking the children. When considering the circumstances in the study setting such as educational background, missing parental support and language barriers the methods and measurements chosen can be seen as appropriate.

The main strength of this study is the large sample size. In total 985 children were measured during the baseline assessment. After cleaning the data for this master thesis (Figure 6) 739 children remain in the scope of the study. The study sample contained 379 (51%) girls and 360 (49%) boys and shows an equal distribution of gender. Through the systematic data cleaning and the standardised methods, the quality of the study is ensured and therefore it can be compared to other studies with similar conditions. Additionally, the double-entering of the data help to ensure clean data. All the measurements for body compositions where made by a trained research team which minimalized the bias, especially for the circumferences which are very error prone (Lobstein et al., 2004). A strength of the Tanita scale is the objectivity as the measurements run automatically and independent on measuring person. Furthermore, measure mistakes are indicated on the scale.

7 Conclusion and outlook

The burden of child obesity in developing countries is increasing dramatic. A sedentary lifestyle is gaining popularity and therefore risk factors for non-communicable diseases increase (Tathiah et al., 2013). With less movement, abdominal fat is expanding, which in turn is related to cardiovascular risks (Saelens et al., 2007). The aim of this master thesis is to provide an overview of physical activity patterns of schoolchildren among marginalized communities in Port Elizabeth, South Africa, and to identify the effect on body composition, such as abdominal fat.

This study showed that 53% of the study participants achieved the WHO guideline, with 35% of all girls and 71% of all boys. It was found that boys, on average, spend more time in all levels of physical activities, while girls devote more of their time to sedentary activities. These findings are in line with Kimani-Murage (2013) and shows that children in the study setting engage in insufficient amounts of MVPA per day. With increasing age, children spend more time in sedentary activity, usually at the expense of time spent on light physical activity. Kimani-Murage (2013) emphasised the relationship between the onset of puberty and the decreased physical activity in age and especially among girls. These results support the goal of promoting physical activity among high risk groups identified in this study as girls and children that spent too much time in sedentary activities, if the aim is to avoid overweight in adolescents from this study population. Further causes in the South African setting, for the decreased physical activity in age and gender, such as safety problems, access and affordable sport programs must be considered (Menschik et al., 2008). Furthermore, increased time spent with LPA has a positive correlation with WC, HC, and TRFATP and a negative correlation with FATP. It can be assumed that FATP is more sensitive than TRFATP. Another possible explanation would be that the role of LPA seems to be ambivalent for the health, when it replaces the sedentary activity and not the time spent in MVPA (McGregor et al., 2018). Moderate and vigorous activity levels stay constant throughout the age studied. Especially VPA showed a strong and statistically significant effect on all body composition. These findings were confirmed with similar results in the study of Ferarri et al. (2015). Although the exact amount of physical activity for optimal health is unclear (Ekelund et al., 2012), it can be assumed that higher amounts or intensities have greater benefit on metabolic risk profile (WHO, 2018). To understand the influence of physical activity intensities on the body compositions of children and the associated health risk, further research is needed.

In a further step, the baseline data of this study can be compared with the data after the intervention of the KaziBantu study. High blood pressure is a cardiovascular risk factors sign which can already appear in childhood. To get a better overview of the cardiovascular risk factors in primary schoolchildren the blood pressure could be compared additionally. Furthermore, to evaluate the influence of the school environment such as playground and physical activity opportunities the eight schools could be compared. Additionally, to determine physical activity differences during school hours and leisure time the accelerometer data could be separated in the analyses. With an activity diary and the described separated school and leisure time more information for further intervention steps could be gained.

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Appendix

Appendix 1: Multiple regression model of the hypotheses 3

Table 1

Results of the regression analysis for light physical activity

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.231[a]	0.054	0.047	35.988

a. Predictors: (Constant), Ethnicity Colored, Age, Reported Sick, Female, Ethnicity Black

b. Dependent Variable: Light Day

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	53670.628	5	10734.126	8.288	,000[b]
	Residual	949347.232	733	1295.153		
	Total	1003017.860	738			

a. Dependent Variable: Light Day

b. Predictors: (Constant), Ethnicity Colored, Age, Reported Sick, Female, Ethnicity Black

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	328.369	13.835		23.735	0.000	301.209	355.529
	Age	-6.379	1.211	-0.191	-5.268	0.000	-8.755	-4.002
	Female	-9.424	2.676	-0.128	-3.522	0.000	-14.677	-4.171
	Reported Sick	1.732	3.202	0.020	0.541	0.589	-4.554	8.018
	Ethnicity Black	5.174	3.987	0.068	1.298	0.195	-2.654	13.002
	Ethnicity Colored	-1.291	4.523	-0.015	-0.285	0.775	-10.171	7.589

a. Dependent Variable: Light Day

Annotation. Light time in minutes and per day, Age: from 8 to 13-year olds, Gender: as reference category male. Ethnicity: as reference category mixed. Reported sick: headache, cough, stomach pain, fever.

Table 2

Results of the regression analysis for moderate physical activity

Model Summary[b]				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.429[a]	0.184	0.179	13.515

a. Predictors: (Constant), Ethnicity Colored, Age, Reported Sick, Female, Ethnicity Black

b. Dependent Variable: Moderate Day

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	30265.242	5	6053.048	33.141	,000[b]
	Residual	133879.542	733	182.646		
	Total	164144.783	738			

a. Dependent Variable: Moderate Day

b. Predictors: (Constant), Ethnicity Colored, Age, Reported Sick, Female, Ethnicity Black

Coefficients[a]								
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	54.424	5.195		10.476	0.000	44.225	64.624
	Age	-0.466	0.455	-0.035	-1.025	0.306	-1.359	0.426
	Female	-12.703	1.005	-0.426	-12.643	0.000	-14.676	-10.731
	Reported Sick	-0.787	1.202	-0.022	-0.655	0.513	-3.148	1.573
	Ethnicity Black	1.512	1.497	0.049	1.010	0.313	-1.428	4.452
	Ethnicity Colored	2.505	1.699	0.072	1.475	0.141	-0.830	5.840

a. Dependent Variable: Moderate Day

Annotation. Moderate time in minutes and per day, Age: from 8 to 13-year olds, Gender: as reference category male. Ethnicity: as reference category mixed. Reported sick: headache, cough, stomach pain, fever.

Table 3

Results of the regression analysis for vigorous physical activity

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.433[a]	0.188	0.182	10.038

a. Predictors: (Constant), Ethnicity Colored, Age, Reported Sick, Female, Ethnicity Black

b. Dependent Variable: Vigorous Day

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	17046.789	5	3409.358	33.839	,000[b]
	Residual	73851.150	733	100.752		
	Total	90897.940	738			

a. Dependent Variable: Vigorous Day

b. Predictors: (Constant), Ethnicity Colored, Age, Reported Sick, Female, Ethnicity Black

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	30.280	3.859		7.847	0.000	22.705	37.856
	Age	-0.542	0.338	-0.054	-1.604	0.109	-1.205	0.121
	Female	-9.640	0.746	-0.434	-12.917	0.000	-11.105	-8.175
	Reported Sick	-0.269	0.893	-0.010	-0.302	0.763	-2.022	1.484
	Ethnicity Black	0.626	1.112	0.027	0.563	0.574	-1.557	2.810
	Ethnicity Colored	0.805	1.262	0.031	0.638	0.524	-1.672	3.282

a. Dependent Variable: Vigorous Day

Annotation. Vigorous time in minutes and per day, Age: from 8 to 13-year olds, Gender: as reference category male. Ethnicity: as reference category mixed. Reported sick: headache, cough, stomach pain, fever.

Appendix 2: Multiple regression model of the hypotheses 4

Table 1

Results of the regression analysis for hip circumference

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,452[a]	0.204	0.194	8.836

a. Predictors: (Constant), Vigorous Day, Age, Ethnicity Black, Reported Sick, Light Day, Female, Ethnicity Colored, Sedentary Day, Moderate Day

b. Dependent Variable: HC

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	14592.710	9	1621.412	20.765	,000[b]
	Residual	56922.524	729	78.083		
	Total	71515.233	738			

a. Dependent Variable: HC

b. Predictors: (Constant), Vigorous Day, Age, Ethnicity Black, Reported Sick, Light Day, Female, Ethnicity Colored, Sedentary Day, Moderate Day

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	49.601	8.160		6.078	0.000	33.580	65.622
	Age	2.713	0.309	0.304	8.794	0.000	2.108	3.319
	Female	2.081	0.741	0.106	2.808	0.005	0.626	3.537
	Reported Sick	-1.491	0.787	-0.063	-1.895	0.059	-3.037	0.054
	Ethnicity Black	-0.707	0.981	-0.035	-0.721	0.471	-2.634	1.219
	Ethnicity Colored	-3.537	1.118	-0.153	-3.164	0.002	-5.731	-1.342
	Sedentary Day	-0.009	0.009	-0.051	-0.992	0.322	-0.026	0.009
	Light Day	0.024	0.012	0.092	2.005	0.045	0.001	0.048
	Moderate Day	0.000	0.042	0.000	0.007	0.994	-0.083	0.083
	Vigorous Day	-0.266	0.050	-0.300	-5.288	0.000	-0.365	-0.167

a. Dependent Variable: HC

Annotation. Physical activity in minutes and per day, Age: from 8 to 13-year olds, Gender: as reference category female. Ethnicity: as reference category mixed. Reported sick: headache, cough, stomach pain, fever.

Table 2

Results of the regression analysis for total body fat percentage

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,516[a]	0.266	0.257	6.060

a. Predictors: (Constant), Vigorous Day, Age, Ethnicity Black, Reported Sick, Light Day, Female, Ethnicity Colored, Sedentary Day, Moderate Day

b. Dependent Variable: FATP

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9706.743	9	1078.527	29.373	,000[b]
	Residual	26767.920	729	36.719		
	Total	36474.663	738			

a. Dependent Variable: FATP

b. Predictors: (Constant), Vigorous Day, Age, Ethnicity Black, Reported Sick, Light Day, Female, Ethnicity Colored, Sedentary Day, Moderate Day

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	32.377	5.596		5.786	0.000	21.391	43.363
	Age	-0.153	0.212	-0.024	-0.722	0.470	-0.568	0.263
	Female	3.232	0.508	0.230	6.358	0.000	2.234	4.230
	Reported Sick	0.133	0.540	0.008	0.246	0.806	-0.927	1.193
	Ethnicity Black	-0.055	0.673	-0.004	-0.082	0.935	-1.376	1.266
	Ethnicity Colored	-1.543	0.767	-0.094	-2.012	0.045	-3.047	-0.038
	Sedentary Day	-0.013	0.006	-0.102	-2.057	0.040	-0.025	-0.001
	Light Day	0.018	0.008	0.096	2.182	0.029	0.002	0.035
	Moderate Day	-0.029	0.029	-0.061	-0.989	0.323	-0.085	0.028
	Vigorous Day	-0.224	0.034	-0.354	-6.497	0.000	-0.292	-0.156

a. Dependent Variable: FATP

Annotation. Physical activity in minutes and per day, Age: from 8 to 13-year olds, Gender: as reference category female. Ethnicity: as reference category mixed. Reported sick: headache, cough, stomach pain, fever.

Table 3

Results of the regression analysis for visceral fat percentage

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.449[a]	0.202	0.192	6.261

a. Predictors: (Constant), Vigorous Day, Age, Ethnicity Black, Reported Sick, Light Day, Female, Ethnicity Colored, Sedentary Day, Moderate Day

b. Dependent Variable: TRFATP

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7227.359	9	803.040	20.484	,000[b]
	Residual	28578.882	729	39.203		
	Total	35806.241	738			

a. Dependent Variable: TRFATP

b. Predictors: (Constant), Vigorous Day, Age, Ethnicity Black, Reported Sick, Light Day, Female, Ethnicity Colored, Sedentary Day, Moderate Day

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	25.896	5.782		4.479	0.000	14.544	37.248
	Age	0.025	0.219	0.004	0.115	0.909	-0.404	0.454
	Female	1.812	0.525	0.130	3.451	0.001	0.781	2.844
	Reported Sick	0.063	0.558	0.004	0.113	0.910	-1.032	1.158
	Ethnicity Black	-0.013	0.695	-0.001	-0.018	0.985	-1.378	1.352
	Ethnicity Colored	-1.616	0.792	-0.099	-2.040	0.042	-3.171	-0.061
	Sedentary Day	-0.012	0.006	-0.099	-1.908	0.057	-0.024	0.000
	Light Day	0.019	0.009	0.100	2.191	0.029	0.002	0.036
	Moderate Day	-0.027	0.030	-0.058	-0.906	0.365	-0.086	0.032
	Vigorous Day	-0.227	0.036	-0.361	-6.364	0.000	-0.297	-0.157

a. Dependent Variable: TRFATP

Annotation. Physical activity in minutes and per day, Age: from 8 to 13-year olds, Gender: as reference category female. Ethnicity: as reference category mixed. Reported sick: headache, cough, stomach pain, fever.

Appendix 3: Clinical examination sheet

KaziBantu Project; Field Testing; version of 21/11/2018 Page 2 / 2 ☒ CATCH-UP ☐ COMPLETE

PARTICIPANT EVALUATION – FITNESS SCORE SHEET

BIOGRAPHICAL INFORMATION			
ID STICKER	[redacted]	TEST DATE	(dd / mm): 20 / 02 / 2019
WEATHER CONDITIONS	☐ Hot ☐ Overcast ☐ Drizzling ☒ Extremely Windy ☐ Cold		

PHYSICAL FITNESS TESTS						
			Tick Dominant Hand	TRIAL 1	TRIAL 2	TRIAL 3
Station 1	Muscular Strength	Grip Strength (kg)	☒ Right	22	18	17
			☐ Left	20	18	20

Station 2	Cardiorespiratory Fitness	Shuttle Run (completed laps)	Bib Number	6
			Cumulative Laps	17

Special Notes:

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KaziBantu Project; Field Testing; version of 21/11/2018 Page 1 / 2 ☒ CATCH-UP ☐ COMPLETE

KaziBantu

CLINICAL EXAMINATION – INDIVIDUAL SHEET FOR MONITORING

TEST DATE (dd/mm): 20 / 02 /2019

DONE BY INVESTIGATOR:

- Did you have something to eat at home this morning before school? ☒ yes ☐ no
- Did you go to bed hungry last night? ☐ yes ☒ no
- How many meals did you eat yesterday? 3

FUNCTIONAL SIGNS BY NURSE:

Do you have any of the following health complaints right now?

Fever	☐ yes ☒ no
Vomiting	☐ yes ☒ no
Allergy	☐ yes ☒ no
Cough	☒ yes ☐ no
Blood in the stool	☐ yes ☒ no
Problems with breathing	☐ yes ☒ no
Diarrhea	☐ yes ☒ no
Belly ache	☐ yes ☒ no
Headache	☐ yes ☒ no
Nausea	☐ yes ☒ no
Vertigo	☐ yes ☒ no

- Gender: ☒ FEMALE ☐ MALE
  IF FEMALE ask for menarche: ☐ yes ☒ no
  First menstrual period date: ________/________ (mm/yyyy)
- Taking medication (last week): ☐ yes ☒ no
  If "yes", please specify the name or description of medication.
  Against worms: ____________ Other: ____________

DONE BY NURSE/BIOKINETICIST:

Temperature: 36.7 °C

Pulse 1: 96 bpm	Blood Pressure 1 (DIA): 68 / (SYS): 105 mmHg
Pulse 2: 92 bpm	Blood Pressure 2 (DIA): 65 / (SYS): 100 mmHg
Pulse 3: 93 bpm	Blood Pressure 3 (DIA): 62 / (SYS): 100 mmHg

PHYSICAL EXAMINATION BY NURSE:

Conjunctiva 0
(0=normal, 1=moderately colored, 2=slightly colored, 3=pale or slightly colored)

Jaundice (0=no, 1=sub-jaundice, jaundice franc=2) 0

Splenomegaly (0-5) 0

Hepatomegaly (0-4) 0

Skin lesions (0=no, 1=presence, specify) 0

Pulmonary auscultation (0=no, 1=presence, specify) 0

Cardiac auscultation (0=no, 1=presence, specify) 0

DONE BY NURSE/DOCTOR

(Clearance to participate in maximal exertion test)

Included ✓

Excluded (pattern) ____________

Name of the nurse / doctor in block letters: [illegible]

Signature of the nurse/doctor: [signature]

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Declaration of authenticity

I hereby declare that I have prepared the submitted work independently and have used no other than the tools specified in the work. I have marked all passages that were taken literally or by analogy from sources as such. In addition, I certify that the submitted work has not been submitted to any other university than a seminar, project or dissertation or as part of such work. I am aware that plagiarism according to § 25 of the Regulations for the Master Program «Sport, Exercise and Health» at the Faculty of Medicine of the University of Basel dated 19 December 2016 is considered unfair examination behaviour and I know the consequences of such action.

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Date: 14th October 2019 Signature:

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Date: 14th October 2019 Signature:

Relation between physical activity patterns and body composition among primary schoolchildren in marginalized neighbourhoods of Port Elizabeth, South Africa

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University of Basel | DSBG Universität Basel Departement für Sport, Bewegung und Gesundheit | KaziBantu Healthy Schools for Healthy Communities | NOVARTIS | The Novartis Foundation

Background

- In South Africa a transition from a rural lifestyle to an adoption of an urban way of life is taking place. The changes include the reduction of physical activity, an increased sedentary lifestyle and the change in food consumption habits (Draper et al. 2018).
- Each year 1.6 million deaths are attributed to insufficient physical activity. With more sedentary activity risk factors for non-communicable diseases increase (WHO, 2011).
- With less movement abdominal fat and total body fat is expanding, which in turn is related to cardiovascular risks.
- The Word Health Organization (WHO) formulated physical activity guidelines for 5 to 17 years old children and adolescent with the recommendation to spend at least 60 minutes per day in moderate-to-vigorous physical activity (MVPA) to improve health and reduce the cardiovascular risk factors (WHO, 2010).

Research hypothesis

The study will provide insights into the following:

- Age and gender have a significant influence on the time spent between different intensities of physical activity.
- Body compositions have a negative relation on the time spent with more intense physical activity.
- The body compositions and the time spent with sedentary activity influences the achievement of the WHO's physical activity guideline.

Figure 1: KaziBantu study setting (KaziBantu, 2018).

Aim

The goal of this master thesis is to provide an overview of physical activity patterns of schoolchildren among marginalized communities in Port Elizabeth, South Africa and to identify their effect on body compositions such as the total body and trunk fat percentage as well as the waist and hip circumference.

Figure 2: Physical activity on the playground, study setting (KaziBantu, 2018).

Methods

Research design

- Randomized controlled trial.

Setting and sample

- Conducted in eight quintile 3 primary schools.
- Located in disadvantaged communities in the northern areas and townships of Port Elizabeth, South Africa.
- Approximately 1,000 schoolchildren, aged 8 - 13 years were recruited to participate.

Data collection

- Baseline assessment from February to March 2019.

Measuring instruments

Anthropometry	Body composition, waist and hip circumference.
Physical activity	Objectively assessed physical activity.

Study design

- Cross-sectional survey refers to figure 3.

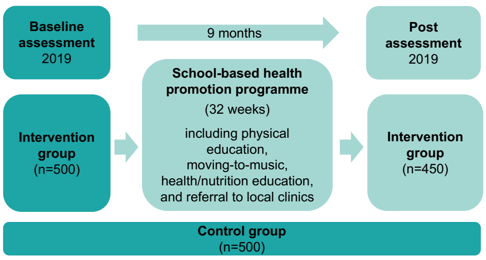

Figure 3: Overview of the KaziBantu study design with the baseline assessment, 9-month intervention time, and post assessment. The results of this master thesis occur from of the baseline assessment in the intervention and control group. (Müller et al., 2019)

Descriptive statistics

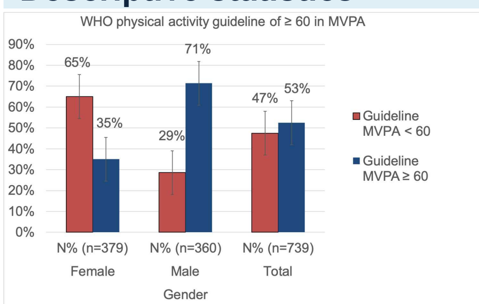

Figure 4: The graph shows a descriptive statistic, according to the WHO physical activity guideline to spend ≥ 60min in moderate-to-vigorous physical activity (MVPA) per day. blue bar = reached guideline, red bars = failed guideline, N% = Counts in percentage. (own graph)

Results

The following results will answer the hypothesis:

Physical activity (PA)

- Boys → Light PA, moderate PA, vigorous PA ↑
- Girls → Sedentary activity ↑

Age ↑

- Sedentary activity ↑
- Light PA ↓

Legend
↑ = increase
↓ = decrease

Light PA ↑

- Trunk fat percentage, waist & hip circumference ↑
- Total body fat percentage ↓

Vigorous PA ↑ (see Figure 4)

- Total body fat percentage, trunk fat percentage and waist & hip circumference ↓

Likelihood to achieve the WHO Guidelines

- No influence: Body compositions
- Gender (female), time spent in sedentary activity ↓

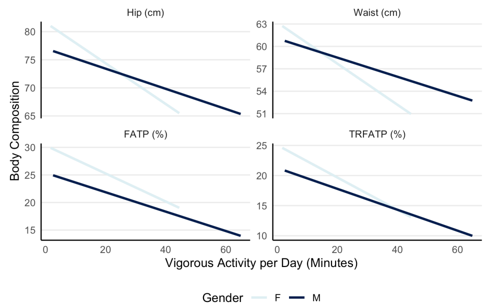

Figure 4: The figure above shows the influence of vigorous physical activity on body composition, separated by gender. An increase in the time spent with vigorous physical activity is associated with a reduction in overall body composition (hip and waist circumference, total body (FATP) and trunk fat percentage (TRFATP). Next to the boys (M) especially girls (F) can benefit from a reduction of the hip and waist circumference during the time spent in high intense physical activity. Attention, the scales for the y axes are different per plot. (own graph)

Conclusion

Boys already spend a large part of their time with physical activity, especially when they are younger. Therefore, girls should be in the focus of physical activity interventions, if the aim is to avoid overweight from adolescents in this study population. Also, an effective intervention would be to increase vigorous activity, as this showed the largest influence on body composition. To achieve further comparisons and to evaluate the consequences on health, according to the time spend with sedentary activity, there is more data of South African children in marginalized communities needed.

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