Physical activity, health-related fitness and social correlates among adolescents: the PAHL study

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It all starts here ™

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To God be the Glory.

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Dedications

I would like to dedicate this thesis to the memory of my late father, Mr. Boxsen Daniel Mashego. He taught me the value of education and motivated me to continue striving higher even when I wanted to give up.

Declaration

Prof. M.A. Monyeki (promoter) and Prof. A.L. Toriola (co-promoter), co-authors of the three articles which form part of this thesis, hereby give permission to the candidate, Mrs H.T. Skaal to include the articles as part of a doctoral thesis. The contribution of each co-author, both supervisory and supportive, was kept within reasonable limits and included:

Mrs HT Skaal:	Developing the proposal, interpretation of the results, writing of the manuscript and the thesis;
Prof MA Monyeki:	Principal investigator for PAHL Study, did statistical analyses, helped with interpretation of the data, commented on the thesis and contributed inputs in the write-up of the articles;
Prof AL Toriola:	Contributed in the write-up of the articles.

This thesis, therefore, serves as fulfilment of the requirements for the PhD degree in Human Movement Science within Physical, Activity, Sport and Recreation (PhASRec) in the Faculty of Health Sciences at the North-West University, Potchefstroom Campus.

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Abstract

Research has shown that social correlates of physical activity play an important role in individual participation in physical activity or sport, hence their link with associated health benefits. However, in spite of the health benefits associated with physical activity, many children do not meet the daily guidelines of being active for at least 30 minutes a day. This study investigated physical activity, health-related fitness and social correlates among 284 adolescents (111 boys and 173 girls) who are part of the on-going Physical Activity and Health Longitudinal Study (PAHLS). Height, weight, skinfold thickness (triceps, subscapular and calf skinfolds), waist and hip circumferences were measured through the standard procedures described by the International Standards of Advancement of Kinanthropometry (ISAK). Body mass index (BMI), waist-to-hip ratio (WHR) and percentage body fat (%BF) were used as measures of body composition. Health-related physical fitness (HRPF) was determined by measuring cardio-respiratory endurance, muscle strength and endurance, and flexibility using standardised tests according to the EUROFIT (1988) test protocol. The standardised International Physical Activity Questionnaire (IPAQ-Short form) and Social Support for Physical Activity questionnaire were used to gather information on participation in physical activity and social correlates for physical activity respectively.

The results show that 29.6% of the adolescents were underweight and 26.4% overweight. Girls were significantly ($p<0.05$) fatter (%BF and BMI) and shorter than the boys. A significant gender difference ($p<0.05$) was also observed in WHR. Thirty four percent (34%) participated in low PA with 35% in high PA. Boys were significantly (z-4.52; $p=0.000$) more highly active compared to the girls. Boys measured significantly higher than girls ($p<0.05$) in SBJ, BAH, SUP, predicted $\dot{V}O_{2max}$. Adolescents' participation in physical activity was affected by *'lack of support by friends', 'encouragement by friends or family members' and 'lack of support during engagement in physical activity'*. A significant difference ($p<0.05$) was found between boys and girls regarding *'friends' encouragement to do physical activity or sports', 'participation in physical activity or sports with friends'* and *'friends' confirmation that the participant is doing a*

good job at physical activity'. Positive correlations were found between Total Physical Activity (TPA) and all social correlates of PA, with a significant relationship between total physical activity (TPA) and *'how often do your friends tell you that you are doing a good job at physical activity?'*, and *'has someone told you that you are doing well in physical activity?'* percentage body fat was negatively associated with social correlates of physical activity with a significant relationship in contrast with '*friends' encouragement that one is doing a good job at physical activity'*. A significant positive correlation was observed between WC, WHR, SBJ, SUP, predicted $\dot{V}O_{2max}$ and *'friends' encouragement in a typical week to do physical activity or sports'*. Further significant positive correlations were found with WC for *'encouragement by someone in a typical week to do physical activity or sports'*; WHR, SBJ, BAH, SUP, predicted $\dot{V}O_{2max}$ for *'participation in physical activity or sports with friends'*; SBJ, SUP, predicted $\dot{V}O_{2max}$ for '*friends' encouragement that one is doing a good job at physical activity';* SBJ, SUP, predicted $\dot{V}O_{2max}$ for '*someone's encouragement that one is doing a good job at physical activity';* BAH, SUP, predicted $\dot{V}O_{2max}$ for *'someone's participation in sport with one';* SUP, predicted $\dot{V}O_{2max}$ for *'one's encouragement to friends to participate in physical activity or sport'*; SUP for '*provision of transportation to physical activity or sport'; and predicted* $\dot{V}O_{2max}$ for *'someone watching one participate in physical activity or sport'*. SAR, on the other hand, was negatively associated with all social correlates for physical activity.

It can be concluded that the adolescent boys in the study were underweight and significantly more active when compared to the relatively overweight and inactive girls. Boys also have higher health-related fitness and higher social correlates compared to the girls. Social correlates for physical activity were positively associated with participation in physical activity and health-related physical fitness variables. Thirty six percent (36%) of the participants indicated lack of transport as a negative factor for their participation in physical activity and sport. Based on these findings, urgent strategic public health intervention by all stakeholders dealing with adolescents, as well as more research studies in the area, is required.

Keywords: Physical activity, sport, health-related fitness, social support, correlates, adolescents.

Opsomming

Navorsing toon dat sosiale korrelate van fisieke aktiwiteit 'n belangrike rol speel in individuele deelname in fisieke aktiwiteite of sport en dus geassosieer word met gesondheidsvoordele. Ten spyte van die gesondheidsvoordele wat met fisieke aktiwiteit assosieer word, is daar egter vele kinders wat nie die daaglikse riglyn van ten minste 30 minute fisieke aktiwiteit per dag haal nie. Hierdie studie het die fisieke aktiwiteit, gesondheidverwante fiksheid en sosiale korrelate onder 284 adolessente (111seuns en 173 meisies) wat deel van die voortgaande Fisieke Aktiwiteit en Gesondheid Longitudinale Studie (PHALS) is, ondersoek. Lengte, gewig, velvou dikte (triseps-, subskapulêr- en kuitvelvoue), middel- en heupomtrek is gemeet volgens die standaard prosedures soos voorgeskryf deur die Internasionale Standaarde vir Bevordering van Kinantropometrie (ISAK). Liggaammassa-indeks (LMI) (gewig/lengte^2), middel-tot-lengte ratio (MLR) en persentasieliggaams vet (%LV) is gebruik as mates van liggaamsamestelling. Gesondheidsverwante fisieke aktiwiteit (GFA) is bepaal deur die kardiorespiratoriese uithouvermoë, spierkrag en –uithouvermoë en soepelheid te meet deur middel van gestandaardiseerde toetse volgens die EUROFIT (1988) toetsprotokol. Die gestandaardiseerde Internasionale Fisieke Aktiwiteit Vraelys (IPAQ – short form) en Sosiale Ondersteuning vir Fisieke Aktiwiteit vraelys is onderskeidelik gebruik om inligting in te insamel rakende deelname in fisieke aktiwiteit en sosiale korrelate vir fisieke aktiwiteit.

Die resultate toon dat 29.6% van adolessente ondergewig was en 26.4% oorgewig. Meisies was betekenisvol ($p<0.05$) vetter (%LV en LMI) en korter as seuns. 'n Betekenisvolle geslagsverskil ($p<0.05$) was ook waargeneem in MLR. Vier en dertig (34%) het in lae FA deelgeneem en 35% in hoë FA. Seuns was betekenisvol (z-4.52; p=0.000) meer aktief in vergelyking met meisies. Seuns het betekenisvol beter presteer ($p<0.05$) as meisies in standverspring (SBJ), buig-arm-hang (BAH), opsitte (SUP) en voorspelde $\dot{V}O_{2max}$. Adolessente se deelname in fisieke aktiwiteit was beïnvloed deur *"tekort aan aanmoediging deur vriende", "aanmoediging deur vriende en familie"* en *"tekort aan aanmoediging tydens deelname aan fisieke aktiwiteit"*. 'n Betekenisvolle verskil ($p<0.05$) is gevind tussen seuns en meisies in terme van *"vriende se aanmoediging om deel te neem aan fisieke aktiwiteit en sport", "deelname aan fisieke aktiwiteit en sport saam met vriende" en "vriende se bevestiging dat die deelnemer goed doen tydens fisieke aktiwiteit"*. Positiewe korrelasies is gevind tussen totale fisieke aktiwiteit (TFA). TFA en alle sosiale korrelate van FA, met 'n betekenisvolle verhouding tussen TFA en *"hoe gereeld vertel jou vriende vir jou dat jy goed doen tydens 'n aktiwiteit?" en " het iemand al vir jou gesê dat jy goed doen tydens*

fisieke aktiwiteit?". Vet persentasie (%LV) het 'n negatiewe assosiasie met sosiale korrelate van fisieke aktiwiteit getoon met 'n betekenisvolle verhouding in teenstelling met *"vriende se aanmoediging dat 'n persoon goed doen tydens 'n fisieke aktiwiteit"*. 'n Betekenisvolle positiewe korrelasie is waargeneem tussen middelomtrek, middel- en heupomtrek, standverspring, opsitte, voorspelde $\dot{V}O_{2max}$, en *"vriende se aanmoediging tydens 'n tipiese week om aan fisieke aktiwiteit of sport deel te neem"*. Verder is betekenisvolle positiewe korrelasies gevind met WC vir *"aanmoediging deur iemand tydens 'n tipiese week om aan fisieke aktiwiteit of sport deel te neem";* middel- en heupomtrek, standverspring, buig-arm-hang, opsitte, voorspelde $\dot{V}O_{2max}$ vir *"deelname in fisieke aktiwiteit of sport saam met 'n vriend"*; standverspring, opsitte, voorspelde $\dot{V}O_{2max}$ vir *"vriende se aanmoediging dat die deelnemer goed doen tydens fisieke aktiwiteit"*; standverspring, opsitte, voorspelde $\dot{V}O_{2max}$ vir *"iemand se aanmoediging dat die deelnemer goed doen tydens fisieke aktiwiteit"*; buig-arm-hang, opsitte, voorspelde $\dot{V}O_{2max}$ vir *"iemand se deelname in sport saam met 'n andere"*; opsitte, voorspelde $\dot{V}O_{2max}$ vir *"'n persoon se aanmoediging aan vriende om aan fisieke aktiwiteit of sport deel te neem";* opsitte vir *"iemand wat na 'n persoon kyk tydens deelname in fisieke aktiwiteit of sport"*. Sit-en-reik, in teenstelling, het 'n negatiewe assosiasie met alle sosiale korrelate vir fisieke aktiwiteit getoon.

Daar kan afgelei word dat die adolessente seuns in die studie ondergewig en betekenisvol meer aktief is in vergelyking met die relatiewe oorgewig en onaktiewe meisies. Seuns toon ook hoër gesondheidsverwante fiksheid en hoër sosiale korrelate in vergelyking met die meisies. Sosiale korrelate vir fisieke aktiwiteit toon 'n positiewe assosiasie met deelname aan fisieke aktiwiteit en gesondheidverwante fisieke fiksheidsveranderlikes. Ses en dertig (36%) van die deelnemers het aangedui dat 'n tekort aan vervoer 'n negatiewe faktor in hul deelname aan fisieke aktiwiteit en sport was. Op grond van hierdie bevindings is ernstige strategiese gesondheidsintervensies deur alle rolspelers wat met adolessente werk, sowel as meer navorsing in hierdie areas, nodig.

Sleutelwoorde: fisieke aktiwiteit, sport, gesondheid-verwante fiksheid, sosiale ondersteuning, korrelate, adolessente

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List of abbreviations

%BF	Percentage Body Fat
BAH	Bent Arm Hang
BMI	Body Mass Index
CDC	Center for Disease Control
HR	Heart Rate
HRPF	Health-Related Physical Fitness
IPAQ	International Physical Activity Questionnaire
IPAQ-A	International Physical Activity Questionnaire modified for Adolescents
ISAK	International Standards of Advancement of Kinanthropometry
MVPA	Moderate to Vigorous Physical Activity
PA	Physical Activity
PAHLS	Physical Activity and Health Longitudinal study
PE	Physical Education
SAR	Sit and Reach
SBJ	Standing Broad Jump
SD	Standard Deviation
SPSS	Statistical Package for the Social Sciences
SUP	Sit Up Test
TPA	Total Physical Activity
$\dot{V}O_{2max}$	Maximal Oxygen Consumption
WC	Waist Circumference
WHO	World Health Organization
WHR	Waist-to-Hip ratio

CHAPTER 1: INTRODUCTION

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1.1 INTRODUCTION

Physical inactivity is a global health problem and contributes to overweight or obesity, which in turn can increase the risk for diabetes, high blood pressure, high cholesterol, asthma, arthritis, mental decline and poor health status (WHO, 2009:10). The poor health status derived from these diseases may increase the risk for dying of heart disease prematurely, and developing breast or colon cancer (Kesaniemi *et al., 2001:*S351; Horn *et al.,* 2008:275). The World Health Organization (WHO) (2009:10) states that globally around 31% of adults aged 15 and over are insufficiently active (men 28% and women 34%). As a result, approximately 3.2 million deaths each year are attributable to insufficient physical activity (Mozaffarian *et al.,* 2012:1515). The health problem is not limited to adults; in children, physical inactivity is one of the leading factors in childhood overweight and obesity and contributes to the development of metabolic syndrome amongst the youth (defined as the clustering of 3 or more risk factors, including adiposity, hypertension, hyperglycemia, low high-density lipoprotein cholesterol, and high triglycerides) (Aires *et al.,* 2011:S198). Overweight and

obesity also have psychological consequences, including low self-esteem, depression, and body dissatisfaction (Antonogeorgos *et al*., 2010:633).

Physical activity is defined as any bodily movement produced by skeletal muscles that results in energy expenditure. Physical activity in daily life is categorised into occupational, sports, conditioning, household, or other activities (Casperson *et al.,* 1985:127). Physical activity, for purposes of this research will only focus on the sports dimension.

Participation in physical activity by adolescents is negatively affected by barriers such as cost, poor access to activity or facilities, lack of core physical literacy skills, growth in technology-related sedentary activities and social correlates to participation in physical activity or sport (Charlton *et al.,* 2014: 773). Sallis, *et al.* (2000:973) summarised the most influential social correlates to adolescent participation in physical activity as support from social (i.e. peers, parents and teachers) and physical (e.g. availability of PA equipment and facilities) environments. These two most influential factors were thus investigated in this study.

1.2 PROBLEM STATEMENT

South Africa is not different to the global picture. In 2003, the International Physical Activity Questionnaire (IPAQ) was administered in South Africa as part of the World Health Survey to a representative sample of South Africans (Steyn *et al.,* 2006:25). The South African data included samples from urban and rural communities. The survey found that less than one-third of South Africans met the American College of Sports Medicine and Center for Disease Control's recommendation for health-enhancing physical activity (to accumulate 30 minutes of moderate activity on most, but preferably all days of the week), and that nearly half were reportedly inactive (46%). The South African Youth Risk Behaviour Study (2002) also found that 38% of youth participated in insufficient or no physical activity (within the past week) while 25% reported watching TV for more than three hours per day (Reddy *et al*, 2012:264). A South African study by Joubert *et al.* (2007:729) also found that 30% of ischaemic heart disease, 27% of colon cancer, 22% of ischaemic stroke, 20% of Type 2 diabetes, and 17% of breast cancer could be attributed to physical inactivity. The study estimated that 3.3% of all deaths in 2000 could be attributed to physical inactivity. Physical

inactivity thus ranked 9th in terms of attributable deaths compared with other risk factors among South African adults.

Physical activity has been shown to decrease with age in children. Among girls, in particular, participation in leisure time physical activity has been shown to decline by about 45% between the ages 12-17 with a sharp decline in early adolescence. Physical activity has been found to decline from the ages of 11-12 (Neissar *et al.,* 2011:332) with sexual maturation and objectified body consciousness among adolescents associated with lower participation in physical activity (Visagurskiene *et al.,* 2012:74).

The United States Department of Health and Human Services' report of the Surgeon general (1996:14) states that influences on physical activity patterns among adults, youth and children include self-efficacy (the belief that one can perform a specified behaviour in a specified situation), enjoyment of physical activity, social support, believing in the benefits of physical activity, and a lack of perceived barriers to physical activity. Janauskas (2013:1020-1021), in a study conducted on Lithuanian students, found that the reasons for physical inactivity were laziness, not having enough time, being dissatisfied with sports facilities, having an insufficient choice of sport clubs, and unwillingness to participate in sport. Dwyer *et al.* (2006:79-83) investigated adolescent girls' perceived barriers to participation in physical activity and also found that lack of time, involvement in technology-related activities, peer influence, parents and teachers, safety concerns, inaccessibility of facilities and the cost thereof, competition, and body-centeredness all impeded adolescent girls from participating in sport.

Physical inactivity is not only a first-world problem. In Kenya it was found that urbanisation has led to decreasing levels of physical activity, partly due to insufficient leisure time available for physical activity, and an increase in sedentary behaviour during occupational and domestic activities (Ojiambo *et al.,* 2012:121). In South Africa, the demise of school sport and the lack of sporting facilities, especially in black schools have also contributed to physical inactivity amongst children and youth (Sport and Recreation South Africa: National Sport and Recreation Plan, 2011:8). Shirinde *et al.* (2012:236) examined physical activity specifically among South African children attending farm schools, and found that the majority of respondents cited lack of time, the demands of work or schoolwork and lack of skills as the major determinants of physical inactivity.

Physical inactivity also creates a huge economic burden. Allender *et al.* (2007:471) found that the estimated direct cost of physical inactivity to the United Kingdom National Health Service was £1.06 billion in 2004, while a study commissioned by Medibank Private, Australia (also conducted in 2004), found that physical inactivity cost the Australian healthcare system $1.5 billion (Zheng *et al.,* 2009:187). Physical activity is therefore a very important variable of public health and cannot be ignored. In South Africa, a key finding from a study conducted by the health insurance company Discovery Health, was that a higher level of participation in the various components of a health insurance-initiated health promotion program (Vitality) was associated with lower health-care costs, compared with no participation, or little participation in the program. This association was most evident for admissions related to lifestyle-related diseases, such as cardiovascular disease, diabetes, and cancers (Patel *et al*., 2010:202).

On the other hand, Koorts *et al.* (2011:1057) showed that a physically active childhood leads to higher physical activity levels in adulthood and that activity in adolescence predicted activity in adulthood in both males and females. The risk for adult inactivity has also been demonstrated to be significantly lower for those who were physically active during adolescence (Huotari, 2011:1139).

Obesity and overweight are becoming an epidemic among South African adolescents. Comparison of data from the South African national youth risk behaviour survey in 2002 and 2008 has shown that rates of overweight and obesity have increased substantially among South African adolescents (obesity rates more than doubled among male adolescents from 1.6% in 2002 to 3.3% in 2008 and increased from 5.0% to 7.5% among female adolescents). Rates of overweight and obesity were also significantly higher among urban youths than among rural youths and among black youths than other races. This means that a chronic disease transition in South Africa may be looming among black, urban young adults (Reddy *et al.,* 2012:264).

The benefits of physical activity have been well documented globally. In 2004, the European Commission's Directorate General, Education and Culture conducted a survey on the educational and social values of sport in the European Union (EU). Seventy eight per cent (78%) of the EU citizens stated that improved health was the principal benefit of sport,

followed by developing physical performance (46%), relaxing (43%), having fun (39%) and being with friends (24%). Sixteen per cent (16%) of EU citizens indicated that the principal benefit of sport was developing new skills, while another 15% stated that sport helped to build character and identity (Bloom *et al.,* 2005:12). Similar results were found in South Africa where Dhurup (2012:622) conducted a factor analysis method at the Vaal University of Technology among university students and found that there was a positive correlation between physical activity and health promotion, revitalisation, physical appearance and stress management.

In adolescence, specifically, it has been documented (Hallal *et al.,* 2006:1020-1021) that physical activity provides many long-term benefits, such as bone strength, decreased risk of breast cancer, and sedentary behaviour. It has also been found that a higher frequency of participation in physical activity is associated with less depression and anxiety as well as higher self-esteem (Moksnes *et al*., 2010:643). Physical activity has also been shown to have mental health benefits in adolescence. Physical activity reduces depression and anxiety, increases self-esteem, and improves cognitive functioning in both children and adolescents (Biddle *et al*., 2011:894).

Physical fitness and motor proficiency were shown to have a positive correlation with physical activity in a study conducted in active and inactive girls aged 12-13 years in Bloemfontein, South Africa (De Milander, 2011:18). Vigorous physical activity was also found to have a positive association with indicators for muscular fitness in adolescents i.e. handgrip strength, a 60-s abdominal test and a standing broad jump (Martinez-Gomez *et al.,* 2011:313-314). Aires *et al.* (2011:S200) also found a positive correlation between cardio-respiratory fitness (assessed through a 20-meter shuttle run test using $\dot{V}O_{2max}$), and physical activity among children and adolescents, and a negative correlation with time spent watching television. Martin *et al.* (2012:40) reported a significant positive relationship between physical activity and cardio-respiratory fitness among Scottish youth. Bauman *et al*. (2012:268) have shown that correlates of physical activity such as age, sex, health status, self-efficacy, and motivation are associated with physical activity. The physical environment was also included by Bungum *et al*. (2012:1101) as a contributor to physical inactivity, for example, urban planning, transportation systems, and parks and trails.

In addition, the social environment has been shown to have a positive correlation with participation in physical activity among adolescents (Hsu *et al.,* 2011:217). Martin-Matillas *et al.* (2012:1332) conducted the HELENA study in 10 cities from nine European countries in 2006-2008 where the relationship between relatives' (father, mother, brother, sister, and best friend) physical activity participation and encouragement of adolescents' physical fitness was examined. It was found that relatives' physical activity participation was positively related to physical fitness, cardio-respiratory fitness and higher muscular strength in adolescents.

Adolescence is a time when independence is established, and dietary and activity patterns may be adopted that are followed for many years (Berkey *et al.,* 2000). Most of the physiological, psychological and social changes within people take place during this period of life. The period of adolescence can be looked upon as a time of more struggle and turmoil than childhood. Adolescents have long been regarded as a group of people who are searching for themselves to find some form of identity and meaning in their lives (Erikson, 1968; Rathi, & Rastogi, 2007), and therefore investigation in this group is important.

This thesis used some factors within ecological model in determining the social correlated of physical activity among adolescents with emphasis on the factors that influence participation in sport as intrapersonal, interpersonal, organisational, community and policy (Sallis *et al.,* 2008:465). Duaney *et al.* (2002), suggested that a comprehensive approach, such as that offered by the socio-ecological model is essential for examining the multiple level factors that might be determinants of PA. It should be noted that model like this can helps us to identify opportunities to promote PA by recognizing the individual (e.g. sex, beliefs, and attitudes), behavioral (sedentary and active time), and social environmental (family, teachers, peers) and physical environmental (e.g. availability of PA equipment and facilities) factors that may influence one's ability to be sufficiently physically active (Sallis & Owen, 2002:483). Peers and family are reported to be social influences which play significant roles on physical activity participation (Ward *et al.,* 2007:24-30).

Krahnstoever (2008:317), though, showed that parents reported community-based, interpersonal, and intrapersonal barriers to supporting their children's physical activity. The highest reported barriers included the importance of children's academic performance, a lack of facilities, and concerns about the children's safety. Parents who reported greater barriers also reported lower support for their children's physical activity. In the United States, the

neighbourhoods' socio-economic status was also found to contribute to participation in physical activity, where lower parental education and higher levels of social deprivation were found to be associated with higher BMI in adolescent girls (Voorhees *et al.,* 2009:736).

Kubayi and Surujlal (2014:203) in their study on adolescents attending public secondary schools in the Hlanganani rural area, Limpopo Province of South Africa showed that physical activity participation is more likely to increase when adolescents receive support from their parents and friends. These two correlates are thus the most focused upon in this study.

It is against this research background that these questions were posed:

- What is the status of physical activity, health-related fitness and social correlates of physical activity among adolescents attending high schools in the Tlokwe Local municipality?
- Is there any relationship between physical activity and social correlates of physical activity among the adolescents?
- Is there any relationship between health-related fitness and social correlates of physical activity in the adolescents?

Tlokwe local municipality is one of the four local municipalities in the Dr Kenneth Kaunda District Municipality of the North West Province of South Africa (Statistics South Africa, 2007). In this area a research findings by Mamabolo *et al.* (2008) indicated that the children had a reduction in levels of physical activity with advancement in maturity and also increase in fatness. The extent of the impact of social correlates of physical activity on health-related fitness and participation in physical activity amongst the youth of Tlokwe local municipality is not known. This study was delimited to adolescents aged 14 years attending school in the Tlokwe local municipality of the North West Province, South Africa. Answers to these questions may not establish a cause-and-effect relationship between physical activity, health-related fitness and social correlates of physical activity among adolescents but instead, scientific knowledge of the status and the relationship between physical activity, health-related fitness and social correlates of physical activity among adolescents in the Tlokwe local municipality will be disseminated. The results will also contribute to the body of knowledge on physical activity, health-related physical fitness and social correlates for physical activity among people dealing with adolescents, health professionals and educators,

as well as the sport sector. The research study will inform policymakers on adolescent physical activity participation trends in the Tlokwe local municipality, the associated health risks, and the social support predictors of participation. This may support policy formulation regarding the creation of access to sport and recreation physical activity programmes and facilities.

1.3 OBJECTIVES

The objectives of the study were to determine:

1.3.1 The status of physical activity, health-related fitness and social correlates of physical activity among adolescents attending high schools in the Tlokwe local municipality.

1.3.2 The relationship between physical activity and social correlates of physical activity among adolescents attending high schools in the Tlokwe local municipality.

1.3.3 The relationship between health-related fitness and social correlates of physical activity in adolescents attending high schools in the Tlokwe local municipality.

1.4 HYPOTHESES

The following hypotheses applied to the study:

1.4.1 There would be a significant difference in the status of physical activity, health-related fitness and social correlates of physical activity among adolescents attending high schools in the Tlokwe local municipality.

1.4.2 There would be a significant relationship between physical activity and social correlates of physical activity among adolescents attending high schools in the Tlokwe local municipality.

1.4.3 There would be a significant relationship between health-related fitness and social correlates of physical activity among adolescents attending high schools in the Tlokwe local municipality.

1.5 STRUCTURE OF THE THESIS

The thesis is submitted in an article format as follows:

Chapter 1: Introduction. A reference list is provided at the end of the chapter in accordance with the guidelines of the North-West University.

Chapter 2: Literature review. Physical activity, health-related fitness and social correlates of physical activity. A reference list is provided at the end of this chapter in accordance with the guidelines of the North-West University

Chapter 3: *Article 1:* The status of physical activity, body composition and social correlates of physical activity among adolescents: the PAHLS study. The article was submitted to the African Journal for Physical, Health Education, Recreation and Dance.

Chapter 4: *Article 2:* The relationship between physical activity and social correlates of physical activity among adolescents: the PAHLS study. The article will be submitted to the *Journal of Physical Activity and Health*.

Chapter 5: *Article 3*: The relationship between health-related physical fitness and social correlates of physical activity among adolescents: the PAHLS study. The article will be submitted to the *European Journal of Clinical Nutrition*.

Chapter 6: Summary, conclusions, limitations and recommendations.

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CHAPTER 2: Physical activity, health-related fitness and social correlates of physical activity: A literature review

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2.1 INTRODUCTION

Lack of regular physical activity is considered to be a global health problem in both children and adults (Mountjoy *et al*., 2012:839). Physical inactivity is found to be associated with excessive use of technology (Noorbhai, 2013:994), overweight or obesity, and limited social correlates of physical activity (Sallis *et al.,* 2000:963). The aim of this literature review was to review the literature on children and adolescents' participation in physical activity, the health-related physical fitness that is attained as a result of participation in physical activity, and the social correlates that affect participation in physical activity, or the lack thereof. As such, this chapter presents the literature review under the following headings:

- Physical activity
- Measurement of physical activity
- Measurement of health-related fitness
- Measurement of social correlates of physical activity
- Physical activity in children and adolescents
- Health-related fitness
- Social correlates of physical activity
- Chapter summary

2.2 PHYSICAL ACTIVITY

Physical activity is defined as "the behaviour that involves human movement, resulting in physiological attributes, including increased energy expenditure and improved physical fitness" (Gabriel *et al.,* 2012:S15). Physical activity leads to direct improvements in childhood health status. Physically active children display healthier cardiovascular profiles, have normal BMIs, and develop higher peak bone masses than their less active counterparts. It is also proven that improved adult health status results from childhood physical activity, for example, higher bone mass in young people reduces the risk of osteoporosis in old age (Boreham & Riddoch, 2001:926).

Participation in physical activity, and the resulting attainment of physical fitness variables, is affected by self-efficacy, social support, physical and social environment social correlates (Gao, 2012:547). Stanley *et al.* (2014:5) categorised the perceived facilitators to participation

in physical activity by youth as the achievement of weight-loss goals, supportive family comments, exercising with family members, enjoyment, supportive peer comments, personal motivation and the availability of a personal trainer. The perceived barriers to participation, on the other hand, are transportation, not enough time, conflict with schoolwork, job, chores or social obligations, low motivation, fatigue, crowded gym, weather or health/injury status (Peeters *et al.,* 2012:654), as well as crime and lack of safety in vulnerable communities (Murray, 2014: 681).

2.3 MEASUREMENT OF PHYSICAL ACTIVITY

a. Laboratory measurements of physical activity

Direct observation in a laboratory setting can be used as a valid and reliable measure of physical activity absolute intensity (Lyden *et al.,* 2014:862). ***Indirect calorimetry,*** where the subject's rates of respiratory gaseous exchange (O2 consumption and CO2 production) are measured in terms of their effects on the composition of the air in a well-sealed room (Goldberg, 2001:95) and ***Doubly labelled water calorimetry*** can also be used to obtain accurate measures of energy expenditure. These methods, though, are too expensive and intensive for most population studies (Nusser *et al.*, 2012:S57).

b. Field measurements of physical activity

Oxygen consumption ($\dot{V}O_{2max}$), is used to calculate energy expenditure during physical activity. Benmark *et al.* (2012:5475-5476) tested the validity of heart-rate based measurements of oxygen consumption on light and moderate physical activity by comparing them with oxygen consumption measurements. It was found that heart rate (HR) measurements combined with HR-$\dot{V}O_{2max}$ calculations are valid in calculating light and moderate physical activity. In the sedentary population, Magnan *et al.* (2013:275) found that greater BMI and waist-hip ratio (WHR) were associated with lower odds of achieving an absolute plateau in $\dot{V}O_{2max}$. Behavioural, physical and motivational factors were also found to contribute to the attainment of $\dot{V}O_{2max}$. For adolescents, in particular, it was found that $\dot{V}O_{2max}$ showed a clear comparability with the IPAQ-A and accelerometer data for assessing PA in adolescents (Ottevaere *et al.,* 2011:322).

A systematic review to investigate ***accelerometer*** methods and decision rule reporting in youth physical activity research articles from 2005-2010 found that the methodology used in different studies was not standardised and hence findings could not be compared. It was recommended that a consensus on protocols for collecting, processing, scoring and reporting accelerometer data for children and adolescents should be developed (Cain *et al.,* 2013:447). In investigating the protocol for accelerometer wear time, Herrmann *et al.* (2013:747) recommended that a minimum accelerometer wear time of 13 hours per day is needed to provide a valid measure of daily physical activity when 14 hours per day is used as a reference, as using daily accelerometer measurements of less than 13 hours per day leads to significantly less minutes of activity and higher than recommended error.

The ***electronic pedometer*** on the other hand, is a valid, reliable and inexpensive instrument for measuring physical activity. However, a major limitation of pedometers is the inability to record arm movement and non-locomotor activity when mounted on the waist. The Walk4Life DUO pedometer, specifically, was found to underestimate steps/minute, overestimate physical activity time and not produce clinically acceptable steps/minute and physical activity time outcomes. It is thus recommended that the Walk4Life DUO pedometer be used for relative, but not absolute, interpretation of physical activity (Scruggs *et al.,* 2010:161-162). Scruggs (2013:737) found that pedometry steps/min guidelines can be applied in the investigation of physical activity amongst the youth. The validity of common physical education steps/min outcomes for quantifying physical education percentage physical activity recommendations was investigated. The common steps/min standards were found to overlap with each physical education percentage physical activity recommendation.

Clemes and Biddle (2013:259-260) conducted a review of 89 pedometer studies and found that in children above five years of age pedometers provide a valid and reliable measure of ambulatory movement. These authors recommended that researchers should always report the wear time criteria applied to constitute a valid day of monitoring, and also that in order to standardise pedometer protocols, standardised wear time criteria be established per age group.

Another objective measure, the ***Actiheart monitor*** (Cambridge Neurotechnology Ltd, Cambridge, UK), provides information on physical activity intensity classification through the simultaneous measurement of heart rate and movement counts. Barreira *et al.* (2009:69)

tested the validity of the Actiheart monitor for the measurement of physical activity and found that the Actiheart monitor measurements and categorisation of physical activity under free living conditions and at low and moderate intensities in the laboratory were valid. Campbell *et al.* (2012:597), though, found that there is relatively poor measurement of agreement between the Actiheart and Doubly-labelled water for assessing free-living physical activity energy expenditure in adolescents.

Specific to the measurement of moderate to vigorous physical activity (MVPA) in a school physical education setting, the ***Simple Activity Measurement*** (SAM) instrument was found to be a user-friendly, economical, valid and reliable observation tool to document MVPA in a small sample of PE classes. The instrument was found to be a significant predictor of heart rate (Surapiboonchai *et al.,* 2012:134).

c. Physical activity recall instruments

In spite of the growing use of motion sensors for the measurement of physical activity in high-income countries, the majority of population-based physical activity studies from low- and middle-income countries still rely on self-report. This is due to financial constraints, limited availability of trained personnel, and instrument importation barriers (Hallal *et al.,* 2012:S88). Physical activity recall instruments are an inexpensive, easy-to-use method of collecting physical activity data, but they are subject to systematic and random measurement error. They therefore have to undergo validity testing to ensure that they assess physical activity behaviour accurately (Milton *et al.,* 2012:46). A more precise measurement method is to ask about very recent activity (e.g. yesterday) to reduce the error associated with long-term recall. The quality of the shorter recall is higher but recalled activity over a short period of time is not a good predictor of long-term behaviour (Nusser *et al*., 2012:S57).

Ainsworth *et al.* (2012:S82) provided a framework that identifies six steps that researchers should follow to reduce error in the administration of self-report instruments:

- Identifying the need to measure physical activity,
- selecting an instrument,
- collecting data,
- analysing data,
- developing a summary score, and

- interpreting data.

The authors further recommended that researchers should understand how to apply error correction models, identify sources of variability that lead to systematic and random errors, identify ways to reduce the error structure, determine how many days are needed to estimate usual behaviour, identify the questionnaires that are able to assess true behaviours, and identify the questionnaires that may be used in intervention studies which are also appropriate to the subgroup that they are measuring.

Sirard *et al.* (2012:90) validated the ***1-year and the 1-week physical activity recall questionnaires*** using accelerometry. Both self-report instruments were found to be significantly associated with accelerometry. Participants, though, significantly over-reported their MVPA on the 1-year recall instrument.

Hermann *et al.* (2013:230-231) investigated the validity, long term test-retest reliability and short-term test-retest reliability of the ***Global physical activity questionnaire*** (GPAQ). The GPAQ is a recall questionnaire administered over the phone which is used to assess physical activity by the World Health Organization. It was found that the GPAQ showed low- to moderately-high validity against measures of physical fitness, body composition, and objective (accelerometer and pedometer) and subjective measures of physical activity (IPAQ). The GPAQ also showed short- and long-term test-retest reliability by activity category.

Hanley *et al.* (2013:394) used the Active Australia Questionnaire, delivered through ***Computer Assisted Telephone Interviewing*** (CATI), to demonstrate that changing the order of physical activity measurement questions in CATI studies has a significant effect on the proportion of participants reporting various activities. In the study, the increase in reported sessions of participation in moderate and vigorous activity, due to the change in question order, led to a significantly higher proportion of participants being categorised as sufficiently physically active. This emphasises the need to add an instructional statement before questions about physical activity behaviour in CATI surveys in order to minimise the effects of social desirability bias.

Milton *et al.* (2012:46) conducted a study to assess whether a ***single question***, as a short self-report tool, could provide an appropriate measure of physical activity against accelerometry (Actigraph GT3X). The wording of the single item was, *"In the past week, on how many days have you done a total of 30 minutes or more of physical activity, which was enough to raise your breathing rate? This may include sport, exercise, and brisk walking or cycling for recreation, or to get to and from places, but should not include housework or physical activity that may be part of your job."* The single-item measure was found to be a valid tool as correlations between the tool and accelerometry were strong (the tool correctly identified over 80% of insufficiently active participants).

A short form of measurement of physical activity is conducted through the ***International Physical Activity Questionnaire (IPAQ)*** (CDC, 2002; WHO, 2002; WHO, 2009), which is a valid and reliable tool for assessing PA (Craig *et al.,* 2003). The IPAQ is considered suitable for use by adolescents at different settings (WHO, 2002) and its short form consists of seven items which identify the frequency and time spent in walking and engaging in other moderate-to-vigorous intensity PA during the seven days prior to questionnaire administration. In the IPAQ only those sessions which lasted 10 minutes or more were analysed. All types of PA related to occupation, transportation, household chores and leisure time activity were included. The IPAQ also elicits information about time spent sitting, which is used as an indicator of inactivity.

Bringolf-Isler *et al.* (2012:242) compared the results of a parental questionnaire to adolescents' accelerometer and diary data and showed that in order to ensure that physical activity studies that use physical activity questionnaires produce valid results, the latter need to be designed for specific age groups and should not be administered in isolation but in combination with objective measurements.

d. Comparison of physical activity methods

Reichert *et al.* (2009:363) showed that it is feasible to conduct high quality studies on physical activity in developing countries. The authors conducted their study in Pelotas, Brazil, and used questionnaires to estimate physical activity, a combined heart-rate and motion sensor (Acti-Heart) and the ActiGraph GT1M accelerometer. All the data was collected in the participants' homes.

Questionnaires are the most cost-effective instruments in population-based studies but it is ideal to combine questionnaires with objective measures as they are not subject to the reporting bias or recall problems that are associated with self-report methods (Trost & O'Neill, 2014:178). Laboratory methods, though, are too expensive and intensive for most population studies (Nusser *et al.*, 2012:S57). In the current thesis the IPAQ questionnaire was used in the assessment of physical activity among the adolescents.

Benmark *et al.* (2012:5475-5476) found that heart rate (HR) measurements combined with HR-VO_2 calculations are valid in calculating light and moderate physical activity while accelerometer data is only valid with minimum accelerometer wear time of 13 hours per day (Herrmann *et al.*, 2013:747). A major limitation of pedometers, on the other hand, is the inability to record arm movement and non-locomotor activity when mounted on the waist (Scruggs *et al.,* 2010:161-162). A relatively poor measurement of agreement was also found between the Actiheart and Doubly-labelled water for assessing free-living physical activity energy expenditure in adolescents (Campbell *et al.,* 2012:597).

Based on the literature above, it is recommended that valid and reliable questionnaires be used in population studies in order to achieve the most reliable measurement of physical activity. As the ***IPAQ questionnaire*** is a valid and reliable tool for assessing physical activity in adolescents (Craig *et al.,* 2003), it is ideal to use for the measurement of physical activity in adolescents.

2.4 MEASUREMENT OF HEALTH-RELATED FITNESS

The components of fitness that have a relationship with health are cardiovascular fitness (or endurance), body composition, muscular strength or endurance and flexibility (Plowman, 2014:175). The globally used indicator for cardiorespiratory fitness is the volume of oxygen consumed at maximal physical exertion ($\dot{V}O_{2max}$) which is objectively measured through laboratory tests such as the progressive run or cycle tests to exhaustion (Dencker *et al.,* 2007:19). The disadvantages of laboratory tests are the high costs of the sophisticated testing equipment, the need for highly trained personnel, and time constraints. This makes the tests impractical for use in population-based studies. Field tests, on the other hand, do not require sophisticated equipment or trained personnel. They are also inexpensive, time efficient and

easily administered in population studies. The two common field tests for the prediction of $\dot{V}O_{2max}$ are the 20 meter shuttle run test and the 550 meter distance run (Dencker *et al.,* 2013:242).

The ***20-meter shuttle test*** is a valid and reliable tool to predict $\dot{V}O_{2max}$ (Leger and Lambert, 1982:9-12). Hamlin *et al.* (2014:114), after adjusting for body fatness and maturity levels, found that both the 20 meter shuttle run test and the ***550 meter distance run test*** are valid and reliable field tests for the measurement of cardiorespiratory fitness in adolescents. Muscular strength, muscular endurance and flexibility assessments are field-based tests stipulated by the EUROFIT test protocol (1988). Muscular strength is assessed through the *sit-up* (SUP) which is a measure of abdominal strength and endurance assessed through the number of correctly performed sit-ups in 30 seconds. The field test is valid, reliable, feasible and safe for the assessment of health-related physical fitness in children and adolescents (Ruiz *et al.*, 2011:520). Muscular endurance is assessed through the ***standing broad jump*** (SBJ) which measures the explosive strength of leg extensors (in centimetres) and the ***bent arm hang*** (BAH) which is used to assess the functional arm and shoulder muscular endurance to exhaustion (in seconds). Castro-Pinero *et al*. (2010:939) found that the SBJ showed the strongest association with the vertical jump, squat jump, countermovement jump, throw basketball, push-ups and isometric strength/muscular strength tests. The test was also found to be valid and reliable. The ***bent arm hang*** was also found to be valid and reliable (Ortega *et al.,* 2008:3). Flexibility is assessed through the ***sit and reach*** (SAR) test which is used to measure hamstring flexibility (in centimetres). The modified SAR is an appropriate and valid test for assessing hip and low back flexibility in children and adolescents (Chillon *et al.,* 2010:646).

The International Standards of Advancement of Kinanthropometry stipulates the standard procedures for the ***anthropometric measurements*** of height, weight, skinfolds thickness (triceps, subscapular and calf skinfolds), and waist and hip circumferences (Norton & Olds, 1996). Laboratory methods of evaluating body composition include dual energy X-ray absorptiometry, underwater weighing, air displacement plethysmography, computer tomography and nuclear resonance. These methods, however, require laboratory settings, are expensive, not easily available and hence not feasible in population studies. Simple

anthropometric measurements are thus widely used in population studies (Goon *et al.,* 2013:822).

McKenna *et al.* (2013:37-39) investigated inter-tester reliability of anthropometric measurement in adolescents with portable tools. Inter-tester reliability of ***height*** (measured with a portable stadiometer), ***weight*** (measured with a digital floor scale), and ***body mass index*** (BMI) as a measure of body composition calculated as body mass/stature² (kg/m²) was investigated. It was found that anthropometric measures that are measured using field-based tools have acceptable inter-tester reliability for use in field-based assessments. BMI, though, has its limitations as it cannot distinguish between muscle mass and fat mass (de Lanerolle-Dias *et al.,* 2011:331), but still remains a useful measure in determining overweight/obesity in children or adults.

Percentage body fat is derived from the ***sum of skinfolds*** measurements according to the equation developed by Slaughter *et al.* (1988). Skinfold measurements were found to be a good assessment of percentage body fat among the general populace but as compared to ultrasound imaging technique, skinfold measurements were found to not allow an accurate assessment of subcutaneous adipose tissue (Muller *et al.,* 2013:1038).

Waist circumference (cm) correlates with plasma lipid and lipoprotein levels in children and is a better predictor of cardiovascular risk in children than body mass index (Savva *et al.*, 2000:1457). Waist circumference also performs significantly better as an index of trunk fat mass than waist-to-hip ratio or the conicity index. It thus provides an effective measure of truncal adiposity in children and adolescents (Taylor *et al.,* 2000:494). BMI, body fat percentage (through skinfold measurements), waist circumference and ***waist-to hip ratio*** in combination are a good indicator of weight and fat profiles in adolescents and thus indicate the predisposition for cardiovascular disease (Esmaeilzadeh *et al.*, 2013:69).

2.5 MEASUREMENT OF SOCIAL CORRELATES OF PHYSICAL ACTIVITY

2.5.1 Theories guiding the assessment of social correlates

Social cognitive theory has been used to identify what should be included in a physical activity programme, for example, confidence and skill development, and how to design instructional programmes (Ward *et al.,* 2007:24-30). Bandura (1986) defined three broad factors that influence one another in participation in physical activity as cognitive or personal factors within the individual, behavioural skills of the individual and environmental factors. Constructs from the social cognitive theory were thus developed by Glanz *et al.* (2002:22-39) to explain participation in physical activity, for example, the social environment as a construct of the environmental factors explains how family members, other adults, friends and peers have an influence on physical activity behaviour.

Social influences theory has been used to understand social influences from groups such as peers and family on physical activity and how to design programmes that have social influence (Ward *et al.,* 2007:24-30). Sallis *et al.* (2000:973) showed that the social environment is an important influence on physical activity in children and adolescents.

Self-regulation theories are used to design programmes that increase participants' self-control or self-management skills necessary for being physically active (Basen-Enquist *et al.,* 2011:33). The skills include goal-setting, self-monitoring, problem-solving, self-adjusting, and self-reward (Kahn *et al.,* 2002:104).

Organisational change theories have been used to design interventions that work with organisations in a way that results in policies and practices which encourage physical activity (Ward *et al.,* 2007:24-30).

An ecological model designed by Sallis and Owen (2002:483) categorises factors that influence participation in sport as intrapersonal, interpersonal, organisational, community and policy. The table (2.1) below is an adapted summary of major influences on physical activity in youth as explained by Ward *et al.* (2007:24-30):

Table 2.1: Major influences on physical activity in youth

Positive Correlates for Physical Activity	**Negative Correlates for Physical Activity**	**Related theory constructs**
Fun, enjoyment	Not enjoying it, finding it boring	-
Intention to be active	-	Behavioural intention
Getting benefits out of it	Perceiving more negatives than benefits	Beliefs, outcome expectations
Perception of ability or competency	Perception of inability or incompetency	Perceived self-efficacy
Exploration of new things, interests	-	-
Having the skills to be successful	-	Behavioural skills, behavioural capability
It's the thing to do	-	Social norm
Being able to do it with friends	Having no one to be active with	Social support
Receiving encouragement from family or friends	-	Social support
Receiving assistance from adults (enrolment, payment for programs & transportation)	-	Social support
Emulating those older than you	-	Role model
Provision by organizations of attractive opportunities for physical activity	-	Organisational policies or practices
Availability and accessibility of attractive physical activity programmes or equipment	Programs not available or not accessible	Community/ environment opportunity and access
Spending time outdoors	Attractive sedentary pursuits	-

Major influences on physical activity in youth (adapted from Ward *et al*). (2007:24-30)

2.5.2 Social Correlates assessment tools

Various scales have been developed for the assessment of social support as a correlate for physical activity. ***The social support for physical activity scale*** is a valid and reliable tool to assess the social correlates for participation in physical activity by adolescents (Sallis *et al.,* 2002). Dominick *et al.* (2012:712) developed a measure for assessing instrumental social support for physical activity based on a theory-based conceptual model, and recommended that when developing scales which have not previously been assessed in a population, investigating modal beliefs about a behaviour should be the primary step in instrument development. Ling *et al.* (2014:886-887) developed an 8-item ***social support scale*** and an 8-item ***peer norms scale*** based on the health promotion model. The scales were found to have adequate internal consistency and test-retest reliability and could thus be used for future observational and experimental studies on adolescent physical activity. Specific instruments were also developed by Theodoropoulou *et al.* (2014:38) who developed Greek versions of

two scales assessing family and friends' support for physical activity behaviour. The scales were also found to be valid and reliable.

The influence of social correlates on physical activity differs from context to context. Self-report instruments thus aim to establish the context-specific impact of social correlates on physical activity (Sallis & Owen, 2002:482). Stanley *et al.* (2014:435), using the context-specific correlates based on the social-ecological perspective, developed and evaluated the psychometric properties of the lunchtime and after-school ***Youth Physical Activity Survey for Specific Settings*** (YPASS) social correlates questionnaires. The YPASS social correlates questionnaires were found to be valid and reliable tools for measuring correlates of context-specific physical activity in children. Reimers *et al.* (2012:713) also assessed the internal consistency, test-retest reliability, construct validity and predictive validity of a German self-report questionnaire that assessed the social support and physical environmental correlates of physical activity. The social support scale and ***physical environment scales*** were found to be reliable and valid and were recommended for use in European and longitudinal studies.

With regard to the impact of the neighbourhood environmental correlates for physical activity, Reimers *et al.* (2013:12-13) conducted a systematic review of questionnaires assessing the impact of the neighbourhood environment on youth physical activity and found that out of the thirteen (13) questionnaires reviewed, only seven (7) questionnaires had substantial test-retest reliability. The studies with substantial test-retest reliability were the 9-item ***neighbourhood environment*** and the 11-item ***convenient facilities scales*** of Erwin, the 5-item ***neighbourhood safety scale*** and 5-item ***sports facilities scales*** of Huang *et al.* (2011:16), and the 15-item ***physical environment scale,*** 9-item ***aesthetics scale*** and 5-item ***safety scales*** of Hume *et al.* (2006:16-21). Two (2) questionnaires had acceptable convergent validity based on sufficient evidential basis (Ommundsen *et al.,* 2008:30; Rosenberg *et al.,* 2009:215). The researchers therefore recommended that cross-culturally adapted questionnaires should be used to assess the impact of the neighbourhood environment on physical activity and that existing questionnaires should be evaluated in diverse samples, preferably outside of the United States of America.

To assess people's attitude towards physical activity, a wide variety of measurement techniques have been used often using ***single questions*** with relatively simple wordings and structures as self-report measurement methods or using ***attitudinal scales*** (Pethkar *et al.,*

2010:33). The ***self-efficacy for physical activity scale*** (Motl *et al.,* 2000:114) and the ***enjoyment of physical activity scale*** (Motl *et al.,* 2001:591) based on the social cognitive theory, are also valid and reliable tools to assess self-efficacy and enjoyment as factors affecting adolescent participation in physical activity.

2.6 PHYSICAL ACTIVITY IN CHILDREN AND ADOLESCENTS

Physical inactivity is a global health problem and contributes to overweight and obesity (Onywera *et al.,* 2013:132), which in turn can increase the risk for diabetes, high blood pressure, high cholesterol, asthma, arthritis, mental decline and poor health status. Poor health status may increase the risk of dying prematurely of heart disease, and developing breast or colon cancer (Kesaniemi *et al.*, 2001:S351). The World Health Organization (WHO) (2009:10) states that globally around 31% of adults aged 15 and over are insufficiently active (men 28% and women 34%). As a result, approximately 3.2 million deaths each year are attributable to insufficient physical activity (Mozaffarian *et al.*, 2012:1515). The health problem is not limited to adults. In children, physical inactivity is one of the leading factors in childhood obesity which has psychological consequences, including low self-esteem, depression, and body dissatisfaction (Antonogeorgos *et al.*, 2010:633). Lemstra *et al.* (2013:431) in their study on the prevalence and correlates of physical activity in Canadian native youth found that only 7.4% of the youth met the Canadian Society for Exercise Physiology (CSEP) recommendation that 5-17 year olds should perform 60 minutes of moderate to vigorous physical activity daily.

Physical inactivity is not only a first-world country problem. In Kenya, it was found that urbanisation has led to decreasing levels of physical activity partly due to insufficient leisure time physical activity, and an increase in sedentary behaviour during occupational and domestic activities (Ojiambo *et al.*, 2012:121). Urban Kenyan children were found to display a higher prevalence of overweight/obesity and lower aerobic fitness levels than their rural counterparts. The urban group partook in more sedentary activities, relied less on active transport and accumulated fewer daily step counts than their rural counterparts (Adamo *et al.,* 2010:4). Inter-country comparisons among children in Canada, Mexico and Kenya showed that Kenya is at an early stage of the physical activity transition as childhood overweight and obesity levels are lowest and physical activity levels are high in Kenya as compared to Canada and Mexico (Onywera *et al.*, 2013:140). Aerobic fitness was also the highest in

Kenyan adolescents (Heroux *et al.,* 2013:5). Though the majority of Kenyan adolescents have healthy body composition and limited sedentary time, it was found that they are not achieving the World Health Organisation's (WHO) recommendations for daily participation in physical activity (Wachira *et al.,* 2014:3).

In South Africa, the demise of school sport and the lack of sporting facilities (especially in black schools) have also contributed to physical inactivity amongst children and youth (Sport and Recreation South Africa: National Sport and Recreation Plan, 2011:8). Shirinde *et al.* (2012:236) examined physical activity specifically among South African children attending farm schools and found that the majority of respondents cited lack of time, the demands of work or schoolwork, and lack of skills as the major determinants of physical inactivity.

In 2003, the International Physical Activity Questionnaire (IPAQ) was administered in South Africa as part of the World Health Survey to a representative sample of South Africans in urban and rural communities (Steyn *et al.*, 2006:25). The survey found that less than one-third of South Africans met the American College of Sports Medicine and Center for Disease Control's recommendation for health-enhancing physical activity (to accumulate 30 minutes of moderate activity on most, but preferably all days of the week), and that nearly half were reportedly inactive (46%) (Steyn *et al.*, 2006:25). The South African Youth Risk Behaviour Study of 2002 also found that 38% of the youth participated in insufficient or no physical activity (within the past week), while 25% reported that they watch TV for more than 3 hours per day (Reddy *et al.*, 2012:264). A South African study by Joubert *et al.* (2007:729) also found that 30% of ischaemic heart disease, 27% of colon cancer, 22% of ischaemic stroke, 20% of Type 2 diabetes and 17% of breast cancer could be attributed to physical inactivity. In this study by Joubert *et al.* (2007:729) it was estimated that 3.3% of all deaths in 2000 could be attributed to physical inactivity. Physical inactivity thus ranked 9th in terms of attributable deaths compared with other risk factors among South African adults.

Physical inactivity also creates a huge economic burden. Allender and Rainer (2007:471) found that the estimated direct cost of physical inactivity to the United Kingdom National Health Service was £1.06 billion in 2004. Physical activity is therefore a very important variable of public health and cannot be ignored. In South Africa, a key finding from a study conducted by a health insurance company, Discovery Health, was that a higher level of participation in the various components of a health insurance-initiated health promotion

program (Vitality) was associated with lower health care costs, compared with no participation or little or no participation with the program. This association was most evident for admissions related to lifestyle-related diseases, such as cardiovascular disease, diabetes and cancers (Patel *et al.*, 2010:202).

The benefits of physical activity have been well documented globally. In 2004, the European Commission's Directorate General, Education and Culture conducted a survey on the educational and social values of sport in the European Union (EU). Seventy eight (78%) per cent of the EU citizens stated that improving health was the principal benefit of sport, followed by developing physical performance (46%), relaxing (43%), having fun (39%) and being with friends (24%). Sixteen per cent (16%) of EU citizens indicated that the principal benefit of sport was developing new skills, and another 15 per cent (15%) of the citizens stated that sport helped to build character and identity (Bloom *et al.*, 2005:12). Similar results were found in South Africa where Dhurup (2012:622) conducted a factor analysis method at the Vaal University of Technology among university students and found that there was a positive correlation between physical activity and health promotion, revitalisation, physical appearance and stress management.

In adolescence, specifically, physical activity provides long-term benefits of bone strength, decreased risk of breast cancer, and sedentary behaviours (Hallal *et al.,* 2006:1020-1021). A higher frequency of participation in physical activity is also associated with less depression and anxiety, and higher self-esteem (Moksnes *et al.*, 2010:643). Physical activity also has mental health benefits in adolescence; it reduces depression and anxiety, increases self-esteem and improves cognitive functioning in children and adolescents (Biddle & Asare, 2011:894).

A positive relationship exists between the frequency and intensity of physical activity and health behaviour in adolescents (Delisle *et al.,* 2010:138). Adolescents who engage in high levels of vigorous physical activity use less marijuana, have a healthier dietary intake, greater stress management skills and better quality of sleep than those who engage in low or no vigorous physical activity (Delisle *et al.,* 2010:138).

With all the known benefits of physical activity, it is concerning that in children and adolescents, physical activity intensity and time spent in physical activity have been found to

reduce with age (Kirby *et al.,* 2011:789-791). Physical activity variables, tracked over two years, have been shown to decrease with age (from 8-10 years). Time spent in activity also decreased over that time. A decrease in intensity and a significant increase in time spent in inactivity were more pronounced in boys than in girls (Dencker *et al.*, 2013:244). The VERB summer scorecard, though, has shown that vigorous physical activity can be increased among teen girls through the use of a national media campaign comprised of advertising, multicultural messages, Internet promotions and school and community support. The scorecard provided teens with incentives for participation in physical activity. In 2007, the intervention led to participants being more likely to report moderate physical activity frequency and high physical activity frequency than girls in the reference group (Alfonso *et al*., 2013:165-166).

Participation in physical activity is moderated by social correlates (Bergh *et al.,* 2011:e321). The International Physical Activity Questionnaire (IPAQ), the perceived self-efficacy in the physical activity scale and the physical activity norms scales were administered by Lu *et al.* (2014:369-371) to 400 Taiwanese junior high school students, leading to the recommendation that self-efficacy and peer norms need to be fostered as motivational strategies to increase participation in physical activity. The IPAQ was also administered on Nigerian young adults (16-39 years) where gender, ethnicity, body mass index (BMI) and parental income were identified as socio-demographic correlates that affect participation in physical activity (Adegoke & Oyeyemi, 2011:1141). A similar study conducted on 405 higher secondary school students in Nepal by Paudel *et al.* (2014:646), through the administration of the IPAQ, found that gender, transportation, family structures, the physical environment and the provision of extra-curricular activities were correlates that affected participation in physical activity.

2.7 HEALTH-RELATED FITNESS

Physical activity, in general, is beneficial to health, whereas the lack of physical activity is considered compromising to health. In addition to energy expenditure, physical activity results in improvements in the five dimensions of health-related physical fitness, i.e. cardio-respiratory fitness, musculoskeletal fitness, flexibility, balance and coordination, and body composition (Gabriel *et al.,* 2012:S15). Kaminska *et al.* (2012:262) found that physical activity duration and physical activity levels have an effect on health-related physical fitness components i.e. waist-to-hip ratio, muscle mass, hamstring muscle flexibility, grip strength and $\dot{V}O_{2max}$ increased with increasing physical activity level in both genders, and body fat had an inverse association with physical activity levels.

Martin *et al.* (2012:39) investigated physical fitness among Scottish youth and found that over 60% of the youth reported low levels of physical activity. 40% of the participants were also categorised as either overweight or obese. A significant relationship also existed between physical activity and cardiorespiratory fitness although the relationship was weaker amongst girls than boys.

Physical fitness and motor proficiency were shown to have a positive correlation with physical activity in a study conducted in active and inactive girls aged 12-13 years in Bloemfontein, South Africa (De Milander, 2011:18). Vigorous physical activity also has a positive association with indicators for muscular fitness in adolescents i.e. handgrip strength, a 60-s abdominal test and a standing broad jump (Martinez-Gomez *et al.*, 2011:1785). Aires *et al.* (2011:S200) also found a positive correlation between cardiorespiratory fitness (assessed through a 20-meter shuttle run test using $\dot{V}O_{2max}$), and physical activity among children and adolescents, and a negative correlation with time spent watching television. Among Scottish youth, Martin *et al.* (2012:40) reported a significant positive relationship between physical activity and cardiorespiratory fitness.

Physical activity has a significant inverse correlation with body weight and body fat in adolescents (Lohman *et al.,* 2013:581). Bergh *et al.* (2011:e320) showed the correlation between BMI and MVPA in Norwegian pre-adolescent children where normal weight was associated with a higher % daily MVPA than being overweight or obese. In South Africa,

Kemp and Pienaar (2009:538-539) investigated the effect of an aerobic-based physical activity programme on the health-related physical fitness of 10-15 year old girls and found a decrease in the body mass, body mass index and the triceps skinfold following the 10-week exercise programme. There was a positive effect on muscular strength and muscular endurance in the abdominal and trunk regions following the implementation of the programme. Drenowatz *et al.* (2013:79) showed that an association between maturity status and body composition, health behaviour and cardiovascular disease (CVD) risk factors was present among 8-year old pre-pubescent children. Early maturing children had a higher CVD risk, lower fitness levels and increased sedentary behaviour. Early maturing boys had a lower performance on sport performance and speed and agility tests, while early maturing girls had higher TV watching times.

A survey of cardiorespiratory fitness, activity level, health-related anthropometric variables, sedentary behaviour and socioeconomic status in 7-11 year old Iranian boys found that cardiorespiratory fitness in 8.9% of the participants was lower than normal while 58.6% of the participants had inadequate physical activity levels (Esmaeilzadeh *et al.*, 2013:69). A significant correlation between cardiorespiratory fitness and physical activity ($p<0.001$) was observed. 18.2% and 21% of the participants had more than normal BMI and fat percentage respectively. A significant correlation was found between socioeconomic status and fat mass with a negative correlation between cardiorespiratory fitness and BMI, waist-to-height ratio, waist circumference and fat mass. The researchers also found a significant relationship between TV watching and video playing time, physical activity and anthropometric measures (Esmaeilzadeh *et al.*, 2013:69).

A research review conducted by Chaddock *et al.* (2012:38) on the effects of physical activity and fitness on cognition and brain health in children, showed that an active lifestyle and higher levels of aerobic fitness are positively associated with superior academic achievement, cognitive abilities, brain structure and brain function. The relationship between physical fitness and academic achievement was also demonstrated in a South African study by Du Toit *et al.* (2011:32) where a positive relationship was found between physical fitness components and academic achievement among urban primary schoolchildren. A stronger correlation was found among girls than boys. A negative correlation has also been demonstrated between physical fitness and depressive symptoms. This finding was corroborated by findings of a negative correlation between the isometric endurance capacity of the trunk extensor muscles

and depressive symptoms in both males and females. In males, particularly, a negative correlation was also demonstrated between handgrip strength and depressive symptoms (Suija *et al.*, 2013:4).

2.8 SOCIAL CORRELATES OF PHYSICAL ACTIVITY

The most important social correlates perceived by children are parental and peer influences, and time available for physical activity (Stanley *et al.,* 2012:38). Among female adolescents, specifically, a systematic review of 19 qualitative studies conducted by Standiford (2013:871) identified three areas of influence that affect the girls' participation in physical activity. The areas were categorised as follows: perceptual influences which included appearance concerns, personal barriers to physical activity, perceived benefits of physical activity, body image, physical activity enjoyment and favoured sports and recreational activities. Interpersonal influences were the second category and included ability comparison and competition, family, peer & teacher influence, and contending with boys. Situational influences (the third category), included accessibility of physical activity, gender role concerns and safety concerns (Standiford, 2013:871).

A systematic search review of peer-reviewed journals for studies published since 2000 (n=106) investigating the influence of friends on children's physical activity, found a positive association between physical activity and positive communication about it from friends, the friends' own physical activity participation levels, and the friends' presence during participation in physical activity (Maturo & Cunningham, 2013:e11). Perceived peer support for physical activity was also positively associated with % daily MVPA (Bergh *et al.,* 2011:e321). Another systematic review of 23 articles conducted by Fitzgerald *et al.* (2012:954) on peer and/or friends' influence on physical activity among American adolescents categorised peer influence into six variables: peer/friend support, the presence of peers/friends during physical activity, perception of peer norms, friendship quality and acceptance, and peer crowds (affiliation with "jocks") all had a positive association with physical activity. The fear of peer victimisation, though, had a negative association with physical activity. On the contrary, Scarpa *et al.* (2012:322) found that peer victimisation during sport practice was a poor predictor of decreased enjoyment of physical activity. The authors attributed enjoyment of physical activity to intrinsic factors.

Macdonald-Wallis *et al.* (2012:639) conducted a systematic review of nine publications that conducted a social network analysis of child and adolescent physical activity so as to determine the extent that the social network structure is associated with physical activity behaviours. Similarities in physical activity behaviours were found within social network friendships and peer groups. It was found that ties were more likely to be formed between individuals with similar physical activity behaviour and that the social network group's physical activity behaviour was a significant predictor of the individual's physical activity behaviour (Macdonald-Wallis *et al.,* 2012:639).

Coppinger *et al.* (2010:779) conducted a two-year longitudinal study and found a significant association between peer influence and physical activity behaviour. The role of peer influence on physical activity was also demonstrated by Rittenhouse *et al.* (2011:56) where overweight boys were found to be less active than normal weight boys when alone, but increased their physical activity behaviour and decreased the time spent in sedentary activities in the presence of peers. Spink *et al.* (2012:99-100) found that in structured activity, compliance with peers and significant others was associated with high physical activity, while in the unstructured environment, peer compliance and conformity were the predictors of physical activity participation. Lopes *et al.* 2012:754) also demonstrated that dyads of best friends were similar in vigorous and moderate physical activity levels and sedentary behaviour. Contrary to the above studies, Seabra *et al.* (2011:321) found that peers had no influence on adolescent physical activity levels.

Kirby *et al.* (2011:789-791) conducted a longitudinal five-year study among Scottish youth to determine the relationship between parental and peer influences and physical activity participation during early to mid- adolescence. It was found that girls had significantly lower levels of physical activity than boys. This correlated with the finding that boys had higher peer support throughout the period than girls. Compared with peer support, parental support was found to be less likely to be associated with physical activity participation but where there was significant parental influence, it was found that physical activity was positively associated with support from the same sex parent (Kirby *et al.,* 2011:789-791).

Cultural and social characteristics of the family have a positive correlation on health-related physical fitness in girls. Mehdipour *et al.* (2012:242) used the AAHPER physical fitness test and the cultural and social characteristics questionnaire and found that cultural and social

characteristics could be predicted through the physical fitness results. Crawford *et al.* (2010:1184-1185) also found that a number of social factors in the home environment, such as the presence of siblings, role modelling by parents or siblings and parents' participation in physical activity with the child were positively associated with participation in physical activity by the child. An active mother and/or sibling were also predictors of participation in high levels of physical activity (Seabra *et al.,* 2011:321).

Jacobi *et al.* (2011:3) assessed familial correlations in pedometer-assessed physical activity and found that parent-offspring correlations were only significant in mothers and stronger between mothers and daughters. The correlations remained of the same strength through the transition from childhood to adolescence. These correlations were found to be due to mothers acting as role models, sharing activities with the children and supporting the children's physical activity. Having parents who watch youth participate in physical activity, parents who provide transportation to physical activity, and friends who are physically active were all positively associated with meeting the recommended physical activity standards (Lemstra *et al.,* 2013:431). A review of current physical fitness profiles of male children and youth demonstrated a worldwide pattern of decreased aerobic fitness and increased obesity. The studies reviewed, though, found a positive association between parental encouragement and increased physical activity in adolescent males. Parental encouragement therefore should be a tool used to effectively alter physical activity patterns of children and adolescents (Kyrolainen *et al.,* 2010:916).

Influence by parents for engagement in physical activity, though, was shown to decrease over time. Alderman *et al.* (2010:65) showed a significant decrease over time in the amount of time parents engaged in physical activity together with their children. Parents engaged in physical activity with their preschool children for approximately 60 minutes per week. As they aged, parents spent approximately 40 minutes per week participating in physical activity with their children. Parents are role models for physical activity habits and behaviours of their children, thus parents who enjoy physical activity are likely to instil positive perceptions of physical activity in their children (Mitchell *et al.,* 2012:1430). Parental physical activity has a positive association with parental supportive behaviour for child physical activity (Santos *et al.,* 2013:4). The parents' BMI also has a positive association with support for girls' physical activity in particular (Nolan *et al.*, 2013:39). Holm *et al.* (2012:666) showed, through a family-based intervention, that parental change in physical activity is positively

associated with child change in physical activity. Social control tactics by parents to influence children's physical activity, though, were found to be counterproductive. Spink *et al.* (2008:196) found that parents who reported high levels of physical activity and reported frequently telling their child to be physically active also reported their child as less active, versus highly active parents who reported less frequent use of social control tactics. This was in agreement with Wilson and Spink (2012:7) where it was found that lower than normal physical activity by the youth was associated with greater use of collaborative social influence by the parent.

Leary *et al.* (2013:343) demonstrated that for girls, parental physical activity had the strongest association with child physical activity. The report on Spanish adolescents by Sanz-Arazuri *et al.* (2012:99-100) indicated that parental factors had a negative influence on their children's participation in physical activity. It was also found that the probability of adolescents' physical inactivity is quadrupled when their parents have never participated in physical activity. Female adolescents were found to be three times more likely to be inactive in the absence of parental role modelling. Parents who were found to put more emphasis on academic performance than physical activity created obstacles to participation in sports activity and consequently physical activity (Sanz-Arazuri *et al.,* 2012:99-100).

The influence of the child's perception of parental physical activity (Voss *et al.,* 2013: 402) and parental support (Barr-Anderson *et al.,* 2010:367) was also demonstrated, where the child's perception for parental physical activity and support was strongly associated with child physical activity behaviour. Associations between parental physical activity and child fitness were found to be higher where the parent and the child were of the same gender. This is in contrast with the findings of Bergh *et al.* (2011:e321) where perceived support from parents and teachers was not associated with % daily MVPA. Maitland *et al.* (2013:16) also demonstrated that parents played an important role in influencing children's physical activity, even in the presence of home environment factors.

Youth with high socioeconomic status are more likely to participate in moderate and high physical activity, than those of a low socioeconomic status (Seabra *et al.,* 2011:321). Barriers most commonly reported by Australian low-income and rural parents to their children's participation in physical activity include cost, lack of opportunities for participation and transport (Smith *et al.,* 2010:8). This indicates that household income is directly related to

parental choices and level of expenditure on children's physical activities. Parental self-efficacy (i.e. their confidence to influence their child's physical activity in a series of challenging situations) was also found by the researchers to be lowest among low-income parents and was significantly related to children's physical activity and screen time. Parental barriers and self-efficacy therefore had a direct association with time that children spent in both physical activity and screen viewing and hence the achievement of the recommended amount of total activity for children. This was consistent with the findings of the systematic view conducted by Mitchell *et al.* (2012:1430) where parental time limitations, fatigue, maternal self-efficacy and psychopathology were found to inhibit physical activity in children.

The role of educators can also not be undermined. A research review conducted by Slingerland and Borghouts (2011:868) showed evidence that if physical education lessons are planned and delivered with MVPA goals in mind, their contribution to the accumulation of physical activity in youth can be increased. Strategies that have proven to be effective in increasing percentage lesson time in MVPA include adjusting activities, teaching physical educators to better organise physical education (PE) classes, providing a PE curriculum that increases intrinsic motivation in learners, and providing schools with specialised physical educators and physical education material (Slingerland & Borghouts, 2011:868). Additionally, Beasley and Garn (2013:248) highlighted the important role physical educators can play in learners' lives regarding self-concept and physical activity behaviours outside of school. The researchers emphasised that the physical educators should design curricula with learners' values and personal goals in mind. If learners appreciate the benefits of physical education activities they will be more likely to have a positive physical self-concept and will also be more active outside class. When learners align their personal belief system with those of the physical education class there is a positive impact on their self-concept and leisure-time physical activity (Slingerland & Borghouts, 2011:868).

The influence of the social context on physical activity in PE classes was demonstrated by Perlman (2013:56) where learners who received physical education in an autonomy-supportive environment (educators who are empathetic, value learners' desires, are not strict and listen to the learners) recorded greater MVPA levels than learners who were in a controlling environment (educators that exert pressure on learners, are authoritarian and neglect learners' feelings). The learners that were exposed to the autonomy-supportive

environment also spent significantly more time in health-enhancing levels of physical activity than those from the controlling environment. The study shows that communication, empathy and diverse forms of language are powerful tools for educators to use physical education to increase participation in MVPA (Perlman, 2013:56).

Smuka (2012:285) showed that the presence of an educator during physical activities in a PE class encouraged the students to participate in physical activity. The participation of boys in the study increased five (5) times, while that of girls increased four (4) times in the presence of an educator. The boys' increased activity was attributed to their desire to demonstrate their skills to the educator. Huberty *et al*. (2013:427) also demonstrated that when educators were either directly engaged or verbally promoting MVPA and when equipment was present, higher proportions of both boys and girls participated in MVPA. They therefore concluded that educator training needs to include information on how to encourage children to be physically active.

Ruch *et al.* (2012:163-164) investigated the correlates of children's physical activity during physical education lessons and found that physical education that was offered in small classes by a specialist educator in larger gyms was positively associated with increased MVPA during physical education. The study also found that children that are more physically active during the day spent more time in MVPA during physical education lessons. This shows that focus should not only be placed on increasing PA during physical education but also on leisure time PA as the two areas of PA influence each other positively (Ruch *et al.,* 2012:163-164).

The investigation of environmental correlates of physical activity and sedentary behaviour in after-school recreation sessions found that sessions held outdoors were significantly more physically active (1.5 more minutes of MVPA) and less sedentary (1.5 less minutes of sedentary behaviour) than those held indoors (Rosenkranz *et al.,* 2011:S219), but perceived neighbourhood safety was a direct predictor of physical activity amongst children (Rutten *et al.,* 2013:285) and (Santos *et al.,* 2013:4). Neighbourhood safety and home settings, travel distance to and from activity areas and the weather, were all found to be the environmental factors that affected participation in physical activity (Stanley *et al.,* 2012:38). A positive correlation between infrastructure of the built environment and physical activity was also highlighted by Loucaides (2009: 727) where urban Cyprian youth reported more sidewalks in

the neighbourhood than rural schoolchildren. The rural schoolchildren presented with higher incidence of sedentary activity, overweight and obesity. Findings by Bergh *et al.* (2011:e321) contradicted the above findings as their study found no relationship between perceived environmental opportunities in the neighbourhood and schools and % MVPA.

Conversely Crawford *et al.* (2010:1184-1185) found that factors in the home environment were more important than the perceived or objective neighbourhood environment factors in influencing youth physical activity and BMI z-score over five years. Only two factors in the neighbourhood environment i.e. the presence of cul-de-sacs and the perception that there was heavy traffic, were independently associated with physical activity in boys. A systematic review of studies on the influence of the home environment on physical activity found that the availability of media equipment (television and games) was positively associated with screen-based sedentary behaviour, but access to physical activity equipment was unrelated to physical activity (Maitland *et al.* 2013:16).

Transport was reported as a barrier by Australian low-income and rural parents to their children's participation in physical activity (Smith *et al.,* 2010:8). Instrumental social support behaviours by parents were identified to be the enrolment of their children for physical activity, paying expenses for participation in it, and providing transport for it (Dominick *et al.*, 2012:709). Activity-related logistical support was identified as an important social correlate by Edwardson *et al.* (2014:578) with the provision of transport to physical activity venues as one of the identified important social correlates. These studies, though, need to be viewed in balance with the findings by Slingerland *et al.* (2012:230) that active transportation (walking or cycling) to school or sport activities contributed 15% to total physical activity energy expenditure. The authors thus recommended that active transport should be encouraged as a physical activity intervention. There are positive relationships between higher levels of self-efficacy and higher levels of participation in physical activity (Rutkowski & Connelly, 2011:56; Bergh *et al.,* 2011:e321; Kololo *et al.,* 2012:268).

Zhu and Chen (2013:301) found that adolescents' expectancy belief (one's thoughts about their chances of success in upcoming tasks) predicted their psychomotor achievements, which are significant predictors for their after-school physical activity participation. Rutten *et al.* (2013:283) also studied the mediating role of autonomous motivation (defined as choice by

the individual to participate in physical activity for fun or personal interest, or if the individual thinks that physical activity will help him/her to attain goals) in the relationship between environmental factors and physical activity among 10-12 year old children. The study showed that autonomous motivation mediates the relationship between social correlates and physical activity in children. Perceived autonomy support (support that values the individual's perspectives) from friends and parents, as well as parental logistic support, increases both the personal value that children attribute to physical activity and the fun that children experience when being physically active. This personal value and/or fun for physical activity then directly influences the children's physical activity behaviour.

Ning *et al.* (2013:7) investigated the associations between socio-motivational factors, physical education activity levels, and physical activity behaviour among the youth attending a suburban public school in the Southern United States, and found a positive relationship between enjoyment and self-efficacy with both physical activity during physical education and daily physical activity. Kololo *et al*. (2012:268) further found that adolescents with negative body image and a negative self-assessment of body weight participated in insufficient physical activity. Perceived competence and enjoyment were the most important intrinsic factors influencing participation in physical activity (Stanley *et al.*, 2012:38).

Gender was found by Loucaides (2009:728) and Leary *et al.* (2013:343) to have a significant role in self-efficacy for physical activity. Girls reported less self-efficacy and hence less participation in physical activity than boys. Loucaides (2009:728) also found that rural girls had the lowest levels of self-efficacy when compared to rural boys, urban girls and urban boys. Their participation in physical activity was also found to be the lowest. Early biological maturation in girls has a negative association with self-efficacy for physical activity. Physical self-concept was found to partially mediate the negative association between biological maturation and self-efficacy for physical activity (Jackson *et al.,* 2013:452).

2.9 SUMMARY

The literature review has shown that globally the physical activity levels of children and adolescents are below the levels recommended for the attainment of health-related physical fitness. This means that the majority of the youth researched have a great probability of attaining resultant chronic diseases of lifestyle in the future.

The literature review also demonstrates that participation by adolescents in physical activity leads to cardiorespiratory fitness, reduction in body weight and body fat and an improvement in muscular strength/endurance and flexibility. All the above benefits lead to a reduction in cardiovascular disease risk factors.

It has been demonstrated that social correlates have an impact on participation in physical activity and are a window of opportunity that can be used to influence and hence improve participation in physical activity and the resultant health-related physical fitness. It has also been demonstrated that girls are more affected by social correlates than boys and hence have lower levels of participation in physical activity.

The various modalities for the measurement of physical activity, health-related physical fitness and social correlates have also been reviewed to inform the instruments that should be used in the study. The above literature review will serve to inform the findings of this study which aim is to determine the following:

- The status of physical activity, health-related fitness and social correlates of physical activity among adolescents.
- The relationship between physical activity and social correlates of physical activity among adolescents.
- The relationship between health-related fitness and social correlates of physical activity in adolescents.

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CHAPTER 3: The status of physical activity, body composition and social correlates of physical activity among adolescents: the PAHL study

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The status of physical activity, body composition and social correlates of physical activity among adolescents: the PAHL study

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3.1 ABSTRACT

Research has shown that social correlates of physical activity play an important role in individual participation in physical activity or sport, and hence their link with associated health benefits. The purpose of this study was to determine the status of physical activity, health-related fitness and social correlates of physical activity. A cross-sectional study design on baseline data was followed on a total of 284 adolescents (111 boys and 173 girls) with the mean age of 14.90±0.72, who are part of the on-going Physical Activity and Health Longitudinal Study (PAHLS). Height, weight, skinfold thickness (triceps, subscapular and calf skinfolds), waist and hip circumferences were measured through the standard procedures described by the International Standard of Advancement of Kinanthropometry (ISAK). Body mass index (BMI), waist-to-hip ratio (WHR) and percentage body fat (%BF) were used as measures of body composition. The standardised International Physical Activity Questionnaire (IPAQ-Short form) and Social Support for Physical Activity questionnaire were used to gather information on participation in physical activity and social correlates for physical activity respectively. The results show that 29.6% of the 284 participants are underweight and 26.4% overweight. With regard to gender, 34.2% of boys are underweight and 17.1% overweight. 26.6% of girls, on the other hand, are underweight and 32.4% overweight. Out of 284 participants, 34% participated in low levels physical activity and 35% in high levels physical activity. With regard to the correlates of PA participation for the total group in a typical week on *"encouragement by friends or someone to do physical activity or sport"*; the percentage scores for 'never' range from 8-18%; 'sometimes' ranges from 46-61% and 'everyday' ranges from 23-43%. Correlates of PA participation in a typical week on *"do you do PA with friends or someone";* 'never' was between 9.3-10.5%, 'sometimes' between 46.8- 51.5% and 'everyday' between 38-43%. Correlates of PA participation in a

typical week on *"does someone or friends watch you when doing PA or sport";* 'never' accounted for 14%, 'sometimes' 48% and 'everyday' 38%. Correlates of PA participation in a typical week on *"did someone or friends tell you that you are doing good or well"*; 'never' was between 12- 19%, 'sometimes' accounted for 40% and 'everyday' between 30-38%. Correlates of physical activity, *"someone provided transportation to a place of PA or sport"*; 'never' was 36%, 'sometimes' 43% and 'everyday' 21%.

Conclusions: It can be concluded that the adolescent boys were underweight and highly active in comparison to the relatively overweight and inactive girls. It was clear from the correlates of PA in a typical week that adolescents' participation in PA was affected by many contrasts with the percentages in the 'never' ranging from 8-36% (of which lack of transportation to the PA facilities was the highest at 36%). Boys have high social correlates compared to the girls. Based on these findings, urgent strategic public health interventions by all stakeholders dealing with adolescents, as well as more research studies in the area are required.

Keywords: Physical activity, sport, health-related fitness, social support, correlates, adolescents.

3.2 INTRODUCTION

Research has shown that social correlates of physical activity play an important role in individual participation in physical activity or sport, and hence their link with associated health benefits (Sallis, Prochaska & Taylor, 2000; Sallis, Taylor, Dowda, Freedson & Pate, 2002). The World Health Organization (WHO) (2009) states that globally around 31% of adults aged 15 and over are insufficiently active (men 28% and women 34%). As a result, approximately 3.2 million deaths each year are attributable to insufficient physical activity (Mozaffarian, Afshin, Benowitz, Bittner, Daniels, Franch, Jacobs Jr, Kraus, Kris-Etherton, Krummel, Popkin, Whitsel & Zakai, 2012). The poor health status may increase the risk of premature death from heart disease, and developing breast or colon cancer (Kesaniemi, Danforth, Jr, Jensen, Kopelman, Lefebvre & Reeder, 2001; Horn, O'Neill, Pfeiffer, Dowda & Pate, 2008). The health problem is not limited to adults: in children, physical inactivity is one of the leading factors in childhood obesity, which also has psychological consequences including low self-esteem, depression, and body dissatisfaction (Antonogeorgos, Papadimitriou, Panagiotakos, Priftis & Polyxeni, 2010).

South Africa is not different to the global picture in terms of physical activity in the sense that the 2003 data on physical activity, as part of the World Health Survey, reported that less than one-third of South Africans met the American College of Sport Medicine (ACSM) and Center for Disease Control's (CDC) recommended physical activity levels, with 46% been inactive (Steyn, Fourie & Temple, 2006). The South African Youth Risk Behaviour Study (2002) reported that 38% of the youth participated in insufficient or no physical activity (within the past week), while 25% reported that they watch TV for more than 3 hours per day (Reddy, Resnicow, James, Funani, Kambaran, Omardien, Masuka, Sewpaul, Vaughan & Mbewu, 2012). A South African study by Joubert, Norman, Lambert, Groenewald, Schneider, Bull & Bradshaw (2007) also found that 30% of ischaemic heart disease, 27% of colon cancer, 22% of ischaemic stroke, 20% of Type 2 diabetes and 17% of breast cancer could be attributed to physical inactivity. The study estimated that 3.3% of all deaths in 2000 could be attributed to physical inactivity. Physical inactivity thus ranked 9th in terms of attributable deaths compared with other risk factors among South African adults.

Physical activity has been shown to decrease with age in children. Among girls, in particular, participation in leisure time physical activity has been shown to decline by about 45%

between ages 12-17 with a sharp decline in early adolescence. Physical activity has been found to decline at ages 11-12 (Neissar & Raudsepp, 2011) with sexual maturation and objectified body consciousness among adolescents associated with lower participation in physical activity (Visagurskiene, Jankauskiene, Vizbaraite, Pajaujiene & Griciute, 2012).

Janauskas (2013), in a study conducted on Lithuanian students, found that the reasons for physical inactivity were laziness, not having enough time, being dissatisfied with sports facilities, having an insufficient choice of sport clubs and an unwillingness to participate in sport. Dwyer, Allison, Goldenberg, Fein, Yoshida and Boutilier (2006) investigated adolescent girls' perceived barriers to participation in physical activity and also found that lack of time, involvement in technology-related activities, peer influence, parents and teachers, safety concerns, inaccessibility of facilities and the cost thereof, competition, and body-centeredness impeded adolescent girls from participating in sport.

Physical inactivity is not only a first-world problem. In Kenya it was found that urbanisation has led to decreasing levels of physical activity partly due to insufficient leisure time for physical activity and an increase in sedentary behaviour during occupational and domestic activities (Ojiambo, Easton, Casajus, Konstabel, Reilly & Pitsiladis, 2012). In South Africa, the demise of school sport and the lack of sporting facilities (especially in black schools) have also contributed to physical inactivity amongst children and youth (Sport and Recreation South Africa: National Sport and Recreation Plan, 2011). Shirinde, Monyeki, Pienaar & Toriola (2012) examined physical activity specifically among South African children attending farm schools and found that the majority of respondents cited lack of time, the demands of work or schoolwork and lack of skills as the major determinants of physical inactivity.

On the other hand, Koorts, Mattocks, Ness, Deere, Blair, Pate & Riddoch (2011) showed that a physically active childhood leads to higher physical activity levels in adulthood and that activity in adolescence predicted activity in adulthood in both males and females. The risk for adult inactivity has also been demonstrated to be significantly lower for those who were physically active in adolescence (Huotari, Nupponen, Mikkelsson, Laakso & Kujala, 2011).

In adolescence, specifically, it has been documented (Hallal, Victora, Azevedo, & Wells, 2006) that physical activity provides long-term benefits of bone strength, decreased risk of

breast cancer, and sedentary behaviours. It has also been found that a higher frequency of participation in physical activity is associated with less depression and anxiety and higher self-esteem (Moksnes, Moljord, Espnes & Byrne, 2010). Physical activity has also been shown to have mental health benefits in adolescence, as it reduces depression and anxiety, increases self-esteem, and improves cognitive functioning in children and adolescents (Biddle & Asare, 2011).

Bauman, Reis, Sallis, Wells, Loos & Martin (2012) have shown that correlates of physical activity such as age, sex, health status, self-efficacy, and motivation are associated with physical activity. The physical environment was also included by Bungum, Landers, Azzarelli & Moonie (2012) as a contributor to physical activity, with contributors such as urban planning, transportation systems, and parks and trails.

The social environment has also been shown to have a positive correlation with participation in physical activity among adolescents (Hsu, Chih-Ping Chou, Nguyen-Rodriguez, McClain, Belcher & Spruijt-Metz, 2011). Martin-Matillas, Ortega, Ruiz, Martinez-Gomez, Vicente-Rodríguez, Marcos, Béghin, Kafatos, González-Gross, Zaccaria, Molnár, De Henauw, Sjöström, Moreno & Castillo (2012) conducted the HELENA study in 10 cities from nine European countries in 2006-2008 where the relationship between relatives' (father, mother, brother, sister, and best friend) physical activity participation and encouragement on adolescents' physical fitness was examined. It was found that relatives' physical activity participation was positively related to physical fitness, cardiorespiratory fitness and higher muscular strength in adolescents.

Davison (2009), though, showed that parents reported community-based, interpersonal, and intrapersonal barriers to supporting their children's physical activity. The highest reported barriers included the importance of children's academic performance, a lack of facilities, and concerns about the children's safety. Parents who reported greater barriers also reported lower support for their children's physical activity. In the United States, the neighbourhoods' socioeconomic status was also found to contribute to participation in physical activity where lower parental education and higher levels of social deprivation were found to be associated with higher BMI in adolescent girls (Voorhees, Catellier, Ashwood *et al*., 2009).

In spite of the health benefits associated with physical activity, many children do not meet the daily guidelines of being active for at least 30 minutes a day (Draper, Basset, de Villiers,

Lambert, Uys, Bartels, Blomkamp, Micklesfield, Kruger, Monyeki, Puoane, Naidoo, Dugmore, Walters, Naidoo, Bacon, McQuaide, Josephs & Christie, 2014). The extent of the impact of social correlates of physical activity on health-related fitness and participation in physical activity amongst the youth of Tlokwe municipality is not known. The purpose of this study was, therefore, to determine the status of physical activity, body composition and social correlates of physical activity. It is hypothesised that girls will be fatter, shorter, less active and have less social correlates for PA than the boys; and boys will be thinner, taller, more active and have more social correlates for PA than the girls. The study findings will inform policymakers on interventions to increase physical activity and thus improve the health of the youth residing in the Tlokwe municipality.

3.3 METHODOLOGY

Design and subjects

The Physical Activity and Health Longitudinal Study (PAHLS) is an observational multidisciplinary longitudinal design that started in 2010 with a group of 312 boys and girls aged 14 years who were purposefully drawn from six secondary schools (two in Potchefstroom town and the other four in its surroundings – Ikageng Township. All the schools were day schools. The schools included in the study are from a high socioeconomic environment (town), and a low socioeconomic status (township). The schools included were those who granted permission for the study to be carried out. School-based locality comprised four schools from town and four schools located in township areas. Therefore, the included schools covered both low (Ikageng Township) and high socio-economic circumstances (Potchefstroom town) of learners. Out of the eight schools initially selected, two urban schools declined to participate (without providing reasons). This article presents the findings of the baseline (2010) data. Included children were those who were healthy, 14 years age at the baseline measurements and completed the inform consent. Of which those who did not comply with the inclusion criteria were excluded. Detailed information regarding the participants has been published elsewhere (Monyeki, Neetens, Moss & Twisk (2012).

Anthropometric measurements

Anthropometric measurements of height, weight, skinfolds thickness (triceps, subscapular and calf skinfolds), and waist and hip circumferences were measured through the standard procedures described by the International Standard of Advancement of Kinanthropometry

(Norton & Olds, 1996). BMI, as a measure of body composition, was calculated as body mass/stature² (kg/m²). Waist to hip ratio (WHR) used as a measure of body fat distribution was calculated as waist divided by hip. Percentage body fat was derived from skinfolds measurements according to the equation developed by Slaughter, Lohman, Boileau, Horswill, Stillman, Van Loan and Bemben (1988).

Physical activity

Physical activity was assessed by the use of the short form International Physical Activity Questionnaire (IPAQ) (CDC, 2002; WHO, 2002; WHO, 2009). The ***IPAQ questionnaire*** is a valid and reliable tool for assessing physical activity (Craig, Marshall, Sjostrom, Bauman, Booth, Ainsworth, Pratt, Yngve & Sallis, 2003). The questionnaire is comprised of seven questions which ask the participants about the frequency and time spent in sitting, walking and moderate-to-vigorous intensity physical activity (including physical activity related to occupation, transportation, household chores and leisure time activity) in the last seven days. Only those sessions which lasted ten minutes or more were analysed. Total Physical Activity (TPA) was calculated as the metabolic equivalent (Total MET-min/week = (Walk METs*min*days) + (Mod METs*min*days) + Vig METs*min*days) scores for moderate-to-vigorous, walking and sitting activities in the last seven days. Subsequently, TPA was categorised into three groups namely, Low level of TPA= 495 MET-min/week, Moderate level of TPA= 600 MET-min/week and High level of TPA= 1200 MET-min/week.

Social Support for Physical Activity

A standardised questionnaire on the Social Support for Physical Activity was used to gather information on social correlates for physical activity (Sallis *et al.,* 2002). The Social Support for Physical Activity Scale included nine (9) statements rated on a three-point Likert-type scale (*i.e.* 'never', 'sometimes', and 'everyday'). For this paper the social support for physical activity in a typical week participation in PA or sport were grouped together under the following sub-themes on the basis of their commonality as reflected in Table 1:

a. *Encouragement by friends or someone* which covers question numbers: 1) During a typical week, how often do you encourage your friend to do physical activity or play sports?, 2) During a typical week, how often do your friends encourage you to do physical activity or sports?, and 5) During a typical week has someone encouraged you to do physical activities or sports?

b. *Do you do PA or sport with friends or someone*, covers question numbers: 3) During a typical week, how often do your friends do physical activities or play sport with you?, and 6) During a typical week has someone done a physical activity or played sports with you?

c. *Did someone watch you when you participated in PA or Sport*, covers question 8) During a typical week has someone watched you participate in physical activities of sports?

d. *Did someone or friends tell you that you are doing good or well,* covers question numbers 4) During a typical week, how often do your friends tell you that you are doing a good job at physical activity?, and 9) During a typical week has someone told you that you are doing well in physical activity?

e. *Transportation to the PA or sport facilities,* covers question 7) During a typical week has someone provided transportation to a place where you can do physical activities or play sports?

Measurement procedures

Prior to data collection, permission to conduct the measurements was granted by the District Manager of the Department of Education in Potchefstroom, North West Province. In addition, clearance was received from the Ethics Committee of North-West University, Potchefstroom Campus (Ethics no: NWU-0058-01-A1). The participating schools were briefed about the purpose of the study, and the informed consent forms were signed by the school authorities as well as the learners and their parents. To minimise loss of interest and fatigue among the participants and prevent disruption of teaching and learning activities at the schools, data were collected on days agreed by the participating schools. Only the data of learners who were 14 years old as at the time of testing were analysed.

Before the anthropometric measurements were carried out, and the IPAQ was administered to the participants who were assembled in a classroom, under the supervision of the principal investigator. In completing the IPAQ adequate instructions and clarifications, with no time limit set for completion, were given to the students who subsequently filled the questionnaires independently, without interference from fellow classmates. All anthropometric sites were measured according to standard procedures as described by

International Standards for Anthropometric Assessment (ISAK) by Level 2 ISAK certified Anthropometrists. The technical error of measurement (TEM) was calculated by applying the formula of Pederson and Gore (1996) and values of 1.27% (1.24 mm) were revealed for all skin-fold measurements, 2.08% (0.56 cm) and 1.23% (0.79 cm) for all length measurements.

Statistical analyses

Descriptive statistics (minimum, maximum, means, SD) and frequencies were determined by the use of the SPSS program. Differences of continuous variables were determined by the use of an independent *t*–test and one-way analyses of variances. For the differences for continuous variable a Chi-square was used. The p-value for significance was set at ≤0.05.

3.4 RESULTS

3.4.1 Body composition

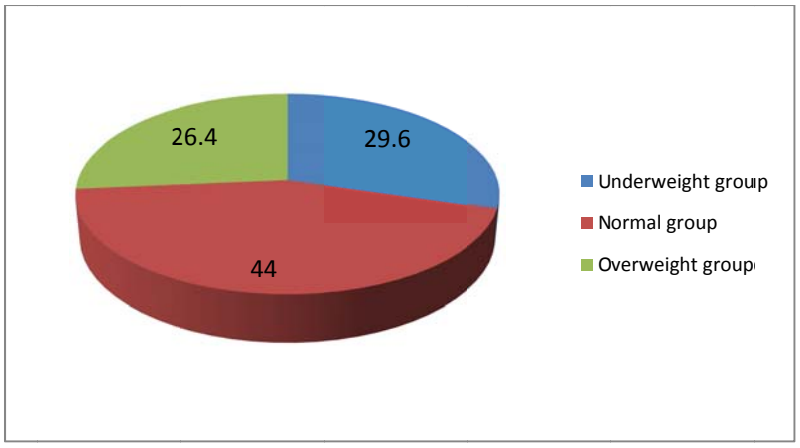

Figure 3.1: Percentage (%) of BMI categories for the total group

Figure 3.1 presents the percentages of BMI categories for the total group (111 boys and 173 girls). 29.6% out of 284 participants were underweight and 26.4% were overweight. With regard to gender, 34.2% of boys were underweight and 17.1% were overweight, while 26.6% of girls were underweight and 32.4% overweight.

Table 3.1: Descriptive characteristics (min, max, mean and SD) for body composition for the total group.

	N	Minimum	Maximum	Mean	SD
Stature (cm)	284	139.60	192.30	160.83	8.85
Body Mass (kg)	284	21.0	110.3	54.33	13.22
BMI	284	8.22	38.65	20.88	4.17
%BF	284	3.60	54.47	20.10	10.57
WC	284	52.30	106.20	67.81	8.51
WHR	284	0.63	0.90	0.76	0.05

%BF=percentage body fat; WC= waist circumference; BMI= body mass index; WHR= waist to hip ratio

Table 3.1 presents the body composition for the total group. The maximum value for BMI is 38.65 (mean=20.88); %BF 54.47 (mean 20.10); WC maximum 106.2 (mean=67.81) and WHR 0.90 (mean=0.76).

Table 3.2: Characteristics of body composition and differences for boys (n=111) and girls (n=173)

	Gender	Mean	SD	P value of the gender differences
Stature (cm)	Male	165.41	9.55	<0.00
	Female	157.89	6.95	
Body Mass (kg)	Male	55.30	13.77	0.33
	Female	53.70	12.86	
BMI (kg/m^2)	Male	20.01	3.71	0.003
	Female	21.43	4.37	
%BF	Male	13.19	8.55	<0.00
	Female	26.01	8.51	
WC (cm)	Male	68.11	8.29	0.64
	Female	67.62	8.67	
WHR	Male	0.80	0.03	<0.00
	Female	0.73	0.04	

%BF=percentage body fat; WC= waist circumference; BMI= body mass index; WHR= waist to hip ratio

Table 3.2 presents the body composition differences between boys and girls. Girls are significantly ($p<0.05$) fatter (%BF and BMI) and shorter than the boys. Although boys were heavier than the girls a non-significant difference was observed. A non-significant difference was also found in waist circumference. A significant difference ($p<0.05$) was observed in WHR.

3.4.2 Physical Activity

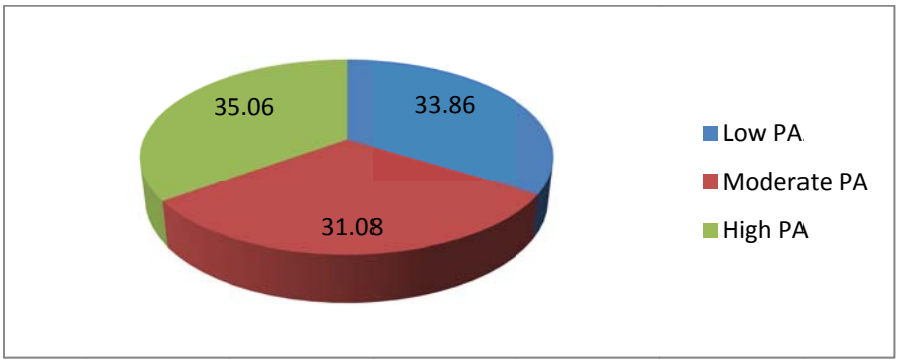

Figure 3.2: Percentage (%) physical activity

Figure 3.2 presents the physical activity for the total group. The results show that out of the total group (n=284), 34% participated in low physical activity with 35% in high PA.

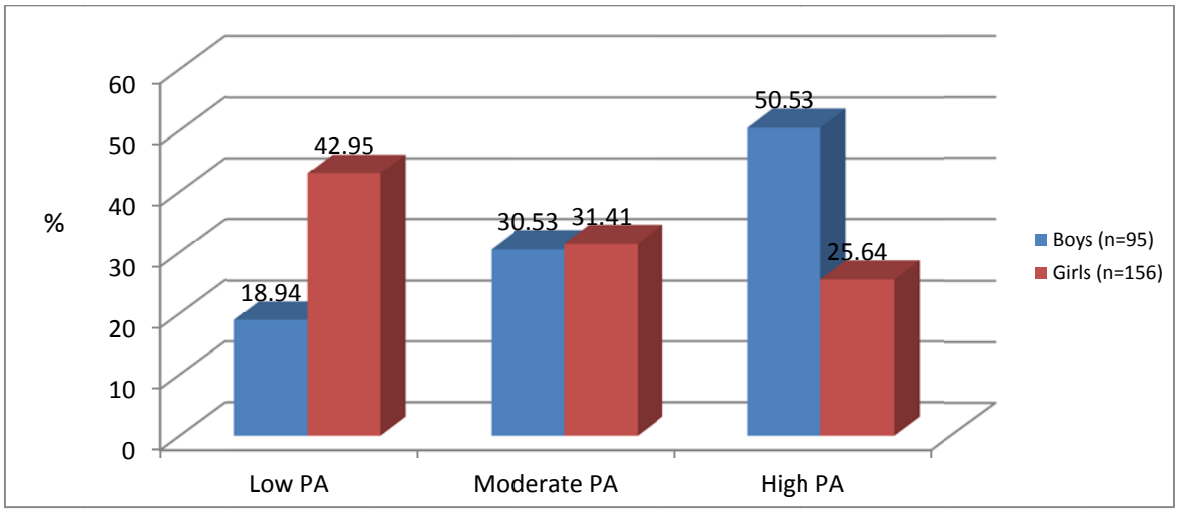

Figure 3.3: Graphic distribution of PA for boys and girls

Figure 3.3 presents the PA distribution by gender. The results show that boys were highly active when compared to the girls.

Table 3.3: Percentage (%) social correlates of PA for the total group (n=237)

Social correlates variables (1-9) During a typical week,....	**Never**		**Sometimes**		**Everyday**	
	n	**%**	**n**	**%**	**n**	**%**
1. How often **do you encourage your friend** to do physical activity or play sports?	19	8.01	157	66.2	61	25.7
2. How often **do your friends encourage you** to do physical activity or sports?	44	18.6	138	58.5	54	22.9
3. How often **do your friends do physical activities or play sport** with you?	22	9.3	111	46.8	102	43.0
4. How often **do your friends tell you that you are doing a good job** at physical activity?	45	19	119	50.2	71	30
5. Has **someone encouraged** you to do physical activities or sports?	37	15	120	51	80	34
6. Has **someone done a physical activity or played sports** with you?	25	10.5	122	51.5	90	38
7. Has **someone provided transportation to a place** where you can do physical activities or play sports?	86	36	101	43	50	21
8. Has **someone watched you participate** in physical activities of sports?	32	14	114	48	90	38
9. Has **someone told you that you are doing well** in physical activity?	22	12	118	50	90	38

Table 3.3 presents the results on the social correlates of PA for the total group during a typical week. For the total group, 36% indicated that they never have someone who provides them with transportation to a place where they can do physical activities or play sports. 19% of the participants indicated that they never have friends who tell them that they are doing a good job at physical activity, followed by 18.6% who indicated that their friends never encourage them to do physical activities or play sport, 15% who never have someone encourage them to do physical activities or sports, 14% never have someone watch them participate in physical activities or sports, and 12% never have someone tell them that they are doing well in physical activity.

Table 3.4: Percentage (%) social correlates of PA by gender

Social correlates variables (1–9) During a typical week, ...		**Never**		**Sometimes**		**Everyday**	
		n	**%**	**n**	**%**	**n**	**%**
1. How often **do you encourage your friend** to do physical activity or play sports?	Males	7	8	50	57.5	30	34.5
	Females	11	7.9	98	70.0	31	22.1
2. How often **do your friends encourage you** to do physical activity or sports?	Males	7	8	55	63.2	25	28.1
	Females	33	23.6	8.	57.1	27	19.3
3. How often **do your friends do physical activities or play sport** with you?	Males	5	5.7	35	40.2	47	54
	Females	17	12.1	72	51.4	51	36.4
4. How often **do your friends tell you that you are doing a good job** at physical activity?	Males	10	11.5	41	47.1	36	41.4
	Females	34	24.3	73	52.1	33	23.6
5. Has **someone encouraged** you to do physical activities or sports?	Males	13	14.9	45	51.7	29	33.3
	Females	19	13.6	71	50.7	50	35.7
6. Has **someone done a physical activity or played sports** with you?	Males	7	8	39	44.8	41	47.1
	Females	11	7.9	82	58.6	47	33.6
7. Has **someone provided transportation to a place** where you can do physical activities or play sports?	Males	26	29.9	39	44.8	22	25.3
	Females	54	38.6	60	42.9	26	18.6
8. Has **someone watched you participate** in physical activities or sports?	Males	10	11.5	41	47.1	36	41.4
	Females	21	15.0	68	48.6	51	36.4
9. Has **someone told you that you are doing well** in physical activity?	Males	9	10.3	41	47.1	37	42.5
	Females	17	12.1	72	51.4	51	36.4

Table 3.4 presents the percentage social correlates of PA during a typical week by gender. Girls indicated a high percentage for ‘never’ (24%) regarding encouragement from friends to do physical activity or sport, in comparison to their male counterparts (8%). Furthermore the results show that girls have a high percentage for ‘never’ (12.1%) compared to (6%) of boys in terms of friends who do physical activity or do sport with them. Additionally, the results show that girls (24%) in comparison to the boys (12%) never have friends tell them that they are doing a good job in physical activity or sport. The results further indicated that girls (39%) and boys (30%) do not have someone who provides transportation to a place where they can do physical activities or play sport.

3.5 DISCUSSION

The purpose of this study was to determine the status of physical activity, health-related fitness and social correlates of physical activity. Girls in the study were found to be significantly fatter (%BF and BMI) and shorter than the boys. A significant difference was also observed in WHR where girls were found to have a higher WHR than the boys. Boys in the present study were more underweight and active when compared to girls who were overweight and inactive. These findings are consistent with the findings of a study on Hong

Kong adolescents, where girls were found to have higher %BF and BMI and a higher waist to stature ratio than boys (Mak, McManus & Lai, 2013).

The adolescents in the study had relatively high physical activity participation. These findings are congruent with the recent findings on the same sample by Toriola and Monyeki (2012). When the current findings were compared with other studies in South Africa variations in terms of participation prevailed (Micklesfield, Pedro, Kahn, Kinsman, Pettifor, Tollman & Norris, 2014; Craig, Bland & Reilley, 2012). The reasons for these variations, amongst others, can be explained by the different instruments used to assess physical activity in children (Cain, Sallis, Conway, Van Dyck & Calhoon, 2013; Scruggs, Mungen & Oh, 2010). The findings of this study are somewhat in line with some findings reported in Mozambican adolescents (Prista, Nhantumbo & Saranga, 2009), Kenyan children (Ojiambo *et al.,* 2012) and Nigerian children (Olubusola, Obembe & Faniran, 2013). Even though the adolescents in the study do not necessarily meet the recommendations of 60 minutes a day they appear to be better than adolescents in developed countries like the USA (Vigo-Valentin, Bush & Hodge, 2014).

It is well known that participation in physical activity is based on the social-ecological model as proposed by Sallis, Owen and Fisher (2008). In the findings of this study it was apparent that adolescents' participation in physical activity was affected by *'lack of support by friends', 'encouragement by friends or family members' and 'lack of support during engagement in physical activity'*. Similar findings were reported by Serra, Casterad and Generelo (2014) who highlighted *'support from friends'*; and Cheng, Mendonca and Farias (2014) who found parents to be a positive factor for engaging in physical activity.

The results show that girls were mostly affected by their friends' *'encouragement to participate in sport or physical activity'* in comparison to their male counterparts. Dwyer *et al.* (2006), in the study on adolescent girls' perceived barriers to participation in physical activity, found that *'lack of peer influence and parents'* were factors, amongst others, which affected the non-participation. Bungum *et al*. (2012) indicated that the physical environment, such as *'lack of transportation'*, affects participation in physical activity. Such a trend was evident in the current study where both boys and girls shared high percentages in terms of *'lack of availability of transportation'* to the place of sport or physical activity. Zhanga, Solmon, Gao & Kosma (2012) reported that 1.1% of variation in physical activity

participation is accounted for by the physical environment. In contrast, findings by Xu, Chepyator-Thomson, Liu and Schmidlein (2010) indicated that transportation did not have a strong impact on students' participation in extracurricular physical activity.

Interpretation of these findings needs to be conducted with caution as the sample size of this study cannot be used for generalisation of the adolescent population in the Tlokwe local municipality or the South African adolescent population. Furthermore, the cross-sectional design of the study may somewhat have affected the interpretation of the results in the sense that some of the aspects/variables change over a period of time. Regardless of these weaknesses, the strength of the PAHLS study is that it is planned for a period of time, where some of the variables will be tracked longitudinally to determine the development over time. The PAHLS study is based on one birth cohort (14 years) that was followed up for a period of five years.

3.6 CONCLUSION

It can be concluded that the adolescent boys were underweight and highly active compared to the relatively overweight and inactive girls. Boys have high social correlates compared to the girls. Transportation played a major role as a correlate to participation in physical activity or sport, with 36% of the participants indicating lack of transport as a negative factor for their participation in physical activity and sport. Based on these findings, urgent strategic public health interventions by all stakeholders dealing with adolescents as well as more research studies in the area are required.

3.7 ACKNOWLEDGEMENTS

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Disclaimer: Any opinion, findings and conclusions or recommendations expressed in this material are those of the author(s), and therefore the NRF and MRC do not accept any liability in this regard.

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CHAPTER 4: The relationship between physical activity and social correlates of physical activity among adolescents: the PAHL study

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Relationship between physical activity and social correlates of physical activity among adolescents: the PAHL study

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4.1 ABSTRACT

Background: Social correlates of physical activity have been shown in numerous studies to have an impact on adolescent participation in physical activity. The extent of the impact of social correlates of physical activity on participation in physical activity amongst the adolescents of Tlokwe municipality is not known.

Purpose: The purpose of this study was to determine the relationship between physical activity and social correlates of physical activity amongst adolescents attending high schools in the Tlokwe municipality of the North West province, South Africa.

Methods: A cross-sectional study design was followed on a total of 284 adolescents (111 boys and 173 girls) with the mean age of 14.90±0.72, who are part of the on-going Physical Activity and Health Longitudinal study (PAHLS). The standardized short form International Physical Activity Questionnaire (IPAQ) and Social Support for Physical Activity questionnaires were used to gather information on social correlates for physical activity.

Results: Out of the 284 participants, 34% participated in low levels physical activity and 35% in high levels physical activity. With regard to the correlates of physical activity; For correlates of physical activity specific to *encouragement and support by friends*, the percentage scores for 'never' range from 8-18%; 'sometimes' ranges from 46-61%, and 'everyday' ranges from 23-43%. The scores for the *transportation-specific correlate of physical activity*; 'never' is 36%, 'sometimes' 43% and 'everyday' 21%. For correlates specific to *encouragement and support by someone*; 'never' ranges from 10-15%; 'sometimes' ranges from 48-51%, and 'everyday' from 34-38%. Participation in physical activity in a week was positively associated with all social correlates of physical activity with a significant ($p<0.05$) relationship with *encouragement from friends and others that one is doing good job or well in physical activity.*

Conclusions: It can be concluded that 34% of the adolescents participated in a low level of physical activity on the one hand, while on the other side 35% participated in a high level of physical activity. Furthermore, participation in physical activity during the week was positively associated with social correlates from encouragement from friends.

Keywords: Physical activity, sport, health, social support, correlates, adolescents.

4.2 INTRODUCTION

The social cognitive theory states that mechanisms in individuals' social environments, including modelling of behaviour, access or barriers to resources, reinforcement of behaviour, and social norms for behaviours influence the individuals' participation in behaviours that promote or harm health.[1] This is demonstrated in physical activity research which has shown that social correlates of physical activity play an important role in individual participation in physical activity or sport, and hence their link with associated health benefits.[2-3]

Physical activity leads to direct improvements in health status.[4] Physically active adolescents display healthier cardiovascular profiles, have healthy body composition and develop higher peak bone masses than their less active counterparts.[5] Physical activity, in addition to energy expenditure, results in improvements in the five (5) dimensions of health-related physical fitness i.e. cardiorespiratory fitness, musculoskeletal fitness, flexibility, balance and coordination, and body composition.[6]

With all the known benefits of physical activity, the South African Youth Risk Behaviour Study (2002) found that 38% of adolescents participated in insufficient or no physical activity (within the past week).[7] Physical activity intensity and time spent in physical activity have also been found to reduce with age in children and adolescents.[8] Furthermore, adolescent girls are less physically active than boys and show significantly lower total daily physical activity than boys. [8-10] The majority of adolescent girls, therefore, do not meet the health recommendations for physical activity and are at risk for the attainment of chronic diseases of lifestyle.[11] Participation in leisure time physical activity among girls has also been reported to show a decline of about 45% between ages 12-17 with a sharp decline in early adolescence.[12]

Participation in physical activity is affected by the social correlates of physical activity such as age, sex, health status, self-efficacy and motivation.[13] The social environment has also been shown to have a positive correlation with participation in physical activity among adolescents.[14] Martin-Matillas *et al*[15] conducted the HELENA study in 10 cities from nine European countries in 2006-2008 where the relationship between relatives' (father, mother, brother, sister, and best friend) physical activity participation and encouragement on adolescents' physical fitness was examined. It was found that relatives' physical activity participation was positively related to physical fitness, cardiorespiratory fitness and higher

muscular strength in adolescents. Parents and friends, specifically, were found to have a social influence on adolescents' level of physical activity through behaviour modelling or through social support.[16]

Tandon *et al*[17] identified parental support for physical activity to be positively associated with Moderate to Vigorous Physical Activity (MVPA) and negatively associated with sedentary behaviour. Trost *et al*[18] also identified positive associations between parental support and encouragement for physical activity and adolescents' physical activity. Parental modelling of physical activity was also found to be consistently associated with physical activity, specifically among adolescent girls.[19] On the contrary, Bauman *et al*[13] and Ferreira *et al*[20] found no significant association between parental activity, support and encouragement and adolescent participation in physical activity.

While parental support is reported to play a positive role in adolescent participation in physical activity, Davison[21] found that parents reported community-based, interpersonal, and intrapersonal barriers to supporting their children's physical activity. The highest reported barriers included the importance of children's academic performance, a lack of facilities, and concerns about the children's safety. Parents who reported greater barriers also reported lower support for their children's physical activity. In the United States, the neighbourhoods' socioeconomic status was also found to contribute to participation in physical activity, where lower parental education and higher levels of social deprivation were found to be associated with higher BMI in adolescent girls.[22]

Bergh *et al*[23] and Serra *et al*[24] found that the influence of friends was positively associated with participation of adolescents in physical activity. The significance of friendship was also demonstrated by a study conducted in two countries by Silva *et al*[25] (Portugal and USA) where social support from friends was categorised as a reinforcing factor in the Youth Physical Activity Promotion (YPAP) model and found to have a significant effect on physical activity in both countries. In support of the above findings, Salvy *et al*[26] found that friendships may increase youth's motivation to engage in physical activity and promote greater physical activity. Kirby *et al*[8] though, found that boys had higher peer support than girls, resulting in girls participating less in physical activity than boys.

The home environment and the physical environment were also found to be contributors to physical activity, with the main contributors being urban planning, transportation systems and parks and trails.[17,27] Zhang *et al*[28] reported that 1.1% of variation in physical activity participation is accounted for by the physical environment. In contrast, findings by Xu *et al*[29] and Evenson *et al*[30] showed that transportation did not have a strong impact on adolescents' participation in extracurricular physical activity.

In spite of the health benefits associated with physical activity, many adolescents do not meet the daily guidelines of being active for at least 30 minutes a day.[31] Research has shown that adolescent participation in physical activity has a positive influence on health-related fitness but is influenced by social correlates for physical activity.[5,2,3] Adolescent girls' participation in physical activity is lower than that of boys, and is impeded by perceived barriers such as lack of time, involvement in technology-related activities, peer influence, parents and teachers, safety concerns, inaccessibility of facilities and the cost thereof, competition, and body-centeredness.[8,32]

The extent of the impact of social correlates of physical activity on participation in physical activity amongst the youth of Tlokwe municipality is not known. The purpose of this study was to determine the relationship between physical activity and social correlates of physical activity.

4.3 METHODS

Participants and Design

The Physical Activity and Health Longitudinal Study (PAHLS) is an observational multidisciplinary longitudinal design which began in 2010 with a group of about 312 boys and girls from six secondary schools in the Tlokwe local municipality, one of the four local municipalities in the Dr Kenneth Kaunda District Municipality of the North West Province of South Africa. Two of the schools were in Potchefstroom town and the other four in its surroundings–Ikageng Township. The schools included in the study are from the high socio-economic (Town) and low socio-economic (Township) status. More details about the PAHLS study are described elsewhere.[33]

4.4 MEASUREMENTS

Physical activity

Physical activity was assessed by the use of both the short form International Physical Activity Questionnaire (IPAQ).[34;35] The ***IPAQ questionnaire*** is comprised of seven questions which ask the participants about the frequency and time spent in sitting, walking and moderate-to-vigorous intensity physical activity (including physical activity related to occupation, transportation, household chores and leisure time activity) in the last seven days. Analysis was only performed on those sessions which lasted ten minutes or more. Total Physical Activity (TPA) was calculated as the metabolic equivalent (Total MET-min/week = (Walk METs*min*days) + (Mod METs*min*days) + Vig METs*min*days) scores for moderate-to-vigorous, walking and sitting activities in the last seven days. Subsequently, TPA was categorised into three groups namely, Low level of TPA= 495 MET-min/week, Moderate level of TPA= 600 MET-min/week and High level of TPA= 1200 MET-min/week.

Social Support for Physical Activity

A standardised questionnaire on Social Support for Physical Activity was used to gather information on social correlates for physical activity.[3] The Social Support for Physical Activity Scale was composed of nine (9) statements rated on a three-point Likert-type scale (*i.e.* Never; Sometimes and Everyday). All nine (9) Social Support for Physical Activity statements showed a Cronbach's alpha of 0.74, with inter-item correlations ranging from r=0.23 to r=0.45, respectively.

Measurement procedures

Prior to data collection, permission to conduct the measurements was granted by the District Manager of the Department of Education in Potchefstroom, North West Province. In addition, clearance was received from the Ethics Committee of North-West University, Potchefstroom Campus (Ethics no: NWU-0058-01-A1). The participating schools were briefed about the purpose of the study, and the informed consent forms were signed by the school authorities as well as the learners and their parents. To minimise loss of interest and fatigue among the participants and prevent disruption of teaching and learning activities at the schools, data were collected on days agreed by the participating schools. Only the data of learners who were 14 years old as at the time of testing were analysed.

Before the anthropometric measurements were carried out, and the IPAQ was administered to the participants who were assembled in a classroom, under the supervision of the principal investigator. In completing the IPAQ adequate instructions and clarifications, with no time limit set for completion, were given to the students who subsequently filled the questionnaires independently, without interference from fellow classmates. All anthropometric sites were measured according to standard procedures as described by International Standards for Anthropometric Assessment (ISAK) by Level 2 ISAK certified Anthropometrists. The technical error of measurement (TEM) was calculated by applying the formula of Pederson and Gore [36] and values of 1.27% (1.24 mm) were revealed for all skin-fold measurements, 2.08% (0.56 cm) and 1.23% (0.79 cm) for all length measurements.

Statistical analyses

Descriptive statistics (means, SD) and frequencies were determined by the use of the SPSS program. Differences of continuous variables were determined by the use of an independent *t*–test and one way analyses of variances. Mann-Whitney *U t-test* was calculated to test the significant differences between boys and girls in all outcome variables of the study. Correlation coefficients (*r*) were analysed to study the relationship between physical activity and social correlates of physical activity. The p-value for significance was set at ≤0.05.

4.5 RESULTS

Physical Activity

Figure 4.1 presents the physical activity for the total group. The results show that out of the total group (n=284), 34% participated in low physical activity, with 35% in high physical activity.

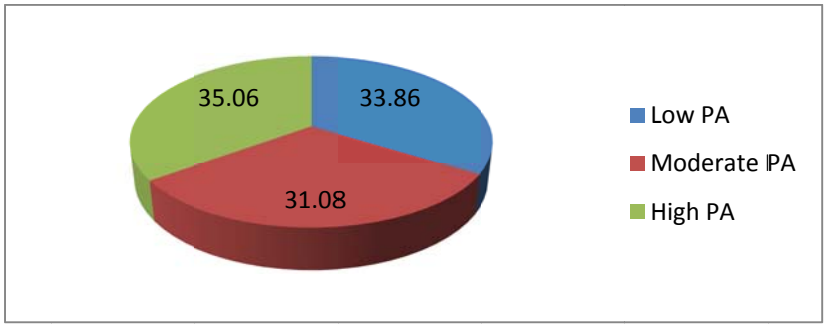

Figure 4.1: Percentage (%) physical activity

Figure 4.2 presents the PA distribution by gender. The results show that boys were significantly (z-4.52; p=0.000) highly active as compared to the girls.

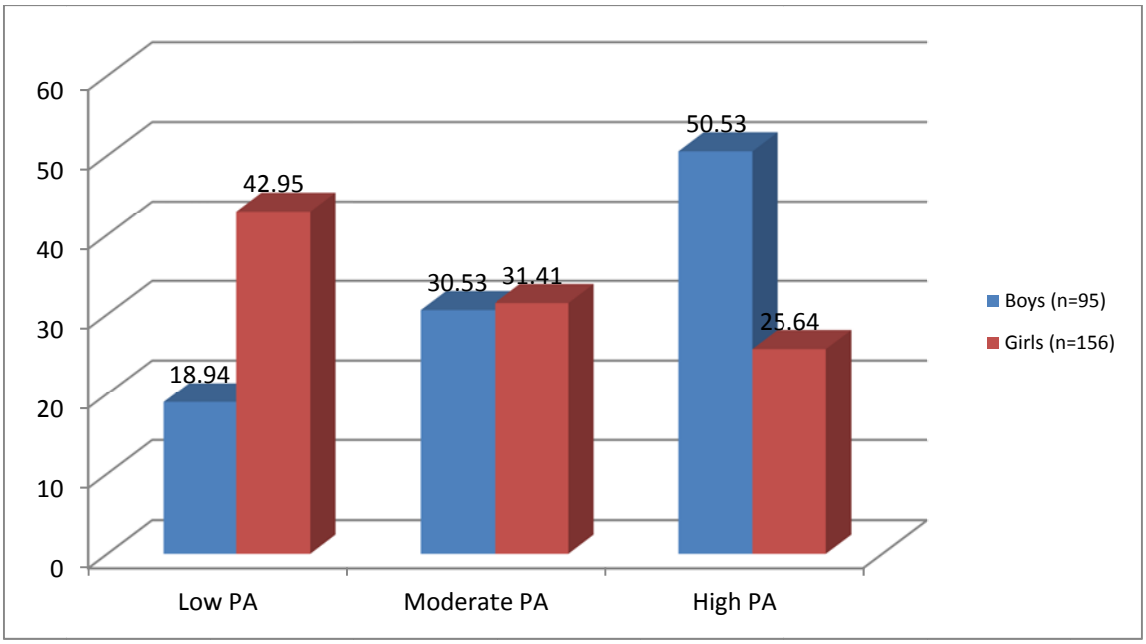

Figure 4.2: Graphic distribution of PA for boys and girls

Social correlates of physical activity

Table 4.1 presents the results on the social correlates of PA for the total group during a typical week. With regard to Social Correlate One (1) of PA, 66% of the participants indicated that sometimes they encourage their friends to do physical activity or sport. Social Correlate Two (2) of PA showed that 59% of the participants indicated that friends in turn sometimes encourage them to do physical activity or sport. The results of Social Correlate Three (3) of PA showed that 9%, 47% and 43% of the participants indicated that they participate in PA or sport never, sometimes and everyday respectively. With regard to doing a good job at participation in sport, the results for Social Correlate Four (4) of PA showed that 50% of the participants are sometimes told by their friends that they are doing a good job, while 19% were never told, and 30% were always told by their friends that they are doing a good job. With regard to Social Correlate Five (5) of PA, 51% indicated that they were sometimes encouraged to do PA or sport.

Table 4.1: Percentage (%) social correlates of PA for the total group (n=237)

Social correlates variables (1-9) During a typical week,....	**Never**		**Sometimes**		**Everyday**	
	n	**%**	**n**	**%**	**n**	**%**
1. How often ***do you encourage your friend*** to do physical activity or play sports?	19	8.01	157	66.2	61	25.7
2. How often ***do your friends encourage you*** to do physical activity or sports?	44	18.6	138	58.5	54	22.9
3. How often ***do your friends do physical activities or play sport*** with you?	22	9.4	111	47.2	102	43.4
4. How often ***do your friends tell you that you are doing a good job*** at physical activity?	45	19.2	118	50.4	71	30.3
5. Has ***someone encouraged*** you to do physical activities or sports?	37	15	120	51	80	34
6. Has ***someone done a physical activity or played sports*** with you?	25	10.5	122	51.5	90	38
7. Has ***someone provided transportation to a place*** where you can do physical activities or play sports?	86	36	101	43	50	21
8. Has ***someone watched you participate*** in physical activities of sports?	32	14	114	48	90	38
9. Has ***someone told you that you are doing well*** in physical activity?	22	12	118	50	90	38

Social Correlate Six (6) of PA showed that 52% of the participants sometimes had another person participate in PA or sport with them. With regard to provision of transportation to a place where the participants could participate in PA or sport, Social Correlate Seven (7) of PA showed that 43% indicated that they were sometimes offered transportation, while 36% stated that they were never offered transportation. Social Correlate Eight (8) of PA showed that 48% of the participants sometimes had someone watch them participate in PA or sport, while Social Correlate Nine (9) of PA showed that 50% indicated that people sometimes told them that they are doing well in PA.

Table 4.2: Percentage (%) social correlates of PA for the total group (n=237) by gender

Social correlates variables (1–9) During a typical week,....		**Never**		**Sometimes**		**Everyday**		**P-value of the differences**
		n	**%**	**n**	**%**	**n**	**%**	
1. How often ***do you encourage your friend*** to do physical activity or play sports?	Males	7	8	50	57.5	30	34.5	0.065
	Females	11	7.9	98	70.0	31	22.1	
2. How often ***do your friends encourage you*** to do physical activity or sports?	Males	7	8	55	62.5	26	29.5	0.002
	Females	33	23.6	8.	57.1	27	19.3	
3. How often ***do your friends do physical activities or play sport*** with you?	Males	5	5.7	35	40.2	47	54	0.006
	Females	17	12.1	72	51.4	51	36.4	
4. How often ***do your friends tell you that you are doing a good job*** at physical activity?	Males	10	11.5	41	47.1	36	41.4	0.002
	Females	34	24.3	73	52.1	33	23.6	
5. Has ***someone encouraged*** you to do physical activities or sports?	Males	13	14.9	45	51.7	29	33.3	0.719
	Females	19	13.6	71	50.7	50	35.7	
6. Has ***someone done a physical activity or played sports*** with you?	Males	7	8	39	44.8	41	47.1	0.081
	Females	11	7.9	82	58.6	47	33.6	
7. Has ***someone provided transportation to a place*** where you can do physical activities or play sports?	Males	26	29.9	39	44.8	22	25.3	0.144
	Females	54	38.6	60	42.9	26	18.6	
8. Has ***someone watched you participate*** in physical activities or sports?	Males	10	11.5	41	47.1	36	41.4	0.389
	Females	21	15.0	68	48.6	51	36.4	
9. Has ***someone told you that you are doing well*** in physical activity?	Males	9	10.3	41	47.1	37	42.5	0.247
	Females	17	12.1	72	51.4	51	36.4	

Table 4.2 presents the percentage social correlates of PA during a typical week by gender. From a total of 111, only 89 boys completed the social correlates, and from a total of 173 girls, 29 did not respond to all the social correlates questions. Girls indicated a significantly ($p<0.05$) high percentage for never (24%) regarding encouragement from friends to do physical activity or sport compared to boys (8%), while boys reported higher percentages for sometimes (62%) and everyday (30%) than the girls who reported 30% and 19% respectively. Furthermore, the results show that girls have a high percentage for never (12%) compared to (6%) of the boys in terms of friends who do physical activity or do sport with them. Additionally, the results show that girls (24%) when compared to boys (12%) never have friends tell them that they are doing a good job in physical activity or sport. The results further indicated that girls (39%) and boys (30%) do not have someone who provides transportation to a place where they can do physical activities or play sport.

Relationship between physical activity and social correlates

Table 4.3 presents the correlation coefficients between physical activity and social correlates for physical activity. For crude analyses, the results show positive correlations between TMPA and all social correlates of PA, with a significant relationship between TMPA and "how often do your friends tell you that you are doing a good job at physical activity", and "has someone told you that you are doing well in physical activity". When the analyses were

adjusted for gender, a significant positive correlation was found between TMPA and the social correlates of "during a typical week has someone told you that you are doing well in physical activity".

Table 4.3: Correlation coefficients for PA and social correlates for physical activity

	1. During a typical week, how often do you encourage your friend to do physical activity or play sports?		2. During a typical week, how often do your friends encourage you to do physical activity or sports?		3. During a typical week, how often do your friends do physical activities or play sport with you?		4. During a typical week, how often do your friends tell you that you are doing a good job at physical activity?		5. During a typical week, has someone encouraged you to do physical activity or sport?		6. During a typical week has someone done a physical activity or played sports with you?		7. During a typical week has someone provided transportation to a place where you can do physical activities or play sports?		8. During a typical week has someone watched you participate in physical activities of sports?		9. During a typical week has someone told you that you are doing well in physical activity?	
	r	***p***	***r***	***P***	***r***	***p***	***r***	***p***	***r***	***p***	***r***	***p***	***r***	***p***	***r***	***p***	***r***	***p***
Model 1 Unadjusted																		
TPA	0.12	0.06	0.12	0.06	0.09	0.16	0.19**	0.004	0.05	0.47	0.08	0.23	0.05	0.41	0.05	0.40	0.16*	0.02
Model 2 Adjusted for gender																		
TPA	.10	.09	.05	.43	.05	.43	.14	.04	.04	.53	.05	.46	.04	.51	.05	.48	.14*	.03

** Correlation is significant at the 0.01 level (2-tailed); *. Correlation is significant at the 0.05 level (2-tailed), TPA=total physical activity per week.

4.6 DISCUSSION

The purpose of this study was to determine the relationship between physical activity and social correlates of physical activity amongst adolescents attending high schools in the Tlokwe municipality of the North West province, South Africa. The adolescents in the study had relatively high physical activity participation. These findings are supported by recent findings on the same sample.[37] The findings of this study are somewhat in line with findings reported in Mozambican adolescents, Kenyan children and Nigerian children.[38-40] Even though the adolescents in the study do not necessarily meet the recommendations of 60 minutes a day they appear to be better than adolescents in developed countries like the USA.[41]

The results show that boys were significantly more highly active compared to the girls. These results are similar to those of Kirby *et al*[8] and Petric *et al*[42] and are supported by findings by Pfeiffer *et al*[43] that girls' participation in physical activity decreased at a higher rate than that of boys during adolescence.

It is well known that participation in physical activity is based on the social-ecological model as proposed by Sallis *et al*[44] In this study, it was apparent that adolescents' participation in physical activity was affected by lack of support from friends, encouragement by friends or family members, and lack of support during engagement in physical activity. These findings,

in relation with the importance of friends as an important social correlate for physical activity, are supported by Serra *et al*[24] who emphasised the significance of support by friends. In a study by Kelly *et al*[45] it was found that friend support was the only social correlate associated with physical activity. Girls in the current study were mostly affected by their friends' encouragement to participate in sport or physical activity in comparison to their male counterparts. These findings are similar to those of Young *et al*[46] who found a positive correlation between participation of girls going through early adolescence in physical activity and social support from friends; and Kirby *et al*[8] who found that boys had higher peer support for participation in physical activity than girls.

The findings regarding parental support in this study are congruent with the study by Cheng *et al*[16] where parents were found to be a positive factor for engaging in physical activity**.** In contrast, Bergh *et al*[23] found no significant relationship between parental support and participation in physical activity. The findings in this study on the physical activity correlates among girls specifically, are in agreement with Leary *et al*[47] who demonstrated that for girls, parental support for physical activity had a strong association with child physical activity.

Bungum *et al*[27] indicated that the physical environment, such as lack of transportation, affects participation in physical activity. Such a trend was evident in the current study where both boys and girls shared high percentages in terms of lack of availability of transportation to the place of sport or physical activity.

The present study has some limitations which need to be considered when interpreting these findings; the sample size cannot be used for generalisation to the adolescent population in the Tlokwe local municipality, nor to the South African adolescent population. Furthermore, the cross-sectional design of the study may somewhat have affected the interpretation of the results in the sense that some of the aspects/variables change over a period of time. Regardless of these weaknesses, the strength of the current study was that the relationship between physical activity and social correlates of physical activity was proven in adolescents attending high schools in the Tlokwe municipality.

It can be concluded that the adolescent boys were significantly more highly active compared to the girls, and have higher positive social correlates than the girls. 36% of the participants indicated lack of transport as a negative factor for their participation in physical and sport.

Social correlates for physical activity were positively associated with participation in PA. Based on these findings, urgent strategic public health intervention by all stakeholders dealing with adolescents, as well as more research studies in the area, are required.

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CHAPTER 5: The relationship between health-related physical fitness and social correlates of physical activity among adolescents: the PAHL study

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Relationship between health-related physical fitness and social correlates of physical activity among adolescents: the PAHL study

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5.1 ABSTRACT

Background/objectives:

Social correlates of physical activity have been shown to have an impact on health-related physical fitness. The extent of the impact of social correlates of physical activity on participation in physical activity and the attainment of health-related physical fitness amongst the youth of Tlokwe municipality is not known. The purpose of this study was to determine the relationship between health-related physical fitness and social correlates of physical activity.

Subjects/methods:

A cross-sectional study design was followed on a total of 284 adolescents (111 boys and 173 girls) with the mean age of 14.90±0.72, who are part of the on-going Physical Activity and Health Longitudinal Study (PAHLS). Height, weight, skinfolds thickness (triceps, subscapular and calf skinfolds), and waist circumferences were measured through the standard procedures described by the International Standard of Advancement of Kinanthropometry (ISAK). Body mass index (BMI), waist-to-height ratio (WHR) and percentage body fat (%BF) were used as measures of body composition. *Health-related physical fitness (HRPF)* was determined by measuring cardiorespiratory endurance, muscle strength and endurance, and flexibility according to the EUROFIT (1988) test protocol. A standard Social Support for Physical Activity questionnaire was used to gather information on social correlates for physical activity.

Results: The results show that 29.6% out of 284 of the participants are underweight and 26.4% are overweight. Girls were found to be significantly ($p<0.05$) fatter (%BF and BMI)

and shorter than the boys. A significant difference ($p<0.05$) was observed in WHR. Boys measured significantly better than girls ($p<0.05$) in SBJ, BAH, SUP, predicted $\dot{V}O_{2max}$, except for SAR in favour of girls. %BF was negatively associated with social correlates of physical activity with a significant relationship in contrast to *'friends' encouragement that one is doing a good job at physical activity'*. A significant positive correlation was observed between WC, WHR, SBJ, SUP, predicted $\dot{V}O_{2max}$ and *'friends' encouragement in a typical week to do physical activity or sports'*. Further significant positive correlations were found with WC for *'encouragement by someone in a typical week to do physical activity or sports'*; WHR, SBJ, BAH, SUP, predicted $\dot{V}O_{2max}$ for *'participation in physical activity or sports with friends'*; SBJ, SUP, $\dot{V}O_{2max}$ for '*friends' encouragement that one is doing a good job at physical activity';* SBJ, SUP, predicted $\dot{V}O_{2max}$ for '*someone's encouragement that one is doing a good job at physical activity';* BAH, SUP, predicted $\dot{V}O_{2max}$ for *'someone's participation in sport with one';* SUP, predicted $\dot{V}O_{2max}$ for *'one's encouragement to friends to participate in physical activity or sport'*; SUP for '*provision of transportation to physical activity or sport'; and* predicted $\dot{V}O_{2max}$ for *'someone watching one participate in physical activity or sport'*. SAR, on the other hand, was negatively associated with all social correlates for physical activity.

Conclusions:

It can be concluded that health-related physical fitness variables were positively associated with social correlates for physical activity. Based on these findings, urgent strategic public health intervention by all stakeholders dealing with adolescents, as well as more research studies in the area, are required.

Keywords: Physical activity, sport, body composition social support, correlates, adolescents.

5.2 INTRODUCTION

Approximately 30% of all adolescents have low levels of health-related physical fitness.[1] Physical inactivity, low physical activity, poor physical fitness, a high body mass index and high levels of blood lipids can lead to cardiovascular disease and diseases such as Type 2 diabetes.[2,3] Participation in physical activity and the resultant attainment of physical fitness, though, are affected by social correlates for physical activity.[4]

Physical inactivity is more prevalent in girls than boys.[5] Approximately 10% less female adolescents meet the recommendations for regular physical activity than adolescent males by the time they reach the 12th Grade. Female adolescents are therefore at a higher risk than their male counterparts of poor health-related physical fitness and attaining chronic diseases associated with physical inactivity.[6]

Physical activity, in addition to energy expenditure, results in improvements in the five dimensions of health-related physical fitness i.e. cardiorespiratory fitness, musculoskeletal fitness, flexibility, balance and coordination, and body composition.[7] Kaminska *et al.*[8] found that physical activity duration and levels have an effect on health-related physical fitness components i.e. waist-to-hip ratio, muscle mass, hamstring muscle flexibility, grip strength and predicted $\dot{V}O_{2max}$ increased with increasing physical activity levels in both genders, and body fat had an inverse association with physical activity levels.

Participation in physical activity and the related attainment of health-related physical fitness, though, are affected by the social correlates of physical activity such as age, sex, health status, self-efficacy and motivation.[9] The most important social correlates perceived by adolescents are parental and peer influences and time available for physical activity.[10] Relatives' physical activity participation is positively related to physical fitness, cardio-respiratory fitness and higher muscular strength in adolescents.[11] Tandon *et al.*[12] identified parental support for physical activity to be positively associated with Moderate to Vigorous Physical Activity (MVPA) and negatively associated with sedentary behaviour. Trost *et al.*[13] also identified positive associations between parental support and encouragement for physical activity and adolescents' physical activity. Parental modelling of physical activity was also found to be consistently associated with physical activity, specifically among adolescent

girls.[14] On the contrary, Bauman *et al.*[9] and Ferreira *et al.*[15] found no significant association between parental activity, support and encouragement, and adolescent participation in physical activity.

While parental support plays a positive role in adolescent participation in physical activity and the attainment of health-related physical fitness, Davison[16] found that parents reported community-based, interpersonal, and intrapersonal barriers to supporting their children's physical activity. The highest reported barriers included the importance of children's academic performance, a lack of facilities, and concerns about the children's safety. Parents who reported greater barriers also reported lower support for their children's physical activity.

Bergh *et al.*[17] and Serra *et al.*[18] found that the influence of friends was positively associated with participation of adolescents in physical activity. The significance of friendship was also demonstrated by a study conducted in two countries by Silva *et al.*[19] (Portugal and USA), where social support from friends was categorised as a reinforcing factor in the Youth Physical Activity Promotion (YPAP) model and found to have a significant effect on physical activity in both countries. In support of the above findings, Salvy *et al.*[20] found that friendships may increase youth's motivation to engage in physical activity and promote greater physical activity. Kirby *et al.*[21], though, found that boys had higher peer support than girls, resulting in girls participating less in physical activity than boys.

Socioeconomic status, as a correlate for physical activity, affects family access to health information, and adolescents' access to sport and recreation facilities.[22] Socioeconomic position, particularly household income, is positively associated with adolescents' physical activity and health-related physical fitness. Higher socioeconomic position among adolescents is associated with greater physical activity involvement and less time watching television and playing video games.[23] Esmaeilzadeh *et al.*[24] also found a significant correlation between socioeconomic status and fat mass with a negative correlation between cardiorespiratory fitness and BMI, waist-to-height ratio, waist circumference and fat mass. The researchers also found a significant relationship between TV watching and video playing time, physical activity and anthropometric measures.

The home environment and the physical environment were also included by Tandon *et al.*[12] and Bungum *et al.*[25] respectively as contributors to physical activity, with contributors such as

urban planning, transportation systems and parks and trails. Zhang *et al.*[26] reported that 1.1% of variation in physical activity participation is accounted for by the physical environment. Female adolescents living in high crime areas were also found to be more affected by the physical environment than their male counterparts as they were found to be less active outdoors.[27]

Dantas *et al*.[5] and Bohr *et al*.[22] found that boys perform higher levels of physical activity at higher frequencies than girls regardless of their socioeconomic circumstance. Participation of girls in leisure time physical activity has been shown to decline by about 45% between ages 12-17 with a sharp decline in early adolescence.[28] Dwyer *et al.*[29] investigated adolescent girls' perceived barriers to participation in physical activity and found that lack of time, involvement in technology-related activities, peer influence, parents and teachers, safety concerns, inaccessibility of facilities and the cost thereof, competition, and body-centeredness impeded adolescent girls from participating in sport. Dunton *et al.*[6] also found that psychosocial variables of self-efficacy and enjoyment were associated with cardiovascular fitness among sedentary adolescent females.

In spite of the health benefits associated with physical activity, many adolescents do not meet the daily guidelines of being active for at least 30 minutes a day.[30] Research has shown that adolescent participation in physical activity has a positive influence on body composition and health-related physical fitness but is influenced by social correlates for physical activity.[31-33] The extent of the impact of social correlates of physical activity on health-related physical fitness amongst the youth of Tlokwe municipality is not known. The purpose of this study was to determine the relationship between health-related physical fitness and social correlates of physical activity.

5.3 SUBJECTS AND METHODS

Design and subjects

The Physical Activity and Health Longitudinal Study (PAHLS) is an observational multidisciplinary longitudinal design that began in 2010 with a group of about 312 boys and girls from six secondary schools (two in Potchefstroom town and the other four in its surroundings – Ikageng Township). The schools included in the study are from a high socioeconomic (town) and low socioeconomic (township) status. The group of pupils studied

may not be considered to be representative of the adolescent population either of Potchefstroom or South Africa in general. The goal of the study was to describe the development of physical activity and determinants of health risk factors of health behaviour, sport determinants and recreational activities in 14 year-old adolescents attending high schools in Potchefstroom areas of the North West Province, South Africa. Additionally, the goal was to investigate the longitudinal relationships between physical activity and determinants of health risk factors of health behaviour variables. All the subjects in this study at the beginning (baseline data) of the study were 14 years of age. The first measurement of PAHLS took place in April 2010 and subsequent measurements were conducted annually on the same month up until 2014.

Anthropometric measurements

Anthropometric measurements of height, weight, skinfold thickness (triceps, subscapular and calf skinfolds), and waist circumferences were measured through the standard procedures stipulated by the International Standard of Advancement of Kinanthropometry.[34] BMI, as a measure of body composition, was calculated as body mass/stature² (kg/m²). Waist to hip ratio (WHR) used as a measure of body fat distribution was calculated as waist divided by hip. Percentage body fat was derived from skinfolds measurements according the equation developed by Slaughter, Lohman, Boileau, *et al*.[35]

Health-related physical fitness measurements

Health-related physical fitness (HRPF) was determined by measuring the participants' cardiorespiratory endurance, muscle strength and endurance, and flexibility using standardised EUROFIT (1988) tests.[36] Cardiovascular endurance was assessed with the 20-metre shuttle run test (predicted $\dot{V}O_{2max}$) which is a valid test of aerobic capacity in adolescents.[37] The following health-related physical fitness test items were measured according to the EUROFIT (1988) test protocol: sit and reach (SAR), a test of hamstring flexibility, expressed in centimetres; sit-up (SUP), a measure of abdominal strength and endurance, determined by correctly performed sit-ups in 30 seconds; standing broad jump (SBJ), a test of explosive strength of leg extensors measured in centimetres, and bent arm hang (BAH), which measures functional arm and shoulder muscular endurance to exhaustion in seconds.

Social Support for Physical Activity

A standardised questionnaire on the Social Support for Physical Activity was used to gather information on social correlates for physical activity.[33] The Social Support for Physical Activity Scale included nine (9) statements rated on a three-point Likert-type scale (*i.e.* Never; Sometimes and Everyday). All nine (9) Social Support for Physical Activity statements showed a Cronbach's alpha of 0.74, with inter-item correlations ranging from r=0.23 to r=0.45, respectively.

Measurement procedures

Prior to data collection, permission to conduct the measurements was granted by the District Manager of the Department of Education in Potchefstroom, North West Province. In addition, clearance was received from the Ethics Committee of North-West University, Potchefstroom Campus (Ethics no: NWU-0058-01-A1). The participating schools were briefed about the purpose of the study, and the informed consent forms were signed by the school authorities as well as the learners and their parents. To minimise loss of interest and fatigue among the participants and prevent disruption of teaching and learning activities at the schools, data were collected on days agreed by the participating schools. Only the data of learners who were 14 years old as at the time of testing were analysed.

Before the anthropometric measurements were carried out, and the IPAQ was administered to the participants who were assembled in a classroom, under the supervision of the principal investigator. In completing the IPAQ adequate instructions and clarifications, with no time limit set for completion, were given to the students who subsequently filled the questionnaires independently, without interference from fellow classmates. The physical and physiological variables were measured in the following order: anthropometry and health-related fitness. All anthropometric sites were measured according to standard procedures as described by International Standards for Anthropometric Assessment (ISAK) by Level 2 ISAK certified Anthropometrists. The technical error of measurement (TEM) was calculated by applying the formula of Pederson and Gore [38] and values of 1.27% (1.24 mm) were revealed for all skin-fold measurements, 2.08% (0.56 cm) and 1.23% (0.79 cm) for all length measurements.

Statistical analyses

Descriptive statistics (means, SD) and frequencies were determined by the use of the SPSS program. Differences of continuous variables were determined by the use of an independent *t*–test and one-way analyses of variances. Mann-Whitney *U t-test* was calculated to test the significant differences between boys and girls. Correlation coefficients were analysed to study the relationship between body composition and social correlates of physical activity. The p-value for significance was set at ≤0.05.

5.4 RESULTS

Health-related physical fitness

Figure 5.1 presents the percentages of BMI categories for the total group (173 girls and 111 boys). 29.6% out of 284 of the participants were underweight and 26.4% were overweight. With regard to gender, 34.2% of boys were underweight and 17.1% were overweight, while girls were 26.6% underweight and 32.4% overweight.

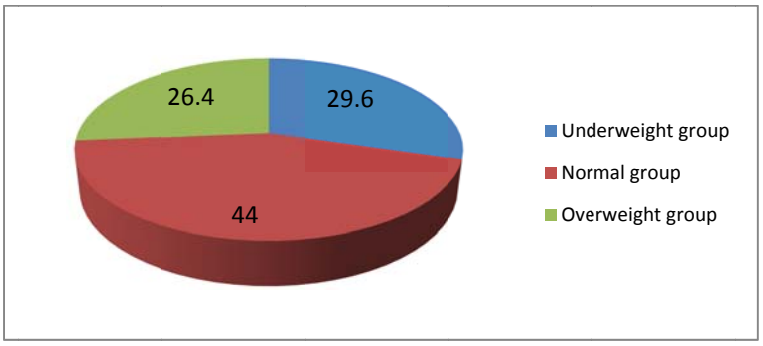

Figure 5.1: Percentage (%) of BMI categories for the total group

Table 5.1 presents the body composition for the total group. The maximum value for BMI is 38.65 (mean=20.88); %BF 54.47 (mean 20.10); WC maximum 106.2 (mean=67.81) and WHR 0.90 (mean=0.76).

Table 5.1: Descriptive characteristics (min, max, mean and SD) for body composition for the total group

	N	Minimum	Maximum	Mean	SD
Stature (cm)	284	139.60	192.30	160.83	8.85
Body Mass (kg)	284	21.0	110.3	54.33	13.22
BMI	284	8.22	38.65	20.88	4.17
%BF	284	3.60	54.47	20.10	10.57
WC	284	52.30	106.20	67.81	8.51
WHR	284	0.63	.90	0.76	0.05

%BF=percentage body fat; WC= waist circumference; BMI= body mass index; WHR= waist to hip ratio

Table 5.2 presents the health-related physical fitness differences between boys and girls. Girls are significantly ($p<0.05$) fatter (%BF and BMI) and shorter than the boys. Though boys are heavier than the girls, a non-significant difference was observed. A non-significant difference was also found in waist circumference.

Table 5.2: Characteristics of health-related physical fitness and difference for boys (n=111) and girls (n=173)

	Gender	Mean	SD	P value of the gender differences
Stature (cm)	Male	165.41	9.55	<0.00
	Female	157.89	6.95	
Body Mass (kg)	Male	55.30	13.77	0.33
	Female	53.70	12.86	
BMI (kg/m^2)	Male	20.01	3.71	0.003
	Female	21.43	4.37	
%BF	Male	13.19	8.55	<0.00
	Female	26.01	8.51	
WC (cm)	Male	68.11	8.29	0.64
	Female	67.62	8.67	
WHR	Male	0.80	0.03	<0.00
	Female	0.73	0.04	
SBJ (cm)	Male	186.87	26.36	0.01
	Female	148.85	20.15	
BAH (sec.)	Male	18.62	13.44	<0.000
	Female	4.27	5.67	
SUP (sec)	Male	35.37	7.32	0.002
	Female	23.57	10.15	
$\dot{V}O_{2max}$	Male	40.85	6.24	0.08
	Female	28.43	5.12	
SAR (cm)	Male	42.13	9.26	0.005
	Female	48.42	7.05	

%BF=percentage body fat; WC= waist circumference; BMI= body mass index; WHR= waist to hip ratio; SBJ = standing broad jump; BAH = bent arm hang; SUP =sit ups; SAR = sit and reach

A significant gender difference ($p<0.05$) was observed in WHR. Boys measured significantly higher than girls ($p<0.05$) in SBJ, BAH, SUP, predicted $\dot{V}O_{2max}$. Girls, though, had significantly higher measurements than boys ($p<0.05$) for SAR.

Social correlates of physical activity

Table 5.3: Percentage (%) social correlates of PA for the total group (n=237)

Social correlates variables (1–9)	Never		Sometimes		Everyday	
During a week,.....	n	%	n	%	n	%
1. How often do you encourage your friend to do physical activity or play sports?	19	8.01	157	66.2	61	25.7
2. How often do your friends encourage you to do physical activity or sports?	44	18.6	138	58.5	54	22.9
3. How often do your friends do physical activities or play sport with you?	22	9.3	111	46.8	102	43.0
4. How often do your friends tell you that you are doing a good job at physical activity?	45	19	119	50.2	71	30
5. Has someone encouraged you to do physical activities or sports?	37	15	120	51	80	34
6. Has someone done a physical activity or played sports with you?	25	10.5	122	51.5	90	38
7. Has someone provided transportation to a place where you can do physical activities or play sports?	86	36	101	43	50	21
8. Has someone watched you participate in physical activities or sports?	32	14	114	48	90	38
9. Has someone told you that you are doing well in physical activity?	22	12	118	50	90	38

Table 5.3 presents the results on the social correlates of PA for the total group during a typical week. 66% of the participants indicated that they sometimes encourage their friends to do physical activity or sport, while 26% encouraged their friends on a daily basis. 59% of the participants indicated that friends in turn sometimes encourage them to do physical activity or sport. 47% and 43% of the participants indicated that their friends participated in PA or sport with them sometimes and every day respectively, while 9% have never had their friends participate with them. With regard to doing a good job at participation in sport, the results showed that 19% were never told by their friends that they are doing a good job, while 50% and 30% of the participants are told by their friends that they are doing a good job sometimes and daily respectively. 51% indicated that they were sometimes encouraged by someone to do PA or sport.

52% of the participants sometimes had another person participate in PA or sport with them while 11% never had anyone participate in sport with them. With regard to the provision of transportation to a place where the participants could participate in PA or sport, 43% indicated that they sometimes were offered transportation while 36% stated that they were

never offered transportation. 48% of the participants sometimes had someone watch them participate in PA or sport, while 50% indicated that people sometimes told them that they are doing well in PA.

Table 5.4: Percentage (%) social correlates of PA for the total group (n=237) by gender

Social correlates variables (1–9)		**Never**		**Sometimes**		**Everyday**	
During a week, ...		**n**	**%**	**n**	**%**	**n**	**%**
1. How often **do you encourage your friend** to do physical activity or play sports?	Males	7	8	50	57.5	30	34.5
	Females	11	7.9	98	70.0	31	22.1
2. How often **do your friends encourage you** to do physical activity or sports?	Males	7	8	55	62.5	26	29.5
	Females	33	23.6	8.	57.1	27	19.3
3. How often **do your friends do physical activities or play sport** with you?	Males	5	5.7	35	40.2	47	54
	Females	17	12.1	72	51.4	51	36.4
4. How often **do your friends tell you that you are doing a good job** at physical activity?	Males	10	11.5	41	47.1	36	41.4
	Females	34	24.3	73	52.1	33	23.6
5. Has **someone encouraged** you to do physical activities or sports?	Males	13	14.9	45	51.7	29	33.3
	Females	19	13.6	71	50.7	50	35.7
6. Has **someone done a physical activity or played sports** with you?	Males	7	8	39	44.8	41	47.1
	Females	11	7.9	82	58.6	47	33.6
7. Has **someone provided transportation to a place** where you can do physical activities or play sports?	Males	26	29.9	39	44.8	22	25.3
	Females	54	38.6	60	42.9	26	18.6
8. Has **someone watched you participate** in physical activities or sports?	Males	10	11.5	41	47.1	36	41.4
	Females	21	15.0	68	48.6	51	36.4
9. Has **someone told you that you are doing well** in physical activity?	Males	9	10.3	41	47.1	37	42.5
	Females	17	12.1	72	51.4	51	36.4

Table 5.4 presents the percentage social correlates of PA during a typical week by gender. Girls indicated a high percentage for ‘never’ (24%) regarding encouragement from friends to do physical activity or sport compared to boys (8%), while boys had a high percentage for ‘sometimes’ (63%) and ‘everyday’ (30%) compared to the girls who scored 57% and 19% respectively. Furthermore, the results show that girls have a high percentage for ‘never’ (12.1%) compared to (6%) in boys in terms of friends who do physical activity or do sport with them. Additionally, the results show that girls (24%) when compared to boys (12%) never have friends tell them that they are doing a good job in physical activity or sport. The results further indicated that girls (39%) and boys (30%) do not have someone who provides transportation to a place where they can do physical activities or play sport. A significant difference ($p<0.05$) was found between boys and girls regarding friends’ encouragement to do physical activity or sports, participation in physical activity or sports with friends and friends’ confirmation that the participant is doing a good job at physical activity.

Relationship between health-related physical fitness and social correlates for physical activity

Table 5.5: Correlation coefficients for health-related physical fitness and social correlates for physical activity

	1		2		3		4		5		6		7		8		9	
	During a typical week, how often do you encourage your friend to do physical activity or play sports?		During a typical week, how often do your friends encourage you to do physical activity or sports?		During a typical week, how often do your friends do physical activities or play sport with you?		During a typical week, how often do your friends tell you that you are doing a good job at physical activity?		During a typical week, has someone encouraged you to do physical activity or sport?		During a typical week, has someone done a physical activity or played sports with you?		During a typical week, has someone provided transportation to a place where you can do physical activities or play sports?		During a typical week, has someone watched you participate in physical activities or sports?		During a typical week, has someone told you that you are doing well in physical activity?	
	r	***p***	***r***	***P***	***r***	***p***	***r***	***p***	***r***	***p***	***r***	***p***	***R***	***p***	***r***	***p***	***r***	***p***
%BF	-0.01	0.09	-0.06	0.37	-0.10	0.12	-0.15*	0.02	0.12	0.07	-0.09	0.18	-0.02	0.80	0.07	0.28	-0.06	0.36
BMI	0.09	0.16	0.09	0.17	-0.04	0.59	-0.02	0.73	0.08	0.21	-0.03	0.65	0.02	0.79	-0.06	0.34	-0.02	0.74
WC	0.08	0.19	0.13	0.05	0.02	0.71	0.01	0.92	0.14*	0.03	-0.01	0.92	0.11	0.10	-0.05	0.44	0.02	0.74
WHR	0.08	0.21	0.14	0.03	0.16	0.01	0.09	0.15	0.08	0.23	0.06	0.36	0.09	0.15	-0.01	0.94	0.02	0.68
SBJ	0.02	0.74	0.16*	0.01	0.17**	0.01	0.13*	0.04	-0.02	0.74	0.12	0.07	0.11	0.10	0.10	0.12	0.14*	0.04
BAH	0.01	0.81	0.09	0.18	0.18**	0.01	0.11	0.09	0.01	0.82	0.13*	0.040	0.12	0.06	0.10	0.12	0.06	0.38
SUP	0.18**	0.01	0.22**	0.001	0.21**	0.001	0.25**	0.000	0.01	0.85	0.15*	0.020	0.25**	0.000	0.18**	0.007	0.25**	0.000
$\dot{V}O_{2max}$	0.20**	0.006	0.29**	0.000	0.30**	0.000	0.27**	0.000	0.05	0.48	0.20**	0.01	0.13	0.07	0.17*	0.02	0.24**	0.001
SAR	-0.05	0.46	-0.10	0.11	-0.05	0.49	-0.09	0.18	-0.05	0.42	-0.09	0.16	-0.06	0.363	-0.03	0.63	-0.09	0.18

**Correlation is significant at the 0.01 level (2-tailed); *Correlation is significant at the 0.05 level (2-tailed); %BF=percentage body fat; WC= waist circumference; BMI= body mass index; WHR= waist to hip ratio; SBJ = standing broad jump; BAH = bent arm hang; SUP =sit ups; SAR = sit and reach

Table 5.5 presents the correlation coefficients between health-related physical fitness and social correlates among adolescents. %BF was negatively associated with social correlates of physical activity with a significant (r=-0.15; p<0.02) relationship in contrast to '*friends encouragement that one is doing a good job at physical activity'*. A significant positive correlation was observed between waist circumference and *'friends' encouragement in a typical week to do physical activity or sports'* and *'encouragement by someone in a typical week to do physical activity or sports'*. Waist-to-height ratio was positively (r=0.14; p<0.05) related with friends' encouragement in a typical week to do physical activity or sports, and participation in physical activity or sports with friends (r=0.16; p<0.02). SBJ was positively associated with social correlates of physical activity with significant relationships with *'friends' encouragement in a typical week to do physical activity or sports'* (r=0.16; p<0.02); *'friends' participation in sport with one'* (r=0.17; p<0.02); '*friends encouragement that one is doing a good job at physical activity'* (r=0.13; p<0.05); and '*someone's encouragement that one is doing a good job at physical activity'* (r=0.14; p<0.05). BAH was positively associated with social correlates of physical activity with significant relationships with *'friends' participation in sport with one'* (r=0.18; p<0.02); and *'someone's participation in sport with one'* (r=0.13; p<0.05). SUP was positively associated with social correlates of physical activity with significant relationships with *'one's encouragement to friends to participate in physical activity or sport'* (r=0.18; p<0.02); *'friends' encouragement in a typical week to do physical activity or sports'* (r=0.22; p<0.02); *'friends' participation in sport with one'* (r=0.21; p<0.02); '*friends' encouragement that one is doing a good job at physical activity'* (r=0.25; p<0.02); *'someone's participation in sport with one'* (r=0.15; p<0.05); '*provision of transportation to physical activity or sport'* (r=0.25; p<0.02); and '*someone's encouragement that one is doing a good job at physical activity'* (r=0.25; p<0.02). predicted $\dot{V}O_{2max}$ was positively associated with social correlates of physical activity with significant relationships with *'one's encouragement to friends to participate in physical activity or sport'* (r=0.20; p<0.02); *'friends' encouragement in a typical week to do physical activity or sports'* (r=0.29; p<0.02); *'friends' participation in sport with one'* (r=0.30; p<0.02); '*friends' encouragement that one is doing a good job at physical activity'* (r=0.27; p<0.02); *'someone's participation in sport with one'* (r=0.20; p<0.02); *'someone watching one participate in physical activity or sport'* (r=0.17; p<0.05); and '*someone's encouragement that one is doing a good job at physical activity'* (r=0.24; p<0.02). SAR, on the other hand, was negatively associated with all social correlates for physical activity.

5.5 DISCUSSION

The purpose of this study was to determine the relationship between health-related physical fitness and social correlates of physical activity. Girls in the study were found to be significantly fatter (%BF and BMI) and shorter than the boys. A significant difference was also observed in WHR where boys were found to have a higher WHR than the girls. Boys in the present study were underweight and active as compared to girls who were overweight and inactive. These findings are consistent with the findings of a study on Hong Kong adolescents where girls were found to have higher %BF and BMI and a higher waist to stature ratio than boys.[39]

The health-related physical fitness measurements of the boys were significantly higher than those of the girls. These results support the findings of Dantas *et al.*[5], and Bohr *et al.*[22] that adolescent boys' physical activity and health-related physical fitness was higher than that of adolescent girls.

It is well known that participation in physical activity is based on the social-ecological model as proposed by Sallis *et al.*[40] In this study, it was apparent that adolescents' participation in physical activity and the resultant health-related physical fitness were affected by lack of support by friends, or encouragement by friends or family members, and lack of support during engagement in physical activity. The findings of this study on the importance of friends as an important social correlate for physical activity are supported by Serra *et al.*[18] who emphasised the significance of support by friends; and Kelly *et al.*[41] who found friend support to be the only social correlate that was consistently associated with physical activity. The results of this study also show that girls specifically, were mostly affected by their friends' encouragement to participate in sport or physical activity, compared to their male counterparts. These findings are similar to those of Young *et al.*[42] who found a positive correlation between the participation of girls going through early adolescence in physical activity, and social support from friends.

The findings in this study on parental support are similar to that of the study by Cheng *et al.*[43] where parents were found to be a positive factor for engaging in physical activity. In contrast, Bergh *et al.*[17] found no significant relationship between parental support and participation in physical activity.

All health-related physical fitness measures were highly correlated to social correlates for physical activity. This finding is in support of Sallis *et al.*[32] that physical fitness is affected by social correlates for physical activity. This study, though, found flexibility to be negatively associated with the social correlates for physical activity. Body composition measures were correlated with significance of friends' encouragement in a typical week to do physical activity or sports, and participation in physical activity or sports with friends. This finding is supported by Morrissey *et al.*[44] who also found a positive correlation between body composition and social correlates.

Bergh *et al.*[17] and Serra *et al.*[18] findings about the significance of the influence of friends on physical activity and physical fitness is in support of the findings of this study. Cardiorespiratory endurance, muscle strength and endurance were all found to be significantly positively associated with social correlates for physical activity, along with significance of friends' encouragement in a typical week to do physical activity or sports, participation in physical activity or sports with friend, and friends' encouragement that one is doing a good job at physical activity.

Strength, endurance and cardiorespiratory fitness were also highly correlated to parents' *encouragement that one is doing a good job at physical activity, participation of parents in physical activity with the adolescent, and parents watching one participate in physical activity or sport*. This finding is aligned to Tandon *et al.*[12]'s who found that participation in moderate or vigorous physical activity is positively associated with social correlates for physical activity.

Bungum *et al*.[25] indicated that the physical environment, such as lack of transportation, affects participation in physical activity. Such a trend was evident in the current study where both boys and girls shared high percentages in terms of lack of availability of transportation to the place of sport or physical activity. The sit-up, a measure of abdominal strength and endurance, was also found in this study to be positively associated with provision of transportation, and hence provision of access to physical activity or sport.

Interpretation of these findings needs to be conducted with caution as the sample size cannot be used for generalisation to the adolescent population in the Tlokwe local municipality, nor

to the South African adolescent population. Furthermore, the cross-sectional design of the study may somewhat have affected the interpretation of the results in the sense that some of the aspects/variables change over a period of time. Regardless of these weaknesses, the strength of the PAHL study is that it is planned for a period of time, where some of the variables will be tracked longitudinally to determine the development over time. The PAHL study is based on one birth cohort (14 years) that was followed up for a period of five years.

It can be concluded that the adolescent boys were underweight and highly active compared to the relatively overweight and inactive girls. Boys have high social correlates compared to girls. 36% of the participants indicated lack of transport as a negative factor for their participation in physical activity and sport. Health-related physical fitness variables were positively associated with social correlates for physical activity.

Conflict of interest

The authors declare no conflict of interest.

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CHAPTER 6: SUMMARY, CONCLUSIONS, LIMITATIONS AND RECOMMENDATIONS

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6.1 SUMMARY

Physical inactivity, low physical activity, poor physical fitness, a high body mass index and high levels of blood lipids can lead to cardiovascular disease and diseases such as Type 2 diabetes (Levitan *et al.,* 2009:203; Richardson *et al.,* 2004:1924). Poor health status may increase the risk of premature death through heart disease, and developing breast or colon cancer (Kesaniemi *et al.*, 2001:S351).

The benefits of physical activity have been well documented globally. In adolescence, specifically, physical activity provides long-term benefits of bone strength and a decreased risk of breast cancer (Hallal *et al.,* 2006:1020-1021). A higher frequency of participation in physical activity is also associated with less depression and anxiety and higher self-esteem (Moksnes *et al.*, 2010:643). Physical activity also has mental health benefits in adolescence as it reduces depression and anxiety, increases self-esteem and improves cognitive functioning in children and adolescents (Biddle & Asare, 2011:894).

Physical activity, in addition to energy expenditure, results in improvements in the five dimensions of health-related physical fitness i.e. cardiorespiratory fitness, musculoskeletal fitness, flexibility, balance and coordination, and body composition (Gabriel *et al.,* 2012:S15). Kaminska *et al.* (2012:262) found that physical activity duration and levels have an effect on health-related physical fitness components i.e. waist-to-hip ratio, muscle mass, hamstring muscle flexibility, grip strength and predicted $\dot{V}O_{2max}$ increased with increasing physical activity level in both genders, and body fat had an inverse association with physical activity levels.

With all the known benefits of physical activity, less than one-third of South Africans meet the American College of Sports Medicine and Center for Disease Control's recommendation for health-enhancing physical activity (to accumulate 30 minutes of moderate activity on most, but preferably all days of the week), and nearly half are reportedly inactive (46%) (Steyn *et al.*, 2006:25). It is also concerning that in children and adolescents, physical activity intensity and time spent in physical activity have been found to reduce with age (Kirby *et al.,* 2011:789-791). Approximately 30% of all adolescents, as a result, have low levels of health-related physical fitness (Carnethon *et al.,* 2005:2981). Furthermore, adolescent girls are less

physically active than boys (Kirby *et al.,* 2011:790) and show significantly lower total daily physical activity than boys (Gavarry *et al.,* 2003:529; Loucaides & Jago, 2008:110). The majority of adolescent girls, therefore, do not meet the health recommendations for physical activity and are at risk of attaining chronic diseases of lifestyle (Butcher *et al.,* 2008:365). Participation in leisure time physical activity among girls has also been reported to show a decline of about 45% between ages 12-17 with a sharp decline in early adolescence (Neissaar & Raudsepp, 2011:340).

Research has shown that social correlates of physical activity play an important role in individual participation in physical activity or sport, and hence their link with associated health benefits (Sallis *et al.,* 2000:963; Sallis *et al.,* 2002:41). Bauman *et al.* (2012:269-271) have shown that correlates of physical activity such as age, sex, health status, self-efficacy, and motivation are associated with physical activity. The physical environment was also included by Bungum *et al.* (2012:1100) as a contributor to physical in activity with contributors as urban planning, transportation systems, and parks and trails.

The social environment has also been shown to have a positive correlation with participation in physical activity among adolescents (Hsu *et al.,* 2011:217) with the most important social correlates perceived by children being parental and peer influences, and time available for physical activity (Stanley *et al.,* 2012:38). Tandon *et al.* (2014:44) identified parental support for physical activity to be positively associated with MVPA and negatively associated with sedentary behaviour. Trost *et al.* (2203:282) also identified positive associations between parental support and encouragement for physical activity and adolescents' actual physical activity. Parental modelling of physical activity was also found to be consistently associated with physical activity, specifically among adolescent girls (Bauer *et al.,* 2011:34-35).

Bergh *et al.* (2011:e324) and Serra *et al.* (2014:750) found that the influence of friends was positively associated with participation of adolescents in physical activity. Salvy *et al.* (2009:225) found that friendships may increase youth's motivation to engage in and promote greater physical activity. Kirby *et al.* (2011:790) though, found that boys had higher peer support than girls, resulting in girls participating less in physical activity than boys.

Dantas *et al*. (2014:128) and Bohr *et al*. (2013:547) found that boys perform higher levels of physical activity at higher frequencies than girls regardless of their socioeconomic

circumstance and that girls were therefore more affected by social correlates than boys. Dwyer *et al.* (2006:161) investigated adolescent girls' perceived barriers to participation in physical activity and found that lack of time, involvement in technology-related activities, peer influence, parents and teachers, safety concerns, inaccessibility of facilities and the cost thereof, competition, and body-centeredness impeded adolescent girls from participating in sport. Dunton *et al.* (2007:943) also found that psychosocial variables of self-efficacy and enjoyment were associated with cardiovascular fitness among sedentary adolescent females.

The study was consequently designed to answer the following questions:

1. What is the status of physical activity, health-related fitness and social correlates of physical activity among adolescents?
2. What is the relationship between physical activity and social correlates of physical activity among adolescents?
3. What is the relationship between health-related fitness and social correlates of physical activity in adolescents?

It is therefore envisaged that in addition to providing baseline data for future studies on physical activity, health-related physical fitness and social correlates that affect participation in physical activity, the results of the study will facilitate the development of interventions to promote participation in physical activity and the resultant attainment of health-related physical fitness. The findings will also clarify the relationship between physical activity, health-related physical fitness and social correlates for physical activity among South African schoolchildren.

6.2 CONCLUSIONS

1. The results partially support Hypothesis 1 that there will be a significant difference in the status of physical activity, health-related fitness and social correlates of physical activity among adolescents attending high schools in the Tlokwe Local municipality. Girls were found to be significantly fatter (%BF and BMI) and shorter than the boys. A significant difference was also observed in WHR where girls were found to have a higher WHR than the boys. A non-significant difference, though, was found in waist circumference. Boys were underweight and more highly active compared to girls, who were overweight and

inactive. Girls were mostly affected by their friends' '*encouragement to participate in sport or physical activity', 'participation in physical activity or sport with them'* and '*encouragement that they are doing a good job in physical activity or sport'* in comparison to their male counterparts.

2. The results partially support Hypothesis 2 that there will be a significant relationship between physical activity and social correlates of physical activity among the adolescents attending high schools in the Tlokwe Local municipality. Boys were significantly (z-4.52; p=0.000) more highly active compared to the girls. Girls indicated a significantly ($p<0.05$) high percentage for 'never' (24%) regarding *'encouragement from friends to do physical activity or sport'* compared to the boys. Girls also have a high percentage for 'never' (12%) compared to boys (6%) in terms of friends who *'participate in physical activity or sport with them'*. Additionally, girls (24%) in comparison to boys (12%) never have friends *'encourage them that they are doing a good job in physical activity or sport'*. A significant positive correlation was only found between TPA and the social correlates of *"during a typical week has someone told you that you are doing well in physical activity"*.

3. The results partially support Hypothesis 3 that there will be a significant relationship between health-related fitness and social correlates of physical activity among the adolescents attending high schools in the Tlokwe Local municipality. Girls are significantly ($p<0.05$) fatter (%BF and BMI) and shorter than the boys. A significant gender difference ($p<0.05$) was also observed in WHR. Boys measured significantly higher than girls ($p<0.05$) in SBJ, BAH, SUP, predicted $\dot{V}O_{2max}$. Girls, though, had significantly higher measurements than boys ($p<0.05$) for SAR. A significant positive correlation was observed between WC, WHR, SBJ, SUP, predicted $\dot{V}O_{2max}$ and *'friends' encouragement in a typical week to do physical activity or sports'*. Further significant positive correlations were found with WC for *'encouragement by someone in a typical week to do physical activity or sports'*; WHR, SBJ, BAH, SUP, predicted $\dot{V}O_{2max}$ for *'participation in physical activity or sports with friends'*; SBJ, SUP, $\dot{V}O_{2max}$ for '*friends' encouragement that one is doing a good job at physical activity';* SBJ, SUP, predicted $\dot{V}O_{2max}$ for '*someone's encouragement that one is doing a good job at physical activity';* BAH, SUP, predicted $\dot{V}O_{2max}$ for *'someone's participation in sport with one';* SUP,

predicted $\dot{V}O_{2max}$ for *'one's encouragement to friends to participate in physical activity or sport'*; SUP for '*provision of transportation to physical activity or sport'; and* predicted $\dot{V}O_{2max}$ for *'someone watching one participate in physical activity or sport'*. SAR, on the other hand, was negatively associated with all social correlates for physical activity.

6.3 LIMITATIONS

The findings of this study should be interpreted in the light of the following limitations:

1. Whilst an attempt was made to randomly select the schools and learners in the Tlokwe local municipality that participated in the study, this was not feasible as the research was carried out only in the schools which gave the necessary permissions. Therefore, the sample size cannot be applied for generalisation to the adolescent population in the Tlokwe local municipality, nor to the South African adolescent population. Furthermore, the cross-sectional design of the study may somewhat have affected the interpretation of the results in the sense that some of the aspects/variables change over a period of time. Regardless of these weaknesses, the strength of the PAHL study is that it is planned over a period of time, where some of the variables will be tracked longitudinally to determine the development over time.

2. Studies on adolescents' body composition and health-related fitness should ideally assess the adolescents' nutritional status and control for the effects of growth and development which could clarify the findings obtained. However, this approach was not feasible in the present research.

3. Excluding the effects of physical growth and maturation may have yielded more interesting findings; however, this approach was not feasible in the present research.

4. The lack of standard sports facilities at the schools from where data were collected was also a constraining factor. This was a challenge in the execution of the health-related fitness tests as the adolescents had to be transported to the research facility for tests to be conducted.

6.4 RECOMMENDATIONS

1. The adolescents' low PA status warrants that school authorities should provide opportunities for the adolescents to participate in PA, physical education and school sport. Teachers, school governing bodies, parents, members of the community, sport structures and all stakeholders should be involved in creating the right social and emotional environment which will encourage adolescents to be physically active.
2. Physical Education (PE) provides the ideal opportunity for learners to participate in PA and PE therefore should be prioritised and taught as a standalone subject separated from Life Orientation. Teacher training in PE should be amplified and resources for effecting teaching of PE provided.
3. Financial resources should be prioritised for the construction of sport facilities in schools and communities to ensure access to physical activity and sport facilities by children and adolescents.
4. More research should be conducted on the effect of social correlates on the participation of adolescents in physical activity and health-related fitness in South Africa in order for South African patterns to be fully understood. This will guide interventions to improve physical activity amongst adolescents in the country.

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APPENDIX A (1)

GUIDELINES FOR AUTHORS

The African Journal for Physical, Health Education, Recreation and Dance (AJPHERD) is a peer-reviewed journal established to:

i) Provide a forum for physical educators, health educators, specialists in human movement studies and dance, as well as other sport-related professionals in Africa, the opportunity to report their research findings based on African settings and experiences, and also to exchange ideas among themselves,

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An abstract of 200-250 words is required with up to a maximum of 5 words provided below the abstract. Abstract must be typed on a separate page using single line spacing, with the purpose of the study, methods, major results and conclusions concisely presented. Abbreviations should either be defined or excluded.

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Text should carry the following designated headings: Introduction, materials and methods, results, discussion, acknowledgement, references and appendices (if appropriate).

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This section should provide sufficient and relevant information regarding study participants, instrumentation, research design, validity and reliability estimates, data collection procedures, statistical methods and data analysis techniques used. Qualitative research techniques are also acceptable.

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Book references should specify the surname and initials of the author(s), year of publication of the book, title, edition, page numbers written in brackets, city where book was published and name of publishers. Chapter references should include the name(s) of the editor(s) and other specific information provided in the third example below:

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Manuscripts generally should not exceed 25 pages (~5000 words including everything *except* title and abstract pages). Reviews should not exceed a total of 30 pages and Brief Reports should not exceed 15 pages. Major exceptions to these criteria must be approved through the Editorial Office before submission. Submissions should not include more than 10 tables/graphics, and should follow the Uniform Requirements for Manuscripts Submitted to Biomedical Journals (visit www.icmje.org/index.html for more detail). *JPAH* welcomes and encourages the submission of supplementary materials to be included with the article. These files are placed online and can be accessed from the *JPAH* website. Supplemental material can include relevant appendices, tables, details of the methods (e.g., survey instruments), or images. Contact the Editorial Office for approval of any supplemental materials.

Standardized Publication Reporting Guides

JPAH highly recommends that authors refer to relevant published reporting guidelines for different types of research studies.

Examples of reporting guidelines include

1. Consolidated Standards of Reporting Trials (CONSORT) — www.consort-statement.org/
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3. Quality of Reporting of Meta-analyses (QUOROM) — www.consort-statement.org/mod_product/uploads/QUOROM%20Statement%201999.pdf
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names on the title page. The order of submission must be 1) Title page, 2) Abstract, 3) Text, 4) Acknowledgments, 5) Funding source, 6) References, 7) Tables, 8) Figures/Graphics.

Manuscript types

Original Research: A manuscript describing the methods and results of a research study (quantitative or qualitative), including the background and purpose of the study, a detailed description of the research design and methods, clear and comprehensive presentation of results, and discussion of the salient findings.

Public Health Practice: A manuscript describing the development or evaluation of a public health intervention to increase or promote physical activity in a community setting, or a study that describes translation of research to practice.

Technical Note: A short article that presents results related to a new or modified method or instrument related to physical activity measurement or an important experimental observation.

Brief Reports: A short article (15 or fewer pages), usually presenting the preliminary or novel results of an original research study or public health practice program.

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Manuscript sections

Abstract: All manuscripts must have a structured abstract of no more than 200 words. Required headings are 1) Background, 2) Methods, 3) Results, and 4) Conclusions.

Text: The entire manuscript must be double-spaced, including the abstract, references, and tables. Line numbers must appear on each page in the left margin. A brief running head is to be included on the upper right corner of each page; page numbers must appear on the bottom right corner of each page.

For studies involving human subjects, the Methods section must include a statement regarding institutional approval of the protocol and obtaining informed consent. For studies

using animals, the Methods section must include a statement regarding institutional approval and compliance with governmental policies and regulations regarding animal welfare.

References: For reference lists, authors must follow the guidelines found in the *American Medical Association Manual of Style: A Guide for Authors and Editors* (10th ed.). Examples of reference style:

Journal Articles: Surname of first author, initials, then surname and initials of each coauthor; title of article (capitalize only the first word and proper nouns), name of the journal (italicized and abbreviated according to style of Index Medicus), year, volume, and inclusive page numbers.

Melby CL, Osterberg K, Resch A, Davy B, Johnson S, Davy K. Effect of carbohydrate ingestion during exercise on post-exercise substrate oxidation and energy intake. *Int J Sport Nutr Exerc Metab.* 2002;12:294–309.

Book References: Author(s) as above, title of book (italicized and all major words capitalized), city and state/province of publication, publisher, and year.

Pearl AJ. *The Female Athlete*. Champaign, Ill: Human Kinetics; 1993.

Chapter in an Edited Book. Same as book references, but add the name of the chapter author(s) and title of chapter (capitalize first word and proper nouns) before the book information and inclusive page numbers.

Perrin DH. *The evaluation process in rehabilitation*. In: Prentice WE, ed. *Rehabilitation Techniques in Sports Medicine*. 2nd ed. St Louis, Mo: Mosby Year Book; 1994:253–276.

Acknowledgments: Provide the names, affiliations, and the nature of their contribution for all persons not included as an author, who played a critical role in the study.

Funding source/trial registration: Details of all funding sources for the work should be provided (including agency name, grant numbers, etc.). Provide the registry name and registration number for all clinical trials (see JPAH Policies below).

Example: **"**This work was supported by a grant (grant #) from the National Cancer Institute, National Institutes of Health.This study is registered at www.clinicaltrials.gov (No. xxxxx)."

Tables: Each table must be accompanied by an explanatory title so that it is intelligible

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- Page numbers appear in bottom right corner
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- Title page does not include author names or affiliations
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- Page count under limit for the manuscript type (15, 25, or 30 pages).
- Fewer than 10 tables/figures
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Copyright Assignment Form

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When submitting a revised manuscript, the author must be certain to answer all reviewer questions, comments, and concerns by including a separate response document in addition to the revised manuscript. The response document should include each reviewer comment, the author response, and the modification made to the revised manuscript. **For an example of how to format the response document,** please view this file**.**

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Authorship Criteria: All authors must be willing to certify that they have contributed substantially to the 1) conception, design, analysis, and/or interpretation of the data; 2) drafting of the manuscript; 3) revision of the manuscript; and 4) approval of the final version. Each author must provide any relevant information upon request to substantiate their contributions.

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APPENDIX A (3)

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Aims and Scope

The *European Journal of Clinical Nutrition* is an international, peer-reviewed journal covering all aspects of human and clinical nutrition. The journal welcomes original research, reviews, clinical case reports and short communications based on clinical, metabolic and epidemiological studies that describe methodologies, mechanisms, associations and benefits of nutritional interventions for clinical disease and health promotion. Topics of interest include but are not limited to:

- Food and health (including functional foods and consumer protection)
- Interventions and public health nutrition
- Nutrition epidemiology
- Maternal and pediatric nutrition
- Nutrigenomics and molecular nutrition
- Body composition, energy expenditure and physical activity
- Carbohydrates, glycemic index and diabetes mellitus
- Lipids and cardiovascular/metabolic health
- Protein, malnutrition and wasting diseases
- Enteral and parenteral nutrition
- Vitamins and plant food
- Minerals, trace elements and bone health

Editorial Note

Manuscripts based on animal nutrition and in vitro studies will not be considered. Papers reporting validation of generally accepted methodologies in specific population groups and prevalence or incidence data on nutritional problems from countries have very low priority. When validation studies and prevalence or incidence data specific to countries are submitted for publication to *EJCN*, they will be processed only if they are submitted as a short communication with the clear understanding that supplementary data will be made available by the authors to anyone interested in compiling regional or global comparisons.

Journal Details

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Current Contents Current Contents Clinical Medicine Current Contents Life Sciences EMBASE/Excerpta Medica Elsevier BIOBASE/Current Awareness in Biological Sciences MEDLINE/Index medicus Science Citation Index BIOSIS CAB Abstracts CAB Health and Nutrition Newsletter Revised 04/03/2015 2

ARTICLE TYPE SPECIFICATIONS

ARTICLE DESCRIPTION	ABSTRACT AND KEYWORDS	WORD LIMIT	TABLES/ FIGURES	REFERENCES
Original Articles (Please see 'Preparation of Original Articles' below for further details) These are reports of current basic or clinical research. *EJCN* strongly encourages authors adhere to the reporting guidelines relevant to their specific research design. Any clinical trials submitted to *EJCN* must adhere to the registration requirements listed in the Editorial Policies.	Structured abstract: • Background/ Objectives • Subjects/ Methods • Results • Conclusions	Abstract: 250 words Article: 3,000 words max excluding abstract, references, figures and tables.	Max of 6	Max of 50. Please use as recent as possible.
Clinical Case Reports These fall short of the criteria for full Original Articles (e.g. preliminary experiments limited by sample size or duration, or novel hypotheses). Apart from including an abstract, there is no strict obligation to divide the text into sections but structuring according to case history, major findings, discussion and conclusions (i.e. what can we learn from this case?) is recommended.	Unstructured abstract	Abstract: 150 words Article: 1,000 words max excluding abstract, references, figures and tables.	Max of 2	Max of 10
Short Communications These are studies that fall short of the criteria for full Original Articles (e.g. preliminary experiments limited by sample size or duration, or novel hypotheses). Apart from including an abstract, there is no obligation to divide the text into sections.	Unstructured abstract	Abstract: 150 words Article: 1,000 words max excluding abstract, references, figures and tables.	Max of 2	Max of 10
Reviews Reviews are comprehensive analyses of specific topics that are solicited by the Editor. Proposals for reviews may be submitted by sending a covering letter and abstract to the Editor for consideration. PLEASE NOTE: All reviews should include search criteria and selection criteria in a Methods Section, along with the total number of	Unstructured abstract	Abstract: 250 words Article: 5,000 words max excluding abstract, references, figures and tables.	Max of 8	Max of 100

articles identified and the total number selected for inclusion in the review. All invited reviews will undergo peer review prior to acceptance.				
Mini-reviews Mini-Reviews should focus on a clearly defined topic of current interest, and describe recent developments in the field	Unstructured abstract	Abstract: 200 words Article: 3,000 words max excluding abstract, references, figures and tables.	Max of 6	Max of 50
Perspectives Perspectives are a hybrid between a commentary and a review, providing an opinion-driven perspective on a particular research topic or field of interest to the EJCN readership. Authors should present a (provocative) view that can be supported by data and literature with the goal of sparking debate and stimulating future research avenues.	No abstract required	2,000 words max excluding, references, figures and tables.	Max of 4	Max of 25
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PREPARATION OF ARTICLES

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 Cover letter
 Title page (excluding acknowledgements)
 Abstract
 Introduction
 Materials (or Subjects) and Methods
 Results
 Discussion
 Acknowledgements
 Conflict of Interest
 References
 Figure legends
 Tables
 Figures

Reports of clinical trials must adhere to the registration and reporting requirements listed in the Editorial Policies.

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Add note about including conflict of interest statement.

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 Subjects/Methods: How many subjects were recruited, how many dropped out? Was the study randomised, case-controlled etc? Interventions/methods used and duration of administration.

 Results: Indicate 95% confidence intervals and exact *P* value for effects.

 Conclusions: Answer (significant or not) to main question.

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Acknowledgements: These should be brief, and should include sources of support including sponsorship (e.g. university, charity, commercial organisation) and sources of material (e.g. novel drugs) not available commercially.

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spaced) in numerical order corresponding to the order of citation in the text. Where a reference is to appear next to a number in the text, for example following an equation, chemical formula or biological acronym, citations should be written as (ref. X) and not as superscript. Revised 04/03/2015 4.

Example. "detectable levels of endogenous Bcl-2 (ref. 3), as confirmed by western blot"
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Journal article, in press: Gallardo RL, Juneja HS, Gardner FH. Normal human marrow stromal cells induce clonal growth of human malignant T-lymphoblasts. *Int J Cell Cloning* (in press).
Complete book: Atkinson K, Champlin R, Ritz J, Fibbe W, Ljungman P, Brenner MK (eds). *Clinical Bone Marrow* and *Blood Stem Cell Transplantation*, 3rd edn. Cambridge University Press: Cambridge, UK, 2004.
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Abstract: Syrjala KL, Abrams JR, Storer B, Heiman JR. Prospective risk factors for five-year sexuality late effects in men and women after haematopoietic cell transplantation. *Bone Marrow Transplant* 2006; **37**(Suppl 1): S4 (abstract 107).

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 Statistical methods: For normally distributed data, mean (SD) is the preferred summary statistic. Relative risks should be expressed as odds ratios with 95% confidence interval. To compare two methods for measuring a variable the method of Bland & Altman (1986, Lancet 1, 307–310) should be used; for this, calculation of P only is not appropriate.

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Advance Online Publication

The final version of the manuscript is published online in advance of print. AOP represents the official version of the manuscript and will subsequently appear unchanged, in print. Revised 04/03/2015 7

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Colour Charges

There is a charge if authors choose to publish their figures in colour in print publication:

Number of colour illustrations	1	2	3	4	5	6	7+
Cost	Rest of world £590 USA $909	£877 $1,351	£1,132 $1,795	£1,341 $2,067	£1,516 $2,336	£1,667 $2,569	£150 $232	per additional colour figure

APPENDIX B

The District Operational Director

Department of Education
North West Province
Potchefstroom

REQUEST TO CONDUCT RESEARCH WITHIN YOUR DISTRICT

Dear Sir,

We the researcher from the School of Bio kinetics, Recreation and Sport Science are hereby making a request to conduct research in the district under your authority.

To give the background of the study, research revealed that physical activity in adolescents is drastically declining. The decline in the level of physical activity of human populations has been observed, and such decline is been associated with increased mechanization, reliance on technology and urbanization, and the high rate of crime in South Africa and elsewhere in the world. Physical inactivity is thought to be one of the main risk factors for the development of obesity, diabetes, cardiovascular disease, osteoporosis and psychological constraints or risks of behavioural health.

Cross-sectional studies in South Africa which investigate the relationship between physical activity and determinants of cardiovascular disease for children and adults are available. Findings from these study revealed inactivity was significantly related to the determinants of cardiovascular disease. Little from the abovementioned studies could investigate physical activity and determinants of cardiovascular disease on a longitudinal basis. It is therefore important to note that South Africa is a country of paradox where obesity in children co-exists with malnutrition and many other ailments of health. It is therefore, against this background that a longitudinal study investigating the development and tracking of physical activity and the determinants of cardiovascular diseases in South African adolescents is needed. Adolescence is a time when independence is established, and dietary and activity patterns may be adopted that are followed for many years. Most of the physiological, psychological and social changes within people take place during this period of life. The period of adolescence can be looked upon as a time of more struggle and turmoil than childhood. Adolescents have long been regarded as a group of people who are searching for themselves to find some form of identity and meaning in their lives. Thus, it has great influence on adult fatness and chronic disease of lifestyle as well as long-term outcome on quality of life. If youth health behaviours are tracked during adolescence, it would add support to the primary assumptions given for early interventions to prevent cardiovascular disease as well as delay in cognitive development. For this longitudinal study, tracking is defined as the stability of health behaviours over time, or the predictability of future values by early measurements. From the above given background, therefore, the aims of the study is to investigate over a five year period (2010-2014) a follow-up longitudinal development of physical activity and determinants of health risk factors of health behaviour in 14 years-old adolescents attending schools in Potchefstroom area of the North West Province of South Africa.

The above matter background information refers:

1. Permission is requested to conduct research in selected schools in your district as follows:
    1.1. BA Seobi Sec. School
    1.2. Tlokwe High School
    1.3. Resolofetse High School
    1.4. Botokwa High School
    1.5. Potchefstroom High School for Boys

1.6. Potchefstroom High School for Girls

1.7. Hoer Volkskool Potchefstroom

1.8. Potchefstroom Gimnasium School

2. The targeted groups are boys and girls aged 14 years, in essence the grade 8 learners (NB: the proportion will be as follow: in mixed schools, 35 girls and 35 boys; in blacks schools 30 boys and 30 girls will be required).

3. The targeted term is the first term of 2010 (to be continued during the same term in the subsequent years up until 2014)

4. Items to be assessed or measured are:

4.1. Demographic information of the selected participants

4.2. Anthropometric measurements (i.e. body height; weight; skin folds thickness (triceps, sub scapular and calf skin folds), and waist and hip circumferences)

4.3. Maturation (Tanner questionnaire)

4.4. Blood pressure measurement (mercury sphygmomanometer)

4.5. Physical activity questionnaire

4.6. ActiHeart (heart rate recorder with an integrated omnidirectional accelerometer. It is clipped onto two ECG electrodes worn on the chest.)

4.7. Health-related physical fitness (i.e. 20m shuttle run, standing broad jump, sit-and-reach, bent arm hang, sit-ups)

4.8. Social and self-efficacy questionnaire

4.9. Resting metabolic rate (determined by means of a mobile gas analyser)

4.10. Blood sampling (i.e. The participants will be requested to fast overnight (10 hours). A fasting sample of 10 ml blood will be taken from each participant in order to obtain ample blood for the various analyses of the study.)

4.11. Nutritional intake questionnaire.

4.12. Leisure and recreation constraint questionnaires

5. The schedule of the project will be as follow (Specific dates for selected schools will be finalised per arrangement with the principals concerned):

Month and week	Duration
April 2010, week 12 – 16	3 hours per child in a selected school
April 2010, week 19 – 23	3 hours per child in a selected school

Due to the fact that participants will be asked to fast 10 hours without eating breakfast in the morning, therefore sandwiches provision will be made available upon completion of the

measurements. The outcomes of this project will benefit the children and the schools with the information regarding the physical activity status and the determinants of health for future.

Hoping for a positive response.

Yours sincerely,

Thank you,

Prof. M. Andries. Monyeki
(Principal Investigator, NWU-Potchefstroom)

Dr Hanlie Moss
Leader of Niche Area for Physical Activity, Sports and Recreation, NWU-Potchefstroom

APPENDIX C

NORTH-WEST UNIVERSITY
YUNIBESITI YA BOKONE-BOPHIRIMA
NOORDWES-UNIVERSITEIT

Science

INFORMATION LETTER TO THE PARENTS AND CONSENT FORMS: *PAHLS STUDY*

Dear Parent or Guardian,

Your child is been invited to participate in a study entitled – Five year Longitudinal Study of Physical Activity status and the Determinants of Health in Adolescents attending high school in Potchefstroom areas of South Africa (*PAHLS-Study, 2010–2014*).

My name is Professor Makama Andries Monyeki (from Potchefstroom Campus of the North-West University) principal investigator in the project together with the research team would like to ask your permission to allow your child (or a child under your care) to participate in our study. To give the background of the study, research revealed that physical activity in adolescents is drastically declining. The decline in the level of physical activity of human populations has been observed, and such decline is been associated with increased mechanization, reliance on technology and urbanization, and the high rate of crime in South Africa. Physical inactivity is thought to be one of the main risk factors for the development of obesity, diabetes, cardiovascular disease, osteoporosis and psychological constraints or risks of behavioural health. Therefore, the purpose of this study is to gather information about physical activity (i.e. by questionnaire & ActiHeart rate monitor) and health determinants (i.e. through measurements of anthropometry, maturation, blood pressure measurement, health-related physical fitness, social and self-efficacy questionnaire, resting metabolic rate, oxygen consumption (by the use of a portable gas analyser apparatus), blood sampling, leisure and recreation constraint questionnaires, nutritional intake questionnaire as questionnaire on risk factors of life) over a period of five years (2010–2014).

Participation in this study is not part of the child's regular classroom work; it is an optional activity in which the learner can choose to participate. The study will assess and test the following variables: anthropometric measurements, maturation, blood pressure measurement, health-related physical fitness, social and self-efficacy questionnaire, resting metabolic rate, oxygen consumption, blood sampling, leisure and recreation constraint questionnaires, nutritional intake questionnaire as questionnaire on risk factors of life. Blood samples will be collected by a registered professional nurse who will be obliged to health profession practices at all times.

The data of the study will be used for research purpose only. The measurements will not be shared with your child classmates or teacher. All information collected in this study will be kept confidential. Your child's participation is important because the information that shall be gathered on him/her will help him/her with knowledge for personal development and life skills.

Your child participation in the project is very important, but it is entirely your choice. If your child chooses to refuse to participate in any part of the study or withdraw from the study at any time, for any reason, this will not cause anyone to be upset or angry, and this will not results in any type of penalty.

There are no costs required from your child (or a child under your care) to participate in the study. Further, no payment will be granted to your child (or a child under your care) for participating in the study.

If you have any question regarding this study, please feel free to call me at (018) 2991790 / e-mail:andries.monyeki@nwu.ac.za or the PHASrec Niche Area Leader Dr Hanlie Moss at (018) 2991821 / e-mail:hanlie.moss@nwu.ac.za. If you have any questions regarding your rights or your child's rights as participants in this study you can call Ms Hannekie Botha at (018) 299 4850 from Potchefstroom Campus of the North-West University Research Ethics Office.

Thank you, in advance, for considering your child participation in this study. Should you choose that your child participate, please read and sign the attached consent form. Keep one

consent form for your records and return the other copy. All received consent form will be kept locked during the entire period of the study. In addition, your child is requested to bring along his/her birth clinic card. The card will be given back to the child immediately after collecting information on birth date and birth weight. A child who shall have returned a completed and signed consent form will participate in the study.

Sincerely,
Prof. Makama Andries Monyeki
Principal Investigator – PAHLS Study
CONSENT FORM
(Parent/Guardian Copy)

FIVE YEAR LONGITUDINAL STUDY OF PHYSICAL ACTIVITY STATUS AND THE DETERMINANTS OF HEALTH IN ADOLESCENTS ATTENDING HIGH SCHOOL IN POTCHEFSTROOM AREAS OF SOUTH AFRICA (*PAHLS-STUDY, 2010–2014*).

I, ..., father/mother/guardian of .....
agree to permit my child to provide the information on physical activity (i.e. by questionnaire & ActiHeart rate monitor) and health determinants (i.e. through measurements of anthropometry, maturation, blood pressure measurement, health-related physical fitness, social and self-efficacy questionnaire, resting metabolic rate, oxygen consumption (by the use of a portable gas analyser apparatus), blood sampling, leisure and recreation constraint questionnaires, nutritional intake questionnaire as questionnaire on risk factors of life), by the researchers at my child school. I understand that the results of this study of Five year longitudinal study of physical activity status and the determinants of health in adolescents attending high school in Potchefstroom areas of South Africa (*PAHLS-STUDY NWP*) will be used for research purpose and nothing else. I am aware that if I have any question or concerns about the study I can contact the researcher at (018) 299 1790 or the PHASRec Niche Area Leader at (018) 299 1821. Any questions or concerns regarding my child rights as a participant in this study can be addressed to Ms Hannekie Botha at (018) 299 4850 from Potchefstroom Campus of the North-West University Research Ethics Office. I understand that there will be no discomfort or foreseeable risks for my child to participate in the study. I understand that all information my child provide will remain strictly confidential. I have read and understand the information provided above and in the information letter. I have been provided with the opportunity to ask questions and my questions have been answered satisfactorily. I consent to have my child participate in the study described above, understanding that he/she may refuse to participate in any part of the study and can withdraw from the study at any time. I have kept one copy of this consent for my records and will return the second copy with the clinic birth card. I am aware that by giving consent my child can participate in the study. The return consent form will be kept locked during the entire period of the study.

Child's Age:.....
Grade:.....
Teacher:.....
School Name:.....

Name of Child:.....

Name of Parent/Guardian:.....

.....	.....
(Signature of Child)	(Signature of Parent/Guardian)
.....	.....
(Date)	(Date)

CONSENT FORM (*PAHLS*)

(Return this copy with the demographic questionnaire)

FIVE YEAR LONGITUDINAL STUDY OF PHYSICAL ACTIVITY STATUS AND THE DETERMINANTS OF HEALTH IN ADOLESCENTS ATTENDING HIGH SCHOOL IN POTCHEFSTROOM AREAS OF SOUTH AFRICA (*PAHLS-STUDY, 2010–2014*).

I, ..., father/mother/guardian of .....

agree to permit my child to provide the information on physical activity (i.e. by questionnaire & ActiHeart rate monitor) and health determinants (i.e. through measurements of anthropometry, maturation, blood pressure measurement, health-related physical fitness, social and self-efficacy questionnaire, resting metabolic rate, oxygen consumption (by the use of a portable gas analyser apparatus), blood sampling, leisure and recreation constraint questionnaires, nutritional intake questionnaire as questionnaire on risk factors of life), by the researchers at my child school. I understand that the results of this study of Five year longitudinal study of physical activity status and the determinants of health in adolescents attending high school in Potchefstroom areas of South Africa (*PAHLS-STUDY NWP*) will be used for research purpose and nothing else. I am aware that if I have any question or concerns about the study I can contact the researcher at (018) 299 1790 /e-mail:andries.monyeki@nwu.ac.za or the PHASRec Niche Area Leader at (018) 299 1821 /e-mail:hanlie.moss@nwu.ac.za. Any questions or concerns regarding my child rights as a participant in this study can be addressed to Ms Hannekie Botha at (018) 299 4850 from Potchefstroom Campus of the North-West University Research Ethics Office. I understand that there will be no discomfort or foreseeable risks for my child to participate in the study. I understand that all information my child provide will remain strictly confidential. I have read and understand the information provided above and in the information letter. I have been provided with the opportunity to ask questions and my questions have been answered

satisfactorily. I consent to have my child participate in the study described above, understanding that he/she may refuse to participate in any part of the study and can withdraw from the study at any time. I have kept one copy of this consent for my records and will return the second copy with the clinic birth card. I am aware that by giving consent my child can participate in the study. The return consent form will be kept locked during the entire period of the study.

Child's Age:.....

Grade:.....

Teacher:.....

School Name:.....

Name of Child:.....

Name of Parent/Guardian:.....

.....	.....
(Signature of Child)	(Signature of Parent/Guardian)
.....	.....
(Date)	(Date)

APPENDIX D

PAHLS Project - Anthropometry Proforma

Subject number:	

Name: …… Sport: ……

Surname first names

Date of Birth:			
	Day	Month	Year

Test Date:			
	Day	Month	Year

Box height: .....

Gender: M ☐ F ☐

	ID	*Site*	*Trail 1*	*Trail 2*	*Trail 3*	*Mean/ Median*
Basic	1	Body mass				
	2	Stature				
	3	Sitting height				
	4	Armspan				

Skinfolds	5a	Triceps : R				
(SF)	5b	Triceps : L				
(mm)	6a	Subscapular : R				
	6b	Subscapular : L				
	7a	Biceps : R				
	7b	Biceps : L				
	8a	Supraspinale : R				
	8b	Supraspinale : L				
	9	Abdominal : R				
	10a	Front thigh : R				
	10b	Front thigh : L				
	11a	Medial calf : R				
	11b	Medial calf : L				

Girths	12	Head				
GR	13a	Arm (relaxed) : R				

(cm)	13b	Arm (relaxed) : L				
	14a	Arm (flexed & tensed) : R				
	14b	Arm (flexed & tensed) : L				
	15	Waist (minimum)				
	16	Gluteal (hips)				
	17a	Thigh (mid) : R				
	17b	Thigh (mid) : L				
	18a	Calf (maximum) : R				
	18b	Calf (maximum) : L				

Breadths	19	Wrist				
BR	20	Ankle				
(cm)	21	Foot length				
	22	Humerus				
	23	Femur				

APPENDIX E

PAHLS PHYSICAL FITNESS DATA FORM

NAME OF LEARNER: _____ SUBJECT NO. _____

TEST COMPONENT	**1ST TIME**							
POLE HEIGHT (CM)								
Vertical jump Reaching height (cm)	**A**							
FINAL VERTICAL JUMP HEIGHT A-B (cm)								
TEST COMPONENT	**1ST READING**	**2ND READING**	**HIGHEST**					
Vertical jump height (cm)			**B**					
Tendo peak power (W)								
Tendo speed (m/sec)								
TEST COMPONENT	**1ST READING**	**2ND READING**	**HIGHEST**					
horizontal jump distance (cm)								
TEST COMPONENT	**1ST READING**	**2ND READING**	**HIGHEST**					
basketball throw distance (m)								
TEST COMPONENT	**1ST READING**	**2ND READING**	**HIGHEST**					
L: hand grip strength (kg)								
R: hand grip strength (kg)								
TEST COMPONENT	**1ST READING**							
ABDOMINAL STRENGTH TEST (LEVEL)	0	1	2	3	4	5	6	7
TEST COMPONENT	**1ST TIME**							

bent arm hang (sec)			
TEST COMPONENT	**1ST TIME**		
sit ups (reps)			
TEST COMPONENT	**1ST READING**	**2ND READING**	**LOWEST**
5m Speed (sec)			
10m speed (sec)			
40m speed (sec)			
TEST COMPONENT	**1ST READING**	**2ND READING**	**LOWEST**
L: agility 505-test (sec)			
R: agility 505-test (sec)			

TEST COMPONENT	**1ST READING**
gender	**M / F**
birth date	**year / month / day**

20M SHUTTLE RUN									
LEVEL	**SHUTTLE NUMBER AND HEART RATES**								
1	1	2	3	4	5	6	7		
2	1	2	3	4	5	6	7	8	
3	1	2	3	4	5	6	7	8	
4	1	2	3	4	5	6	7	8	9
5	1	2	3	4	5	6	7	8	9
6	1	2	3	4	5	6	7	8	9	10

7	1	2	3	4	5	6	7	8	9	10					
8	1	2	3	4	5	6	7	8	9	10	11				
9	1	2	3	4	5	6	7	8	9	10	11				
10	1	2	3	4	5	6	7	8	9	10	11				
11	1	2	3	4	5	6	7	8	9	10	11	12			
12	1	2	3	4	5	6	7	8	9	10	11	12			
13	1	2	3	4	5	6	7	8	9	10	11	12	13		
14	1	2	3	4	5	6	7	8	9	10	11	12	13		
15	1	2	3	4	5	6	7	8	9	10	11	12	13		
16	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
17	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
18	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
19	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
20	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

TEST COMPONENT	**1ST TIME**
vo_{2MAX} (ML/KG/MIN) - INDIRECT	
vo_{2MAX} (ML/KG/MIN) - DIRECT	
ve_{MAX} (l/MIN) - DIRECT	
r_{MAX} - DIRECT	
hr_{MAX} (BEATS/MIN) - DIRECT	

APPENDIX F

PHYSICAL ACTIVITY QUESTIONNAIRE (PAHLS-IPAQ)

A: GENERAL INFORMATION ABOUT YOU

School:	
Grade:	
School number:	
Name of the participant:	
Subject number:	
Address:	
Race	

Date of Survey			**Grade**	**Sex (mark with a X)**		**Date of birth**			**Age**
dd	**mm**	**Yy**		**F**	**M**	**dd**	**mm**	**yy**	

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at school, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous/ very hard** activities that you did in the **last 7 days**. **Vigorous/ Very hard** physical activities refer to activities that take hard physical effort and make you breathe much

harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

1. During the **last 7 days**, on how many days did you do **very hard** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

_____ **days per week**

☐ No very hard physical activities → ***Skip to question 3***

2. How much time did you usually spend doing **very hard** physical activities on one of those days?

_____ **hours per day**
_____ **minutes per day**

☐ Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

_____ **days per week**

☐ No moderate physical activities → ***Skip to question 5***

4. How much time did you usually spend doing **moderate** physical activities on one of those days?

_____ **hours per day**
_____ **minutes per day**

☐ Don't know/Not sure

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure.

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

_____ **days per week**

☐ No walking → ***Skip to question 7***

6. How much time did you usually spend **walking** on one of those days?

_____ **hours per day**
_____ **minutes per day**

☐ Don't know/Not sure

The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the **last 7 days**, how much time did you spend **sitting** on a **week day**?
(watching TV, Videogames/Internet, Listening to music, reading)

_____ **hours per day**
_____ **minutes per day**

☐ Don't know/Not sure

This is the end of the questionnaire, thank you for participating.

APPENDIX G

SOCIAL SUPPORT FOR PHYSICAL ACTIVITY

This section asks you about the social support for participation in physical activity. Answer all questions. Answer these questions by putting a **Tick (√)** or **Cross (X)** in an appropriate box.

For an example:

During a typical week, how often	**NEVER**	**SOMETIMES**	**EVERY DAY**
do my friend play soccer with me		√	

Now is your term **ANSWER THESE QUESTIONS, and Remember no answer is WRONG**

DURING A TYPICAL WEEK, HOW OFTEN	**NEVER**	**SOMETIMES**	**EVERY DAY**
do you encourage your friends to do physical activities or play sports?			
do your friends encourage you to do physical activities or play sports?			
do your friends do physical activities or play sports with you?			
do your friends tell you that you are doing a good job at physical activity?			
has someone encouraged you to do physical activities or sports?			
has someone done a physical activity or played sports with you?			
has someone provided transportation to a place where you can do physical activities or play sports?			
has someone watched you participate in physical activities or sports?			
has someone told you that you are doing well in physical activity?			

THIS IS THE END OF THE QUESTIONNAIRE, THANK YOU FOR PARTICIPATING