

**Body composition and television viewing  
among high school adolescents residing within  
the Tlokwe municipality: PAHL study**

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**P.M SATHEKGE**

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among high school adolescents residing within  
the Tlokwe municipality: PAHL study**

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S.T.D., B.A., B.A. Hons

Dissertation submitted in fulfilment of the  
requirements for the degree *Master of Arts* in  
Biokinetics at the Potchefstroom Campus of the  
North-West University

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## Declaration

Prof. M.A. Monyeki (supervisor) and Prof. J.H. De Ridder (co-supervisor), the co-authors of the article which forms part of this dissertation, hereby give permission to the candidate, Mr P.M. Sathekge to include the article as part of a Masters' dissertation. The contribution of each co-author, both supervisory and supportive, was kept within reasonable limits and included:

Mr P.M. Sathekge: Developed the proposal, data collection, statistical analyses, interpretation of the results, writing of the manuscript;

Prof. M.A. Monyeki: Principle investigator of the PAHL study. Coordinated the study, planning of the master's degree study, advised on statistical analyses and interpretation thereof, structure of the manuscript, reviewing of the manuscript;

Prof. J.H. de Ridder: Planning of the master's degree study, interpretation of the results, reviewing of the manuscript; thereby enabling the candidate to submit this dissertation for examination purposes.

This dissertation, therefore, serves as fulfilment of the requirements for the M.A. degree in Biokinetics 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

Television viewing is one of the most easily modifiable causes of obesity among children. The purpose of this study was to determine the relationship between body composition and TV viewing among adolescents attending high schools in the Tlokwe municipality area of the North West province of South Africa. A cross-sectional study design which is part of the Physical Activity and Health Longitudinal Study (PAHLS) was followed on 154 learners (58 boys and 96 girls) who were aged 14 years in the Tlokwe municipality area. All the learners underwent anthropometric measurements of height, weight, and two skinfolds (triceps and subscapular skinfolds). Percentage body fat (%BF) was calculated from the two skinfolds according to Slaughter's *et al.* (1988) equation. Children were classified into three groups (*viz.* normal, overweight and obese) according to BMI cut-off point suggested by Cole *et al.* (2000). Pearson correlation coefficients were used to determine the relationship between television viewing and body composition. The results show respectively high prevalence of overweight and obesity in girls (10.4%; 6.3%) as compared to the prevalence of 5% overweight in boys. With regard to TV viewing, the results show that 54% of the total group watch TV more than two hours a day, while only 11% watched TV less than one hour a day. The results show that the group that watches TV for more than 3 hours had high BMI (21.27kg/m<sup>2</sup>) and body mass (51.54kg). The group that watches TV for 1-2 hours had low BMI (18.36kg/m<sup>2</sup>) and body mass (44.79kg). There was a statistical significant relationship between BMI and body mass ( $p=0.001$ ). A significant positive relationship between body mass and TV viewing ( $r=0.56$ ;  $p=0.05$ ) in overweight group was found, whilst in the obese group strong significant positive relationship was observed between percentage body fat and TV viewing ( $r=0.94$ ;  $p=0.01$ ). It can be concluded that girls were more overweight and obese respectively as compared to the boys. Furthermore, both boys and girls had high percentages of TV viewing for more than two hours a day. In addition, the results indicated that adolescents who watched TV more than 3 hours are heavier and fatter. Therefore, it is recommended that parents and educational

heads should encourage periods of daily physical activity. In addition, it is also important that parents play a more positive role in limiting the amount of hours their children spent watching television.

**Keywords:** Sedentary lifestyle, television viewing, body composition, adolescents, habitual physical activity, anthropometry.

# OPSOMMING

Televisie kyk (TV) is een van die mees maklikste wysigbare oorsake van obesiteit onder kinders. Die doel van die studie was om die verhouding tussen liggaamsamestelling en TV kyk onder adolessensie wat hoër skole in die Tlokwe munisipaliteit omgewing van die Noordwes Provinsie van Suid Afrika bywoon vas te stel. 'n dwarsdeursnit studie-ontwerp wat deel is van die Fisieke Aktiwiteit en Gesondheid Longitudinale Studie (PAHLS) is geduer op 154 leerlinge (58 seuns en 96 meisies) van 14 jaar oud in die Potchefstroom omgewing. Daar is antropometriese metings van lengte, gewig en twee velvoue (trisepsvelvou en kuitvelvou) op al die leerlinge gedoen. Persentasie liggaamsvet (% LV) is bereken van die twee velvoue, volgens die vergelyking van Slaughter' *et al.* (1988). Die kinders is geklassifiseer in drie groepe (normaal, oorgewig en obees) volgens die BMI af-sny-punt soos voorgestel deur Cole *et al.* (2000). Die Pearson korrelasie koëffisiënt is gebruik om, die verbandskap tussen TV-kyk en liggaamsamestelling te bepaal. Die resultate toon onderskeidelik hoë prevalensie van oorgewig en obesiteit by meisies (10.4%, 6.3%) in vergelyking met die prevalensie van 5% oorgewig by seuns. Met betrekking tot TV-kyk, wys die resultate dat 54% van die totale groep TV-kyk vir meer as twee ure per dag, terwyl net 11% TV-kyk vir minder as 'n uur per dag. Die resultate wys vander dat die groep wat TV-kyk vir meer as drie ure per dag 'n hoër BMI ( $21.27\text{kg/m}^2$ ) en liggaamsmassa (51.54kg) getoon het. Die groep wat TV gekyk het vir 1-2 ure per dag het 'n laer BMI ( $18.36\text{kg/m}^2$ ) en liggaamsmassa (44.79kg) getoon. Daar was 'n statistiese betekenisvolle verbandskap tussen BMI en liggaamsmassa ( $p=0.05$ ). 'n Betekenisvolle positiewe verbandskap tussen liggaamsmassa en TV-kyk ( $r=0.56$ ;  $p=0.05$ ) in die oorgewig groep is gevind, terwyl in die obese groep, sterk positiewe en betekenisvolle verhouding waargeneem is tussen die persentasie liggaamsvet en TV-kyk ( $r=0.94$ ;  $p=0.01$ ). Gevolglik blyk dit dat meisies meer oorgewig en obese was as die seuns. Verder toon beide seuns en meisies 'n hoë persentasie van TV-kyk vir meer as twee ure per dag. Resultate dui verder aan dat die adolessente wat vir meer as 3 ure per dag TV-kyk swaarder en vetter is. Derhalwe word voorgestel dat die ouers en opvoedkundige hoofde daaglikse periodes van fisieke aktiwiteit aanmoedig. Dit is ook verder belangrik dat ouers 'n meer positiewe rol speel in die vermindering van die ure wat hul kinders spandeer om TV te kyk.

**Sleutelwoorde:** Onaktiewe leefstyl, televisie kyk, liggaamsamestelling, adolessente, fisieke aktiwiteit, antropometrie

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## List of abbreviations

**ACSM** = American College of Sports Medicine

**BMI** = Body mass index

**DLW** = Doubly-labelled Water

**HEPA** = Health-enhancing Physical Activity

**IPAQ** = International Physical Activity Questionnaire

**MET** = Metabolic Equivalent

**MVPA** = Moderate to Vigorous Physical Activity

**PAHLS** = Physical Activity and Health Longitudinal Study

**%BF** = Percentage Body Fat

**TEE** = Total Energy Expenditure

**TV** = Television

**WHO** = World Health Organisation

## Conference presentations and publications

**Topic:** Body composition and television viewing among high school adolescents in the Tlokwe Local Municipality, South Africa: The PAHL Study.

PM Sathekge, MA Monyeki and JH De Ridder

The research findings of this dissertation were presented at the international conferences as follows:

1. 9<sup>th</sup> Biennial conference of the Africa Association for Health, Physical Education, Recreation, Sport and Dance (AFAHPER-SD), Kyambogo University, Kampala, Uganda, 13<sup>th</sup> to 15<sup>th</sup> September 2011.
2. Be Active 2012 incorporating: 4th International Congress on Physical Activity and Public Health, Sydney Convention and Exhibition Centre, Oct 31 - 3 Nov 2012,

The abstract has been published in the *Journal of Science and Medicine in Sport (JSMS)*, Vol.15, Issue 6. (December), 2012, p.91.

# **Chapter 1: Introduction and aim of the study**

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## 1.1 INTRODUCTION

Obesity is a major and rapidly growing global public health problem among children and adolescents (Ogden *et al.*, 2002:1729; Gorden-Larsen *et al.*, 2004:570; York *et al.*, 2004:e466; WHO, 2007; Boone *et al.*, 2007:26). A study conducted in the US in 2003-2004, revealed that 26.2% of children aged 2-5 years, 37.2% of children aged 6-11 years, and 34.4% of adolescents between 12-19 years were at risk of being overweight or obese (Ogden *et al.*, 2002:1729). In South Africa, the prevalence of overweight and obesity in children is reported to be 14.0% and 3.2% in boys respectively and 17.9% and 4.9% in girls respectively (Armstrong *et al.*, 2006:441). From an epidemiologic study (Andersen *et al.*, 1998:938) and meta-analyses study (Marshall *et al.*, 2004:1238) positive associations between obesity and television viewing were reported. In addition, it was also indicated that people in industrialized countries are expending less energy in activities of daily living and at work (Prentice & Jebb, 1995:438; US Department of Health and Human Services, 1996). Furthermore, Lazzer *et al.* (2005:37) revealed that physical activity is declining drastically during the adolescent stage, and this raises a serious concern for public health which warrants investigation.

Obesity is a strong predictor of morbidity, with central obesity associated with insulin resistance, dislipidemia and hypertension, all independent risk factors for cardiovascular disease and features of the metabolic syndrome (Steele *et al.*, 2009:1185). According to Lazzer *et al.* (2005:37), approximately half of all obese children and adolescents are likely to become obese adults, who are more prone to suffer from chronic diseases than their thinner counterparts. Children who are less exposed to TV viewing and participate in regular physical activity, have significantly lower levels of adiposity (Robinson, 1999:1561). It was suggested that an active lifestyle during childhood and adolescence can play an important role in optimizing growth and development (US Department of Health and Human Services, 1996). The American Center for Disease Control and Prevention recommended that comprehensive school and community programmes should be developed to promote physical activity among children and adolescents (Center for Disease Control and Prevention, 1997). The goals of these programmes are to increase knowledge about



physical activity and exercise, to develop behavioural and motor skills that promote lifelong activity, and encourage physical activity outside of physical education classes (Andersen *et al.*, 1998:938).

## **1.2 PROBLEM STATEMENT**

One of the possible explanations for the decline in physical activity among children and adolescents is the increased hours of television viewing. Television viewing is one of the most easily modifiable causes of obesity among children (Eisenman *et al.*, 2002:380; Fulton *et al.*, 2009:30). Children spend more time watching television and videotapes, and playing video games than doing anything else except for sleeping (Bryant *et al.*, 2007:199). Two mechanisms by which television viewing contributes to obesity have been suggested as reduced energy expenditure from displacement of physical activity, and increased dietary energy intake, either during TV viewing or as a result of food advertising (Bryant *et al.*, 2007:199; Fulton *et al.*, 2009:30). TV viewing time is also influenced by different factors such as the weather, school-systems, family structures, and social status (Grund *et al.*, 2001:1245). Studies have found that having a TV in the bedroom, few family rules about TV viewing, and family meals in front of the TV are associated with more TV viewing among the youth (Swinburn & Shelly, 2008:S133) and as such are all found to be associated with the rapid rise in obesity (Proctor *et al.*, 2003:829). Strong scientific evidence exists showing that physical inactivity is associated with substantially reduced physical, mental and social health among children and adults (Lazzer *et al.*, 2005:38).

From the reviewed literature it is clear that low levels of moderate to vigorous physical activity (MVPA) and high levels of sedentary behaviour (e.g. television viewing) have been shown to be associated with obesity, although epidemiologic evidence in this area is not entirely consistent (Nelson *et al.*, 2005:154; Mota *et al.*, 2006:114; Mendoza *et al.*, 2007:5). In a research study on Americans which investigated physical activity, body weight and TV viewing among children by Andersen *et al.* (1998:938), it was suggested that more studies focusing on other populations or countries should be conducted. Furthermore, the reviewed literature

revealed that physical activity plays an important role in enhancing active healthy lifestyle. It is against this background information that the following research questions are posed:

- a) What are the body composition and TV viewing profiles among high school adolescent boys and girls in the Tlokwe municipality?
- b) What is the relationship between body composition and TV viewing among high school adolescent boys and girls in Tlokwe municipality?

Answers to these research questions will provide more insight with regard to the relationship between TV viewing and body composition among adolescents in the Tlokwe municipality. In addition, it will help the Biokineticists, Human Movement Scientists and Recreationists to develop physical activity programmes to assist in combating obesity. And finally it is hoped that the results of this study will provide information to policymakers in the education department, as well as educators and parents about the importance of physical activity in adolescents.

### **1.3 OBJECTIVES**

The objectives of this study were to determine:

- The body composition and TV viewing profiles among high school adolescent boys and girls in the Tlokwe municipality.
- The relationship between body composition and TV viewing among high school adolescent boys and girls in the Tlokwe municipality.

### **1.4 HYPOTHESES**

The study was based on the following hypotheses:

- High prevalence of overweight and obesity and TV viewing hours among high school adolescent boys and girls in the Tlokwe municipality will be found.
- Significant positive relationship between overweight and obesity and TV viewing among high school adolescent boys and girls in the Tlokwe municipality will be found.

## 1.5 STRUCTURE OF THE DISSERTATION

The dissertation is presented in four main chapters, namely an introductory chapter (Chapter 1), a literature review (Chapter 2), and a research article (Chapter 3), followed by a summary with conclusions, limitations and recommendations (Chapter 4).

**Chapter 1:** Introduction comprised of problem statement, objectives, hypotheses and proposed chapters of the dissertation.

**Chapter 2:** Literature review: Body composition and television viewing in adolescents. (Reference Lists for both Chapters 1 and 2 will be provided at the end of each chapter according to the Harvard Style of referencing as stipulated by the guidelines in the postgraduate manual of the North-West University).

**Chapter 3:** Article 1. Body composition and television viewing among high school adolescents: the PAHL study. (The article will be submitted for publication in the *African Journal for Physical, Health Education, Recreation and Dance (AJPHERD)*).

**Chapter 4:** Summary, conclusions, limitations and recommendations.

## 1.6 REFERENCES

- Andersen, R.E., Crespo, C.J., Bartlett, S.J., Cheskin, L.J. & Prattbl, M.T. 1998. Relationship of physical activity and television watching with body weight and level of fatness among children. *American medical association*. 279(12):938-942.
- Armstrong, M.E., Lambert, M.I., Sharwood, K.A. & Lambert, E.V. 2006. Obesity and overweight in South African primary school children – the Health of the Nation Study. *South African medical journal*. 96:439-44.
- Boone, J.E., Gordon-Larsen, P, Adair, L.S. & Popkin, B.M. 2007. Screen time and physical activity during adolescence: longitudinal effects on obesity in young adulthood. *International journal of behavioural nutrition and physical activity*, 4:26-36.
- Bryant, M.J., Lucove, J.C., Evenson, K.R. & Marshall, S. 2007. Measurement of television viewing in children and adolescents: a systematic review. *The international association for the study of obesity*, 8:197-209.
- Eisienman, J.C., Bartee, R.T. & Wang, M.Q. 2002. Physical Activity, TV Viewing, and Weight in U.S. Youth: 1999 Youth Risk Behaviour Survey. *Obesity research*, 10(5):379-385.
- Fulton, J.E. Wang, X., Yore, M.M, Carlson, S.A., Galuska, D.A. & Caspersen, C.J. 2009. Television viewing, computer use, and BMI among U.S. Children and Adolescents. *Journal of physical health*, 6(Suppl 1):28-35.
- Gordon-Larsen, P., Adair, L.S., Nelson, M.C. & Popkin, B.M. 2004. Five-year obesity incidence in the transition period between adolescence and adulthood: the National Longitudinal Study of Adolescent Health. *American journal of clinical nutrition*, 80:569-575.

Grund, A., Krause, H., Siewers, M., Rieckert, H. & Müller, M.J. 2001. Is TV viewing an index of physical activity and fitness in overweight and normal weight children? *Journal of public health nutrition*, 4(6):1245-1251.

Lazzer, S., Boirie, Y., Poissonnier, C., Petit, I., Duché, P., Taillardat, M., Meyer, M. & Vermorel, M. 2005. Longitudinal changes in activity patterns, physical capacities, energy expenditure, and body composition in severely obese adolescents during a multidisciplinary weight-reduction program. *International journal of obesity*, 29(1):37-46.

Marshall, S.J., Biddle, S.J.H., Gorely, T., Cameron, N. & Murdey, I. 2004. Relationships between media use, body fatness and physical activity in children and youth: a meta-analysis. *International journal of obesity*, 28, 1238–1246.

Mendoza, J.A., Zimmerman, F.J. & Christakis, D.A. 2007. Television viewing, computer use, obesity, and adiposity in US preschool children. *International journal of behavioural nutrition and physical activity*, 4(44):1-10.

Mota, J., Ribeiro, J., Santos, M.P. & Gomes, H. 2006. Obesity, Physical Activity, Computer Use, and TV Viewing in Portuguese Adolescents. *Paediatric exercise science*, 17:113-121.

Nelson, M.C., Gordon-Larsen, P., Adair, L.S. & Popkin, B.M. 2005. Adolescents activity and sedentary behaviour patterning and long-term maintenance. *American journal of preventative medicine*, 28(3):153-266

Ogden, C.L., Flegal, K.M., Carroll, M.D. & Johnson, C.L. 2002. Prevalence and trends in overweight among US children and adolescents, 1999-2000. *Journal of American Medical Association*, 288(14):1728-1732.

Prentice, A.M. & Jebb, S.A. 1995. Obesity in Britain: gluttony or sloth? *British medical journal*, 311:437-439.

Procter, M.H., Moore, L.L, Gao, D., Cupples, L.A., Bradlee, M.L., Hood, M.Y. & Ellison, R.C. 2003. Television viewing and change in body fat from preschool to early adolescence: The Framingham Children's Study. *International journal of obesity*, 27: 827-833.

Robinson, T.N.1999. Reducing children's television viewing to prevent obesity. A randomized controlled trial. *American medical association*, 282(16):1561-1567.

Steele, R.M., Van Sluijs, E.M.F., Cassidy, A., Griffon, S.J. & Ekelund, U. 2009. Targeting sedentary time or moderate- and vigorous-intensity activity: independent relations with adiposity in a population-based sample of 10-y-old British children. *The American journal of clinical nutrition*, 90(1):1185-1192.

Swinburn, B. & Shelly, A. 2008. Effects of TV time and other sedentary pursuits. *International journal of obesity*, 32(1):S132-S136.

US Department of Health and Human Services. 1996. *Physical Activity and Health: A Report of the Surgeon General*. Atlanta, GA: US Department of Health and Human Service, Centers for Disease Control and Prevention, Nutritional Centers for Chronic Disease Prevention and Health Promotion.

World Health Organisation (WHO). 2007. Prevalence of excess body weight and obesity in children and adolescents. The Health Behaviour in School-aged Children (HBSC) 2001/2002. Fact Sheet NO. 23.

York, D.A., Rossner, S., Caterson, I., Chen, C.M., James, W.P.T., Kumanyika, S., Martorell, R. & Vorster, H.H. 2004. Prevention Conference VII: Obesity, a worldwide epidemic related to heart disease and stroke: Group I: world-wide demographics of obesity. *Circulation*, 110:e463-70.

# **Chapter 2: Body composition and television viewing in adolescents: Literature review**

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## 2.1 INTRODUCTION

Overweight and obesity are reported to be associated with too much television viewing among children in many countries (Andersen *et al.*, 1998:938; Gomez *et al.*, 2007:41; Lioret *et al.*, 2007:509). Furthermore, research studies which investigated the combined effects of television and physical activity on overweight and obesity, revealed low levels of physical activity and high levels of television watching among youth (Iannotti *et al.*, 2009:191) and older children (Jago *et al.*, 2005:557; Boone *et al.*, 2007:27; Chen *et al.*, 2007:358) to be associated with increased levels of overweight and obesity. In contrast, regular participation in physical activity has been found to be associated with health benefits such as improved bone mineral density and low blood pressure (Council on Sport Medicine and Fitness and Council on School Health, 2006:1834; Janssen & LeBlanc, 2010:7; Strong *et al.*, 2005:732).

A study in the United States has revealed that watching TV for 4 or more hours per day is related to the increase in obesity and health-related problems among adolescents (Anderson *et al.*, 1998:938). In addition, in this US study it was found that boys and girls who watched TV for more than 4 hours per day have shown to have a high percentage body fat and a greater Body Mass Index (BMI) than those who watched TV for less than 2 hours per day. It has been indicated that in Westernized countries, lifestyles of excessive energy intake and sedentary behaviour are associated with Type 2 diabetes mellitus and obesity in youth (Must *et al.*, 1992:1350; Dietz & Robinson, 1998:191). The purpose of this chapter is to present literature on body composition and television viewing of adolescents, as well as the techniques for measuring body composition. In addition, to also present literature reviews on physical activity, techniques for measuring physical activity, research studies on body composition and TV viewing, and recommendations of physical activities for adolescents.



## **2.2 BODY COMPOSITION AND MEASURING TECHNIQUES**

### ***Body composition measures***

Body composition is reported to be one component of physical fitness (Caspersen *et al.*, 1985:126). Body composition can therefore be assessed by advanced methods such as under-water weighing, Air-Displacement Phlethysmography (a device such as the BodPod®) and Dual X-ray Absorptiometry. Common field methods used include skin fold's thickness measurement (Norton & Olds, 1996; Brambilla *et al.*, 2006:23), bio-electrical impedance (Ellis *et al.*, 1999:75) or basic measurements of weight and height for calculation of the BMI (Pietrobelli *et al.*, 2004:1479; Hills & Kagawa, 2007:39; ACSM, 2010:58). Of these, BMI is the simplest, most convenient and frequently used method. BMI is a useful measure of the relative proportion of fat mass in groups (Norton & Old, 1996).

Percentage body fat estimates can be derived by measuring skin fold's thickness at three or more standard anatomical sites on the body (Stewart *et al.*, 2011). The measurements are usually taken from the right side. The researcher pinches the skin at the appropriate site to raise a double layer of skin and the underlying adipose tissue, but not the muscle. The calliper is then applied one centimetre below, and at right angles to the pinched tissue, and a reading is taken two seconds later (Stewart *et al.*, 2011). The mean of two measurements should be taken (Stewart *et al.*, 2011). If the two measurements differ greatly, a third should be done, and then the mean of the two closest values are taken. Either the total sum of the measurements or a conversion to percentage body fat can be used as outcome measures. In converting the sum of the measurements to percentage body fat (%BF), internationally accepted equations for use in children and adolescents from different ethnic groups can be used (Slaughter *et al.*, 1988).

## **2.3 PHYSICAL ACTIVITY AND ASSESSMENT TECHNIQUES**

Physical activity is defined as “any bodily movement produced by skeletal muscles that results in energy expenditure (Caspersen *et al.*, 1985:126; Caspersen *et al.*, 1998:341; Biddle *et al.*, 1998). This broad term means that physical activity includes

almost everything a person does and that inactivity is time spent doing things that do not markedly increase energy expenditure. Physical exercise on the other hand is defined as a subset of physical activity that is “planned, structured, and repetitive bodily movement done to improve or maintain one or more components of physical fitness” (Caspersen *et al.*, 1985:127; Caspersen *et al.*, 1998:341; Biddle *et al.*, 1998). Physical fitness is a set of attributes related to a person’s ability to perform physical activities that require aerobic fitness, endurance, strength, or flexibility and is determined by a combination of regular activity and genetically inherited ability (Caspersen *et al.*, 1985:127). Sport is another sub-set of physical activity that involves structured competitive situations, although it is often used in a wider context to include both exercise and leisure-time activities. Physical activity, exercise and sport may be classified as behaviours; physical fitness is classified as an outcome and is related to the ability to achieve certain performance standards or traits (Caspersen *et al.*, 1998:341; Biddle *et al.*, 1998; Ferron *et al.*, 1999:231; Livingstone *et al.*, 2003:682). Health-enhancing physical activity (HEPA) is defined as “any form of physical activity that benefits health and functional capacity without undue harm or risk” (Foster, 2000; Gregory & Lowe, 2000; Oja & Borms, 2004). These health-related physical fitness components include cardiovascular endurance, muscular endurance, muscular strength, body composition and flexibility, which, to varying extent, reflect genetic inheritance and gender, as well as levels of physical activity (Livingstone *et al.*, 2003:682).

In epidemiological research, it has been indicated that being inactive or insufficiently active is often defined as not reaching the current physical activity recommendations, i.e. not being active enough for health (Dishman *et al.*, 2004). Physical activity results in increased energy expenditure. Energy expenditure is usually expressed as the oxygen required per time unit based upon measurements of oxygen consumption ( $1.\text{min}^{-1}$  or  $\text{ml}.\text{min}^{-1}.\text{kg}^{-1}$ ). From the oxygen consumption, energy expenditure ( $\text{kcal}.\text{min}^{-1}$ ) can be calculated. The energy expenditure can be expressed as a multiple of resting metabolic rate. To account for differences in resting metabolic rates related to gender, age and body composition the Metabolic Equivalent (MET) classification has been developed. One MET corresponds to average resting oxygen uptake (i.e. resting metabolic rate) in the sitting position, which is roughly equivalent

to 1 kcal. per kilogram body weight per hour or 3.5 ml oxygen per kg body weight per minute (Welk, 2002:125; McArdle *et al.*, 2006; Hagströmer, 2007:3).

Livingstone *et al.* (2003:682) suggested that the dose of physical activity or exercise required to affect a particular health benefit response varies along four basic dimensions, to wit, frequency, intensity, duration & product of the frequency. Frequency is described as the number of activity sessions per time period (e.g. day or week). Intensity describes the measured or predicted energy cost associated with physical activity and may be described in relative or absolute terms. Duration may refer to a single bout of physical activity or a cumulative time measure, while type of activity is a qualitative descriptor. The product of the frequency, intensity and duration yields the total energy expenditure (TEE) associated with physical activity and is a measure of the volume of exercise performed (Livingstone *et al.*, 2003:682).

### **Assessment of physical activity**

It has been found that the accurate measurement of physical activity at population level is difficult due to the complex nature of physical activity itself (Murgatroyd *et al.*, 1993:154; Melanson & Freedson, 1996:386; Motl *et al.*, 2001:110; Mahar & Rowe, 2002; Morrow, 2002:37; Livingstone *et al.*, 2003:682). Different techniques for assessing free-living physical activity can be grouped into two broad categories namely, subjective and objective:

a) **Subjective physical activity measurements**, includes observation and questionnaires (including activity diaries, recall questionnaires, interviews). Generally, questionnaires are most useful for assessing patterns, frequency, type and the context of physical activity. In particular, they are probably most effective for assessing easily-recalled, structured and time-delineated activities such as participation in sport, and routine activities such as walking to school. However, on the one hand, as pointed out by Wareham and Rennie (1998:S33), the undue emphasis in many questionnaires on sport and other recreational activities has been disproportionate to their true importance. On the other hand, activities of light-to-moderate intensity such as playing out of the home, occupational activities and a range of household tasks are no less important, but are difficult to define, and are

even more difficult to recall accurately (Sallis *et al.*, 1985:93; Hopkins *et al.*, 1991:75; Ainsworth *et al.*, 2000a:S498). In addition, lower-intensity activities may display a great deal of intra-individual variation, and even if they are included in a survey, their usual patterns may not be characterized fully with just a single time-point assessment. The period of activity questionnaires can vary enormously, but in general the shorter the period the easier it is to recall, particularly for young children. However, this approach may be at the expense of capturing information about habitual activity patterns, particularly if there are marked seasonal differences in activity patterns (Livingstone *et al.*, 2003:683).

***The International Physical Activity Questionnaire (IPAQ):*** Different national and international studies on physical activity have used different methods of assessment, limiting the comparability of findings. The IPAQ instrument assesses health-enhancing physical activity. It measures time in walking and other moderate-to-vigorous intensity activities, in a seven day period, counting only those sessions which lasted 10 minutes or more (Craig *et al.*, 2003:1381). The limit of 10 minutes was chosen because the recommendation for health-enhancing physical activity states that 30 minutes per day in at least moderate intensity is needed and that the 30 minutes can be split into 10 minute bouts (Pate *et al.*, 1995:402; Haskell, 2007:303). All types of physical activity are included whether they are part of work, chores, transportation or leisure-time activity. The IPAQ also asks about time spent sitting, as an indicator of inactivity. This makes it possible to assess the amount of time spent at different intensity levels in a week, as well as the amount of total health-enhancing physical activity. The questionnaire is available in both a short (“IPAQ-short”, 7 items) and long form (“IPAQ-long”, 27 items), respectively. The short and long versions of the questionnaire have been piloted in 12 different countries in 14 sites to assess reliability and validity (Craig *et al.*, 2003:1381; Lachat *et al.*, 2008). The results suggested that the questionnaires had acceptable measurement properties for use in many settings and in different languages, and that the short version is suitable for national population-based prevalence studies (Ainsworth *et al.*, 2000b:S498; Hallal & Victora, 2004:227; Ainsworth *et al.*, 2006:1584; Ekelund *et al.*, 2006:258; Fogelholm *et al.*, 2006:753; Kolbe-Alexander *et al.*, 2006:98; Mader *et al.*, 2006:1255; Macfarlane *et al.*, 2007:45).

**Accuracy of self-reports:** often used in epidemiological studies and have quite high feasibility. Physical activity as a behaviour can be assessed using indirect and direct measures. Direct methods include physical activity records and logs, direct observation, motion detectors and remote sensing systems. Indirect methods include 24-hour recalls, physical activity questionnaires and heart rate monitoring. The common method used is self-reporting by question (“self-reports”). These are easy to administer and cost-effective, but they are hampered by low accuracy (Ainsworth *et al.*, 1999:219; Sallis & Saelens, 2000:S12; Ainsworth & Levy, 2004:239). The low accuracy is related to reactivity, recall biases, differential biases and social desirability.

Each of these methods has its strengths and limitations and can fulfil one or more, but rarely all the needs for epidemiological studies of physical activity. These measurements are only suitable for small and medium sized samples when information on the specific types and duration of activity in a variety of physical and social settings is the primary focus of concern. Because they are not biased by recall or self-reporting ability, these procedures of assessing physical activity are particularly suitable for young children (Bailey *et al.*, 1995:1033). However, the methodology can be time-consuming, labour intensive and interfere with spontaneous activity patterns, and to be effective it requires extreme diligence and control of observer reliability (Livingstone *et al.*, 2003:689).

For reasons of feasibility and cost, the instruments of choice in both small-scale and larger-scale studies of habitual physical activity in adolescents (Riddoch *et al.*, 1990; Sallis *et al.*, 1993:27; Gregory & Lowe, 2000) and adults (Jacobs *et al.*, 1993:191; Philippaerts *et al.*, 1999:284; Livingstone *et al.*, 2001:1107) are standardized questionnaires (either administered by interview or self-reported), or diaries. However, diaries and recalls rely on memory and are subject to misrepresentation (particularly socially-desirable responding), and are inconsistent in reliability and validity (Westerterp, 1997:624). Accuracy in recalling physical activity may also vary by gender and weight status (Sallis *et al.*, 1985:91). The utility of these instruments is especially problematic in children <10 years of age (Pate, 1993:321; Pate *et al.*,

1994:435; Sallis & Owen, 1999) because of cognitive limitations (Harter, 1988), and because their activity patterns tend to be sporadic in terms of intensity and duration (Simons-Morton *et al.*, 1987:295; Armstrong & Bray, 1991:245).

b) **Objective physical activity measurements** which include physical indices such as motion sensors, calorimetry, and the doubly-labelled water (DLW) method.

**Motion sensors** include pedometers and accelerometers (Westerterp & Bouten, 1997:264; Tudor-Locke *et al.*, 2002:2045; Hoos *et al.*, 2004:1425; Tudor-Locke *et al.*, 2004:796; Warms, 2006:80). They are developed in response to the lack of reliability of self-report measures, intrusiveness of direct observation and the complexity of heart rate monitoring (Puyau *et al.*, 2002:152). These devices are, however, more appropriate for physical activity quantification in a typically sedentary population (Tudor-Locke & Myers, 2001:91).

**Accelerometers** offer considerable promise for providing valid assessments of intermittent activity of both low and high intensity (Welk, 2005:S501; Eston *et al.*, 2006:753), however, they are relatively new and their definitive validity under field conditions remains to be established (Bouten *et al.*, 1996:1019; Westerterp & Bouten, 1997:263; Johnson *et al.*, 1998:1046; Ekelund *et al.*, 2001:275; Foster *et al.*, 2005:778). Accelerometer's relative size remains an important practical consideration, particularly for smaller children (Westerterp, 1999:46). The accelerometers are able to determine physical activity intensity and pattern, i.e. the time spent on activities of low (sitting), moderate (walking) and high intensity (running) activities (Freedson *et al.*, 1998:777; Hoos *et al.*, 2004:1425). The high cost of accelerometers, has to date limited their use in large epidemiological studies (Livingstone *et al.*, 2003:683). They are also affected by place of attachment on the body and discomfort to the participant (Westerterp, 1999:46; Tudor-Locke & Myers, 2001:92; Hoos *et al.*, 2004:1426; Warms, 2006:81).

**Pedometers** are a means of measuring ubiquitous, ambulatory activities objectively as well as other structured physical activities (Schneider *et al.*, 2003:1780). The main

areas where pedometers differ are cost, mechanism and sensitivity (Tudor-Locke *et al.*, 2002:2046; Foster *et al.*, 2005:778).

The advantage of pedometers are their accuracy compared to self-reported questionnaires; easy management of obtained data; reliability for determining physical activity in typically sedentary populations; and describing the total daily activities in free-living populations (Tudor-Locke & Myers, 2001:92; Tudor-Locke *et al.*, 2002:796).

**Doubly-labelled water (DLW)** is the most socially acceptable and powerful technique for providing an objective measure of total energy expenditure (TEE) (Ekelund *et al.*, 2001:276; Koebnick *et al.*, 2005:303; Loprinzi & Cardinal, 2011:21). There are several advantages: the technique is non-intrusive and measurements are performed over longer periods than other techniques, typically  $\geq 1$ -2 weeks, thus it is more likely to provide a representative estimate of TEE (Schoeller & Racette, 1990:1492; Murgatroyd *et al.*, 1993:549). When combined with estimates of BMR, the energy cost of physical activity (TEE – BMR) can be calculated. This approach is of particular importance given that the accurate measurement of this component of TEE has traditionally been elusive under free-living conditions (Stager *et al.*, 1995:166). However, because its application in large-scale studies is constrained by cost and technical complexity, one of its main uses is as a reference standard against which to assess the validity of other measures of physical activity. Furthermore, in epidemiological studies it may not even be the most appropriate method to apply since it provides no assessment of the patterns of physical activity (type, frequency, duration, intensity), which are important functional indicators of health status.

The Doubly-labelled water (DLW) method has some disadvantages too: it is expensive, has limited applicability, does not provide information about the type, pattern, frequency, intensity and duration of physical activity carried out during the day. DLW is not feasible for large population due to financial cost. Furthermore, DLW is sparse in the sense that special equipment is needed, highly trained personnel are required for carrying out the test as well as the necessity for collection of complete

urine samples which limits its usefulness for people with disabilities who has incontinence or use urinary collection equipment (Advirsson *et al.*, 2005:377; Koebnick *et al.*, 2005:303; Warms, 2006:80).

## 2.4 RESEARCH STUDIES ON BODY COMPOSITION AND TV VIEWING

Television viewing is one of the most easily modifiable causes of obesity among children (Eisenman *et al.*, 2008:613; Fulton *et al.*, 2009:30; Rivera *et al.*, 2010:160). Children spend more time watching television and videotapes, and playing video games than doing anything else except for sleeping (Bryant *et al.*, 2007:199). Two mechanisms by which television viewing contributes to obesity have been suggested as reduced energy expenditure from displacement of physical activity, and increased dietary energy intake, either during TV viewing or as a result of food advertising (Bryant *et al.*, 2007:199; Fulton *et al.*, 2009:30). TV viewing time is also influenced by different factors such as the weather, school-systems, family structures and social status (Grund *et al.*, 2001:1245). Studies have found that having a TV in the bedroom, few family rules about TV viewing, and family meals in front of the TV are associated with more TV viewing among the youth (Swinburn & Shelly, 2008:S133), and as such are all found to be associated with the rapid rise of obesity (Proctor *et al.*, 2003:829). Strong scientific evidence exists showing that physical inactivity is associated with substantially reduced physical, mental and social health among children and adults (Lazzer *et al.*, 2005:38).

Some large epidemiological and meta-analysis studies have found positive associations between television viewing and childhood obesity (Andersen *et al.*, 1998:938; Gortmaker *et al.*, 1996:356; Marshall *et al.*, 2004:1238). Previous intervention studies in school-age children have supported television and video viewing as causes of childhood obesity (Robinson *et al.*, 1993:273; Gortmaker *et al.*, 1996:356).

The ***Framingham Children's Study*** (Proctor *et al.*, 2003:832) revealed that children who watched the least television had parents with higher levels of education as well as parents who had lower levels of body fatness themselves. These findings are



consistent with other studies showing an inverse association between socioeconomic status and obesity (as well as the subsequent incidence of ischemic heart disease) (Marmot *et al.*, 1991:1387). In addition, the Framingham Children's Study (Proctor *et al.*, 2003:832) indicated that children who watched the most television had the greatest increases in triceps and sum of skin folds and those who watched the least television had the smallest gains in body fat.

In countries such as the United States, the data has indicated a dramatically low level of physical activity, particularly among children and adolescents, so one would conclude that this is a major factor in causing a positive energy balance in the US population (Caballero, 2007:3).

A study from the **National Health and Nutrition Examination Survey, 1999-2002** (Mendoza *et al.*, 2007:1), indicated that preschool children in the US of who watched TV or videos for more than 2 hours/day of TV or videos had a higher risk of being overweight or were at higher risk for overweight and higher adiposity. These findings support national guidelines to limit preschool children's media use. Computer use was also related to higher adiposity in preschool children, but not weight status.

In the project ***Eating Among Teens (EAT)*** (Barr-Anderson *et al.*, 2009:1), it was revealed that television viewing in the middle and high school years predicted poorer dietary intake five years later. In addition, it was indicated that adolescents are primary targets of advertising for fast food restaurants, snack foods and sugar-sweetened beverages, which may influence their food choices. Furthermore it was indicated that TV viewing during high school may have long-term effects on eating choices and contribute to poor eating habits in young adulthood. In the longitudinal findings of Project EAT II of 1999 to 2004, it was found that mid-adolescence to late adolescence boys had increased hours of computer use from 10.4-15.2 hours per week, with an increase of 8.8 to 11.1 hours per week in girls.

A research study ***Greek Cypriot*** (Loucaides *et al.*, 2011:2) reported that boys who attended sports clubs two or more times per week were more likely to be physically active. It was further indicated that girls who attended sports clubs two or more times

per week and who watched television for less than two hours were more likely to be physically active. In this study it was recommended that children must be encouraged to attend sports clubs at least twice per week so as to improve their physical activity levels.

A study conducted in Texas, on child activity and nutrition (Durant *et al.*, 1994:449), presented contrasting results compared with other studies wherein it was found that television-watching was weakly and negatively correlated with physical activity levels, and physical activity was lower during television-watching than non-television-watching time in this sample of children. In addition this study did not show a significant association between TV viewing behaviour and body composition.

Another contrary study by Tammelin *et al.* (2009:1067) found a negative association between television watching and self-reported physical activity in a sample of 6,928, 15-16 year-old Finnish youths. In a sample of 40 boys aged 9-12, Hager (2006:656) observed that those who watched television after school were less likely to be active in comparison to those who did not watch television (as assessed by accelerometer).

In **South Africa**, a study on Youth Risk Behaviour survey (Reddy *et al.*, 2002) reported that 37.5% of the youth aged from 13-19 do not participate in sufficient physical activity. In addition, 25% of the youth reported watching 3 hours of television per day. Indian boys are the most inactive (40.8%), followed by those of mixed ancestry (36.4%), Africans (34.4%), with the least inactive being Caucasian (28.2%). Mixed ancestry girls were the most inactive (56.8%), African (42.4%), Caucasians (37%) and lastly Indians (36%) (Lambert & Koble-Alexander, 2006:25). A study by Engelbrecht *et al.* (2004) in the North West province found that Indian girls (94.1%) were the most inactive group followed by those from mixed ancestry (87.5%), Africans (73.0%), and Caucasians (61.0%). African girls were involved in moderate physical activity (23.2%) and Caucasian girls in high physical activity (16.6%), while traditional games and house chores were the main source of activity among Africans. Walking slowly was found to be an activity enjoyed by all racial groups (Engelbrecht *et al.*, 2004:42). In a study by Franz (2006:77), it was found that 32% of

the children did not meet the requirements of participating in physical activity for three and half hours per week in order to be classified as active.

## **2.5 RECOMMENDATIONS OF PHYSICAL ACTIVITIES FOR ADOLESCENTS**

The American College of Sport Medicine (Table 2.1) (ACSM, 1978) and the American Heart Association (AHA) (Haskell *et al.*, 2007:1081) emphasized that 30 minutes of moderate intensity physical activity should be regularly performed on at least five days per week (compared to “most, preferably all” days in the 1995 recommendation), but also that the 30 minutes of moderate intensity physical activity could be substituted by three occasions of 20 minutes of vigorous activity per week. On top of these activities, ten strength-training exercises, eight to twelve repetitions of each exercise twice a week, are recommended (Table 2.1). The recommendation also highlights that these activities are over and above daily living routines (such as self-care and cooking) or activities which last less than 10 minutes (such as walking around home or office, walking from parking lot). Furthermore, the new recommendation has separated healthy adults and older adults (>64 years) or adults (50-64 years) with chronic conditions (Table 2.1).

The recommendations on health-enhancing physical activity seem straightforward: people are supposed to be more and more active. It is recommended that the dose-response relationship between physical activity and different diseases suggests a need for them to be modified to suit individual circumstances (Suitor & Kraak, 2007). Further in the table, it is recommended that to prevent transition from normal weight to overweight or obesity, 45-60 minutes of moderate intensity daily activity is required, and to prevent weight regain in formerly obese individuals 60-90 minutes of moderate intensity activity is required daily (Saris *et al.*, 2003:101).

**Table 2.1: Physical activity recommendations by the different organisations**

Organization	Year	Recommendation	Rationale
National board of health and welfare (Sweden)	1971	Be active on moderate intensity every day in combination with more intense exercise 2-3 times per week	Health and fitness
ACSM	1978	3-5 times per week, 15-60 min per occasion, 60-90% HRmax on aerobic exercise	Maintain and improve fitness
	1990	In 1990, strength training was added	
Health Education Authority, (England) Pate <i>et al.</i> , and CDC, Surgeon General (US)	1994	30 minutes of daily moderate intensity physical activity	Health
	1995	30 minutes of at least moderate intensity on most, preferably all, days of the week (150 kcal per), accumulated in several bouts of at least 10-minutes duration (Pate, 1995)	Health
ACSM	1998	3-5 times per week, 15-60 min per occasion, 55-90% HRmax on aerobic exercise plus strength and flexibility training	Maintain or improve fitness
IASO	2003	For prevention; 45-60 minutes per day of at least moderate intensity	Prevent obesity or maintain weight loss
		For maintenance: 60-90 min per day	
ACSM, AHA	2007	30 minutes of at least moderate intensity daily, or 20 minutes of vigorous intensity 3 times per week. On top of these, strength training twice a week.	Health and fitness

ACSM; American College Sports Medicine (ACSM, 1978; 1998; 1990; 1998; Haskell *et al.*, 2007)

CDC; Center for Disease Control and Prevention (CDC *et al.*, 1996)

IASO; International Association for the Study of Obesity (Saris *et al.*, 2003)

AHA; American Heart Association (Haskell *et al.*, 2007)

In response to the growing problem of childhood obesity and other health issues associated with television, the American Academy of Paediatrics (AAP) has issued national guidelines for parents to limit their children's total media time (with entertainment media) to no more than 1-2 hours of quality programming per day for children 2 years of age and older (Barlow & Dietz, 1998; Krebs *et al.*, 2007:S195). It was also indicated that energy balance at such a low level of energy output could be maintained only by major reductions in food intake (Caballero, 2007:3).

## 2.6 CONCLUSION

This chapter has outlined the concepts that affirm that body composition and television viewing in adolescents are related and also showed the contrasting ideas

from literature reviewed. Literature reviewed revealed that television viewing is one of the most easily modifiable causes of obesity among children. This has been suggested by two mechanisms that is reduced energy expenditure from displacement of physical activity, and increased dietary energy intake, either during TV viewing or as a result of food advertising. Literature has also revealed the association between having TV in the bedroom, few family rules about TV viewing, and family meals in front of the TV among youth. Scientific evidence showed that physical inactivity is associated with substantially reduced physical, mental and social health among children and adults. Positive associations between television viewing and childhood obesity were found in some large epidemiological and meta-analysis studies. Literature also revealed that children who watched the most television had the greatest increases in triceps and sum of skin folds and those who watched the least television had the smallest gains in body fat. In the United States the data showed a dramatically low level of physical activity, particularly among children and adolescents, so one would conclude that this is a major factor in causing a positive energy balance in the US population. In some studies it was indicated that watching TV more than 2 hours/day in US preschool-age children was associated with a higher risk of being overweight and higher adiposity-findings in support of national guidelines to limit preschool children's media use. It was revealed that television viewing in the middle and high school predicted poorer dietary intake five years later, adolescents were targets of advertising for fast food restaurants, snack foods and sugar sweetened beverages which may influence their food choices. TV viewing may have long term effects on eating choices and contribute to poor eating habits in young adulthood. It was also reported that boys who attended sports clubs for two or more times per week were more likely to be physically active. Girls who attended sports clubs for two or more times per week and who watched television for two hours were more likely to be physically active. Literature also presented contrasting results, in some studies it was found that television watching was weakly negatively correlated with physical activity levels, and physical activity was lower during television-watching than non-television-watching time in the sample of children.

The next chapter will consist of an independent research article which will integrate the information from the reviewed literature in the problem statements hence in the interpretation/discussion of the results findings. The objective of the article was to determine the relationship between body composition and TV viewing among adolescents attending high schools within the Tlokwe Local Municipality: The PAHL study.

## 2.7 REFERENCES

ACSM. 1978. American College of Sports Medicine. The recommended quality and quantity of exercise for developing and maintaining fitness in healthy adults. *Medicine and science in sports and exercise*, 10:vii-x.

ACSM. 1990. American College of Sports Medicine. Position stand: the recommended quantity and quality of exercise for developing and maintaining cardio-respiratory and muscular fitness, and flexibility in healthy adults. *Medicine and science and in sports and exercise*, 22:265-274.

ACSM. 1998. American College of Sports Medicine. Position Stand: the recommended quantity and quality of exercise for developing and maintaining cardio-respiratory and muscular fitness, and flexibility in healthy adults. *Medicine and science in sports and exercise*, 30:975-991.

ACSM. 2010. American College of Sports Medicine. ACSM's Guidelines for Exercise Testing and Prescription. 8<sup>th</sup> ed. Philadelphia (PA): Lippincott Williams & Wilkins, 380p.

Adrvidsson, D., Slinde, F. & Hulthen, L. 2005. Physical activity questionnaire for adolescents validated against labelled water. *European journal of clinical nutrition*, 59:376-383.

Ainsworth, B.E., Bassett, D.R. Jr., Strath, S.J., Swartz, A.M., O'Brien, W.L., Thompson, R.W., Jones, D.A., Macera, C.A. & Kimsey, C.D. 2000a. Comparison of three methods for measuring the time spent in physical activity. *Medicine and science in sports and exercise*, 32:S457-464.

Ainsworth, B. Haskell, W., Whitt, M., Irwin, M., Swartz, A., Strath, S., O'Brien, W., Bassett, D.R. Jr., Schmitz, K., Emplaincourt, P., Jacobs, D.J. & Leon, A. 2000b. Compendium of physical activities: an update of activity codes and MET intensities. *Medicine and science in sports and exercise*, 32:S498-504.

Ainsworth, B.E., Richardson, M.T., Jacobs, D.R., Jr., Leon, A.S. & Sternfeld, B. 1999. Accuracy of recall of occupational physical activity by questionnaire. *Journal of epidemiology*, 52:219-227.

Ainsworth, B.E. & Levy, S. 2004. Assessment of health-enhancing physical: Methodological issues. Health enhancing physical activity. Oja, P.B.J. Oxford, UK, Meyer & Meyer Sport. pp.239-270.

Ainsworth, B.E., Macera, C.A., Jones, D.A., Reis, J.P., Addy, C.L., Bowles, H.R. & Kohl, H.W. 2006. Comparison of the 2001 BRFSS and the IPAQ Physical Activity Questionnaires. *Medicine science sports and exercise*, 38:1584-1592.

Andersen, R.E. Crespo, C.J. Bartlett, S.J., Cheskin, L.J. & Pratt, M. 1998. Relationship of physical activity and television watching with body weight and level of fatness among children. *Journal of American medical association (JAMA)*, 279:938-942.

Armstrong, N. & Bray, S. 1991. Physical activity patterns defined by continuous heart rate monitoring. *Archives of disease in childhood*, 66:245-247.

Bailey, R.C., Olson, J. Pepper, S.L., Porszasz, J. Barstow, T.J. & Cooper, D.M. 1995. The level and tempo of children's physical activities: an observational study. *Medicine and science in sports and exercise*, 27:1033-1041.

Barlow, S.E. & Dietz, W.H. 1998. Obesity evaluation and treatment: Expert committee recommendations. *Paediatrics*, 102 (3):e29.



Barr-Anderson, D.J., Larson, N.I., Nelson, M.C., Neumark-Sztainer, D. & Story, M. 2009. Does television viewing predict dietary intake five years later in high school students and young adults? *International journal of behavioural nutrition and physical activity*, 6:7.

Biddle, S., Sallis, J. & Cavill, N. (eds.). 1998. Young and active? *Young people and health-enhancing physical activity: Evidence and implications*. London: Health Education Authority.

Boone, J.E., Larsen, G.P., Adair, L.S. & B.M. Popkin. 2007. Screen time and physical activity during adolescence: longitudinal effects on obesity in young adulthood. *International journal of behavioural nutrition and physical activity*. 4:26-10.

Bouten, C.V.C., Verboeket-Van Der Venne, W.P.H.G., Westerterp, K.P., Verduin, M. & Jansesen, J.D. 1996. Daily physical activity assessment: comparison between movement registration and doubly-labelled water. *Journal of applied physiology*, 81:1019-1026.

Brambilla, P., Bedogni, G., Moreno, L.A., Goran, M.I., Gutin, B., Fox, K.R., Peters, D.M., Barbeau, P., De Simone, M. & Pietrobelli, A. 2006. Cross-validation of anthropometry against magnetic resonance imagining for the assessment of visceral and subcutaneous adipose tissue in children. *International journal of obesity*, 30(1):23-30.

Bryant, M.J., Lucove, J.C., Evenson, K.R. & Marshall, S. 2007. Measurement of television viewing in children and adolescents: a systematic review. *Obesity review*, 8:197-209.

Caballero, B. 2007. The Global Epidemic of Obesity: An Overview. *Epidemiology review*, 29:1-5.

Caspersen, C.J., Powell, K.E. & Christenson, G.M. 1985. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public health report*. 100:126-31.

Caspersen, C.J., Nixon, P.A. & Durant, R.H. 1998. Physical activity epidemiology applied to children and adolescents. *Exercise and sports science reviews*, 26:341-403.

CDC, USDHHS & NCCDH. 1996. Physical Activity and Health. *A report from the Surgeon General*. Atlanta, GA, Centers for Disease Control and Prevention, US. Department of Health and Human Services, National Centers for Chronic Disease Prevention and Health Promotion.

Chen, L., Haase, M.A. & Fox, K.R. 2007. Physical activity among adolescents in Taiwan. *European journal for clinical nutrition*, 60(16):358–359.

COUNCIL ON SPORTS MEDICINE AND FITNESS AND COUNCIL ON SCHOOL HEALTH. 2006. Active Healthy Living: Prevention of Childhood obesity through increased physical activity. *Pediatric*, 117:1834-1842.

Craig, C., Marshall, A.L., Sjostrom, M., Bauman, A.E., Booth, M.L., Ainsworth, B.E., Pratt, M., Ekelund, U., Yngve, A., Sallis, J.F. & Oja, P. 2003. International physical activity questionnaire: 12-country reliability and validity. *Medicine and science in sports and exercise*, 35:1381-95.

Dietz, W. & Robinson, T. 1998. Use of the body mass index (BMI) as a measure of overweight in children and adolescents. *Journal of pediatrics*, 132:191-193.

Dishman, R.K., Washburn, R.A. & Heath, G.W. 2004. Physical activity epidemiology. Leeds, UK, Human Kinetics.

Durant, R.H. Baranowski, T., Johnson, M. & Thompson, W.O. 1994. The relationship among television watching, physical activity, and body composition of young children. *Pediatrics*, 94:449-455.

Eisenmann, J.C., Barteel, R.T., Smith, D.T., Welk, G.J. & Fu, Q. 2008. Combined influence of physical activity and television viewing on the risk of overweight in US youth. *International journal of obesity*, 32:613-618.

Ekelund, U., Sjöström, M., Yngve, A., Poortvliet, E., Nilsson, A., Frosberg, K., Wedderkopp, N. & Westerterp, K.R. 2001. Physical activity assessed by activity monitor and doubly-labelled water in children. *Medicine and science in sports and exercise*, 33:275-281.

Ekelund, U., Sepp, H., Brage, S., Becker, W., Jakes, R., Hennings, M. & Wareham, N.J. 2006. Criterion-related validity of the last 7-day, short form of the International Physical Activity Questionnaire in Swedish adults. *Public health nutrition*, 9:258-265.

Ellis, K.J., Bell, S.J., Chertow, G.M., Chumlea, W.C., Knox, T.A., Kotler, D.P., Lukaski, H.C. & Schoeller, D.A. 1999. Bioelectrical impedance methods in clinical research: a follow-up to the NIH technology assessment conference. *Nutrition*, 15:74–880.

Engelbrecht, C., Pienaar, A.E. & Coetzee, B. 2004. Racial background and possible relationships between physical activity and physical fitness of girls: The THUSA Bana Study. *South African journal for research in sports, physical education and recreation*, 26(1):41-53.

Eston, R.G., Rowlands, A.V., Fogelholm, M., Malmberg, J. & Suni, J. 2006. International Physical Activity Questionnaire: Validity against fitness. *Medicine and science in sports and exercise*, 38:753-60.

Franz, J.M. 2006. Physical inactivity as one of the chronic disease risk factors among high school learners in public schools in a local community in South Africa. *South African journal for research in sports, physical education and recreation*, 28(2):73-80.

Ferron, C., Narring, F., Cauderay, M. & Michaud, P.A. 1999. Sport activity in adolescence: associations with health perceptions and experimental behaviours. *Health education research*, 14:231–232.

Fogelholm, M., Malmberg, J., Suni, J., Santtila, M., Kyröläinen, H., Mäntysaari, M. & Oja, P. 2006. International Physical Activity Questionnaire: Validity against fitness. *Medicine and science in sports and exercise*, 38:753-760.

Foster, C. 2000. Guidelines for health-enhancing physical promotion programmes. The UKK Institute for Health Promotion Research, Tampere, Finland.

Foster, R.C., Lanningham-Foster, L.M., Manohar, C., McCgrady, S.K., Nysse, L.J., Kauman, K.R., Padgett, D.J. & Levine, J.A. 2005. Precision and accuracy of an ankle worn accelerometer based on pedometer in step counting and energy expenditure. *Journal of preventative medicine*, 41:778-783.

Freedson, P., Melanson, E. & Sirard, J. 1998. Calibration of the Computer Science and Applications, Inc. accelerometer. *Medicine and science in sports and science*, 30:777-81.

Fulton, J.E., Wang, X, Yore, M.M., Carlson, S.A., Galuska, D.A. & Caspersen, C.J. 2009. Television viewing, computer use, and BMI among U.S. children and adolescents. *Journal of physical activity and health*, 6 Suppl 1, S28-35.

Gomez, L.F., Parra, D.C., Lobelo, F., Samper B., Moreno J., Jacoby, E., Lucumi, D.I., Matsudo, S. & Borda, C. 2007. Television viewing and its association with overweight in Colombian children: results from the 2005 National Nutrition Survey: A

cross-sectional study. *International journal of behavioural nutrition and physical activity*. 4:41.

Gortmaker, S.L., Must, A., Sobol, A.M., Peterson, K., Colditz, G.A. & Dietz, W.H. 1996. Television viewing as a cause of increasing obesity among children in the United States, 1986-1990. *Archives of paediatric and adolescent medicine*, 150:356-362.

Gregory, J. & Lowe, S. 2000. *National Diet and Nutrition Survey: Young People Aged 4 to 18 Years: The Stationery Office*.

Grund, A., Krause, H., Siewers M., Rieckert, H. & Müller, M. 2001. Is TV viewing an index of physical activity and fitness in overweight and normal weight children? *Public health nutrition*, 4:1245-1251.

Hager, R.L. 2006. Television viewing and physical activity in children. *Journal of adolescence and health*, 18:656-661.

Hagströmer, M. 2007. Assessment of Health-Enhancing Physical Activity at Population Level (MSc-dissertation Karolinska Institute, Stockholm, Sweden), pp.50.

Hallal, P.C. & Victora, C.G. 2004. Reliability and validity of the International Physical Activity Questionnaire (IPAQ). *Medicine and science in sports and science*, 36:556.

Harter, S. 1988. Developmental processes in the construction of the self. *In Integrative Processes and Early Socialization: Early to Middle Childhood*, pp. 45-78 [TD Yawkey and J.E. Johnson editors]. Hillsdale, NJ. Erlbaum.

Haskell, W.L. 2007. Dose-response issues in physical activity, fitness and health. Physical activity and health. In: Bouchard, C., Blair, S.N. and Haskell, W.L. Leeds, UK Human Kinetics, 303-318.

Haskell, W.L., Lee, I.M., Pate, R.R., Powell, K.E., Blair, S.N., Franklin, B.A., Macera, C.A., Heath, G.W., Thompson, P.D., Bauman, A., American College of Sports Medicine & American Heart Association. 2007. Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation*, 116:1081-93.

Hills, A.P. & Kagawa, M. 2007. Body composition assessment in children and adolescents: implications for obesity. (In Hills, A.P., King, N.A. & Byrne, N.M. eds. *Children, obesity and exercise*. London: Routledge. p. 37-49.).

Hoos, M.B., Kuipers, H., Gerver, W.J.M. & Westerterp, K.R. 2004. Physical activity pattern of children assessed by triaxial accelerometer. *European journal of clinical nutrition*, 58:1425-1428.

Hopkins, W.G., Wilson, N.C. & Russell, D.G. 1991. Validation of the physical activity instrument for the Life in New Zealand national survey. *American journal of epidemiology*, 133:73-82.

Iannotti, R.J., Janssen I., Haug E., Kololo H., Annaheim, B. & Borraccino A. 2009. HBSC Physical Activity Focus Group: Interrelationships of adolescent physical activity, screen-based sedentary behaviour, and social and psychological health. *International journal of public health*, 54(Suppl 2):191-198.

Jacobs, D.R., Ainsworth, B.E., Hartman, T.L. & Leon, A.S. 1993. A simultaneous evaluation of 10 commonly used physical activity questionnaires. *Medicine and science in sports and exercise*, 25:81-91.

Janssen, I. & Leblanc, A.G. 2010. Systematic review of the health benefits of physical activity and fitness in school-based children and youth. *International journal of behavioural nutrition and physical activity*, 146:7-40.

Jago R., Baranowski T., Baranowski J.C., Thompson, D. & Greaves K.A. 2005. BMI from 3-6 year of age is predicted by TV viewing and physical activity, not diet. *International journal obesity*, 29:557-564.

Johnson, R.K., Russ, J & Goran, M.I. 1998. Physical activity related energy expenditure in children by doubly-labelled water as compared with the Caltrac accelerometer. *International journal of obesity*, 22:1046-1052.

Koebnick, C., Wagner, K., Thielecke, F., Moeseneder, J., Hoehne, A., Franke, A., Meyer, H., Garcia, A.L., Trippo, U. & Zunft, H.J.F. 2005. Validation of a simplified physical activity record by doubly-labelled water technique. *International journal of obesity*, 29:302-309.

Kolbe-Alexander, T.L., Lambert, E.V., Harkins, J.B. & Ekelund, U. 2006. Comparison of two methods of measuring physical activity in South African older adults. *Journal of aging and physical activity*, 14:98-114.

Krebs, N.F., Himes, J.H., Jacobson, D., Nicklas, T.A., Guilday, P. & Styne, D. 2007. Assessment of child and adolescent overweight and obesity. *Pediatrics*, 120:S193-S228.

Lambert, E.V. & Kolbe-Alexander, T. 2006. Physical activity and chronic disease of life in South Africa. Chronic diseases of lifestyle in South Africa since 1995-2005: Oxford health alliance annual report, pp23-32.

Lachat, C.K., Verstraeten, R., Bao Khanh, L.N., Hagstromer, M., Cong Khan, N., Do Anh Van, N., Quang Dung, N. & Kolsteren, P.W. 2008. Validity of two physical activity questionnaires (IPAQ and PAQA) for Vietnamese adolescents in rural and urban areas. *International journal of behavioural nutrition and physical activity*, 5:37.

Lazzer, S., Boirie, Y., Poissonnier, C., Petit, I., Duche, P., Taillardat, M., Meyer, M. & Vermorel, M. 2005. Longitudinal changes in activity patterns, physical capacities, energy expenditure, and body composition in severely obese adolescents during a multidisciplinary weight-reduction program. *International journal of obesity*, 29(1):37-46.

Lioret, S., Maire, B., Volatier, J.L. & Charles, M.A. 2007. Child overweight in France and its relationship with physical activity, sedentary behaviour and socioeconomic status. *European journal of clinical nutrition*, 61:509-516.

Livingstone, M.B.E., Robson, P.J., McCarthy, S., Kiely, M., Harrington, K., Browne, P., Galvin, M., Wareham, N.J. & Rennie, K.L. 2001. Physical activity patterns in a nationally representative sample of adults in Ireland. *Public health nutrition*, 4:1107-1116.

Livingstone, M.B.E., Robson, P.J., Wallace J.M.W. & McKinley. 2003. How active are we? Levels of routine physical activity in children and adults. *Proceedings of nutrition society*, 62:681-701.

Loprinzi, P.D. & Cardinal, B.J. 2011. Measuring children's physical activity and sedentary behaviours. *Journal of exercise science and fitness*, 9(1):15-23.

Loucaides, C.A., Jago, R. & Theophanous, M. 2011. Physical activity and sedentary behaviours in Greek-Cypriot children and adolescents: a cross-sectional study, *International journal of behavioural nutrition and physical activity*, 8:90.

McArdle, W.D., Katch, F.I. & Katch, V.L. 2006. Exercise Physiology: energy, nutrition and human performance. Baltimore, Maryland, Lippincott Williams & Wilkins.

Macfarlane, D.J., Lee, C.C., Ho, E.Y., Chan, K.L. & Chan, D.T. 2007. Reliability and validity of the Chinese version of IPAQ (short, last 7 days). *Journal of science in medicine and sport*, 10:45-51.



Mader, U., Martin, B.W., Schutz, Y. & Marti, B. 2006. Validity of four short physical activity questionnaires in middle-aged persons. *Medicine and science in sports and exercise*, 38:1255-66.

Mahar, M.T. & Rowe, D.A. 2002. Construct validity in physical activity research. Physical activity assessments for health-related research. In: Welk, G.J. Leeds, UK, Human Kinetics.

Marmot, M., Smith, G., Stansfeld, S., Patel, C., North, F., Head, J., White, I., Brunner, E. & Feeny, A. 1991. Health inequalities among British civil servants: The Whitehall II Study. *Lancet*, 337(8754):1387-93.

Marshall, S.J., Biddle, S.J.H., Gorely, T., Cameron, N. & Murdey, I. 2004. Relationships between media use, body fatness and physical activity in children and youth: a meta-analysis. *International journal of obesity*, 28:1238-1246.

Melanson, E.L. & Freedson, P.S. 1996. Physical activity assessment: a review of methods. *Critical reviews in food science and nutrition*, 36:385-396.

Mendoza, J.A., Zimmerman, F.J. & Christakis, D.A. 2007. Television viewing, computer use, obesity, and adiposity in US preschool children. *International journal of behavioural nutrition and physical activity*, 4:44

Morrow, J.R.J. 2002. Measurement issues for the assessment of physical activity. Physical assessments for health-related research. In: Welk, G.J. Leeds, UK, Human Kinetics. pp.37-72.

Motl, R.W., Dishman, R.K., Saunders, R., Dowda, M., Felton, G. & Pate, R.R. 2001. Measuring enjoyment of physical activity in adolescent girls. *American journal of preventive medicine*, 21:(2)110–116.

Murgatroyd, P.R., Shetty, P.S. & Prentice, A.M. 1993. Techniques for the measurement of human energy expenditure: a practical guide. *International journal of obesity*, 17:152-157.

Must, A., Jacques, P.F., Dallal, G.E., Bajema, C.J. & Dietz, W.H. 1992. Long-term morbidity and mortality of overweight adolescents. A follow-up of the Harvard Growth Study of 1992-1935. *New England journal of medicine*, 327:1350-1355.

Norton, K. & Olds, T. 1996. Anthropometrica. A textbook of body measurement for sports and health courses. Australia, UNSW Press. pp.80-90.

Oja, P. & Borms J, 2004. Health enhancing physical activity. Oxford, UK. Meyer & Meyer Sport.

Pate, R.R. 1993. Physical activity assessment in children and adolescents. *Critical reviews in food science and nutrition*, 33:321-326.

Pate, R.R., Long, B.J. & Heath, G. 1994. Descriptive epidemiology of physical activity in adolescents. *Pediatric exercise science*, 6:434-447.

Pate, R.R., Pratt, M., Blair, S.N., Haskell, W.L., Macera, C.A., Bouchard, C., Buchner, D., Ettinger, W., Heath, G.W., King, A.C., Kriska, A., Leon, A., Marcus, S., Morrie, B.H., Paffenbarger, R.S., Patrick, M.K.M., Pollock, M.L., Rippe, J., Sallis, J. & Wimore, J.H. 1995. Physical activity and public health. A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *Journal of American medical association*, 273:402-407.

Philippaerts, R.M., Westerterp, K.R. & Lefevre, J. 1999. Double labeled water variation of three physical activity questionnaires. *International journal of sports medicine*, 20: 284-289.

Pietrobelli, A., Rubiano, F., St-Onge, M.P. & Heymsfield, S.B. 2004. New bioimpedance analysis system: improved phenotyping with whole-body analysis. *European journal of clinical nutrition*, 58:1479–1484.

Proctor, M.H., Moore, L.L., Gao, D., Cupples, L.A., Bradlee, M.L., Hood, M.Y. & Ellison, R.C. 2003. Television viewing and change in body fat from preschool to early adolescence: The Framingham children's study. *International journal of obesity*, 27:827–833.

Puyau, M.R., Adolph, A.N., Vhora, F.A. & Butte, N.F. 2002. Validation and calibration of physical activity monitors in children. *Journal of obesity research*, 10(3):150-157.

Reddy, S.P., Panday, S., Swart, D., Jinabhai, C.C., James, S. & Monyeki, K.D. 2002. Umthethe Uhlala Umsila – The South African youth risk behaviour survey. Cape Town: South African Medical Research Council [On line]. Available: <http://www.mrc.ac.za/healthpromotion/reports.htm>[2011,10 October].

Riddoch, C.J., Murphy, N, Nicholls, A., Van Wersche, A. & Cran, G. 1990. *The Northern Ireland Health and Fitness Survey*. Belfast: The Queen's University of Belfast.

Rivera, I.R., Silva, M.A., Silva, R.D., Oliveira, B.A. & Carvalho, A.C. 2010. Physical inactivity, TV-watching hours and body composition in children and adolescents. *Arquivos Brasileiros de cardiologia*, 95:159-65.

Robinson, T.N., Hammer, L.D., Killen, J.D., Kraemer, H.C., Wilson, D.M., Hayward, C. & Taylor, C.B. 1993. Does television viewing increase obesity and decrease physical activity? Cross-sectional and longitudinal analyses among adolescent girls. *Pediatrics*, 91:273-280.

Sallis, J.F. & Owen, N. 1999. *Physical activity and behavioural medicine*. Thousand Oaks, CA. Sage.

Sallis, J.F. & Saelens, B.E. 2000. Assessment of physical activity by self-report: status, limitations, and future directions. *Research quarterly sport for exercise and sport*, 71:S1-14.

Sallis, J.F., Condon, S.A., Goggin, K.J., Roby, J.J., Kolody, B. & Alcaez, J.E. 1993. The development of self-administered physical activity survey for 4<sup>th</sup> grade students. *Research quarterly for exercise and sports*, 64:25-31.

Sallis, J.F., Haskell, W.L., Wood, P.D., Fortmann, S.P., Rogers, T., Blair, S.N. & Paffenbarger, R.S. 1985. Physical activity assessment methodology in the Five-City Project. *American journal of epidemiology*, 121:91-106.

Saris, W.H., Blair, S.N., Van Baak, M.A., Eaton, S.B., Davies, P.S., Di Pietro, L., Fogelholm, M., Rissanen, A., Schoeller, D., Swinburn, B., Tremblay, A., Westerterp, K.R. & Wyatt, H. 2003. How much physical activity is enough to prevent unhealthy weight gain? Outcome of the IASO 1<sup>st</sup> Stock Conference and consensus statement. *Obesity review*, 4:101-14.

Schneider, P.L., Crouter, S.E., Lukajic, O. & Bassett, D.R., Jr. 2003. Accuracy and Reliability of 10 Pedometers for Measuring Steps over a 400-m Walk. *Medicine and science in sports & exercise*, 35(10):1779–1784.

Schoeller, D.A. & Racette, S.B. 1990. A review of field techniques for the assessment of energy expenditure. *Journal of nutrition*, 120(Suppl.):1492–5.

Simons-Morton, B., O'Hara, N., Simons-Morton, D. & Parcel, G. 1987. Children and fitness: A public health perspective. *Research quarterly for exercise and sport*, 58:295-302.

Slaughter, M.H., Lohman, T.G., Boileau, R.A., Horswill, C.A., Stillman, R.J., Van Loan, M.D. & Bembien, D.A. 1988. Skinfold equations for estimates of body fatness in children and youth. *Human biology*, 60:709-723.

Stager, J.M., Lindeman, A. & Edwards, J. 1995. The use of doubly-labelled water in quantifying energy expenditure during prolonged activity. *Sports medicine*, 19:166-172.

Stewart, A., Marfell-Jones, M., Olds, T. & De Ridder, H. 2011. *International Standards for Anthropometric Assessments (ISAK)*. National Library of Australia, p.114.

Suitor, C.W. & Kraak, V.L. 2007. Adequacy of evidence for physical activity guidelines development, workshop summary. Washington, D.C., The national academies press.

Strong W.B., Malina R.M., Blimkie C.J.R., Daniels S.R., Dishman, R.K., Gutin B., Hergenroeder, A.C., Must, A., Nixon, P.A., Pivarnik, J.M., Rowland, T., Trost, S. & Trudeau, F. 2005. Evidence based physical activity for school-age youth. *Journal of pediatrics*, 146:732-737.

Swinburn, B. & Shelly, A. 2008. Effects of TV time and other sedentary pursuits. *International journal of obesity*, 32(1):S132-S136.

Tammelin, T., Ekelund, U., Remes, J. & Nayha, S. 2009. Physical activity and sedentary behaviours among Finnish youth. *Medicine and science in sports and exercise*. 39:1067-1074.

Tudor-Locke, C.E. & Myers, A.M. 2001. Challenges and opportunities for measuring physical activity in sedentary adults. *Sports medicine*, 31:91-100.

Tudor-Locke, C.E. 2002. Taking steps toward increased physical activity: Using pedometers to measure and motivate. President's Council on Physical Fitness and Sports Research Digest, Series 3 No 17.

Tudor-Locke, C.E., Ainsworth, B.E., Thompson, R.W. & Matthews, C.E. 2002. Comparison of pedometer and accelerometer measures of activity of free living physical activity. *Medicine and science in sport exercise*, 34:2045-2052.

Tudor-Locke, C.E., Williams, J.E., Reis, J.P. & Pluto, D. 2004. Utility of pedometer for assessing physical activity: convergent validity. *Sports medicine*, 32:795-808.

Wang, Y., Monteiro, C. & Popkin, B.M. 2002. Trends of obesity and underweight in older children and adolescents in the United States, Brazil, China, and Russia. *American journal of clinical nutrition*, 75:971-977.

Warms, C. 2006. Physical activity measurement in persons with chronic and disabling conditions: methods, issues and strategies. *Journal of family community health*, 29(15):78-88.

Wareham, N.J. & Rennie, K.L. 1998. The assessment of physical activity in individuals and populations: Why try to be more precise about how physical activity is assessed? *International journal of obesity*, 22 (supplement)(2):S30-S38.

Welk, G.L. 2002. Use of accelerometer-based activity monitor to assess physical activity. Physical activity assessment in health-related research. In: Welk, G.J. Leeds, UK, Human Kinetics, pp. 125-142.

Welk, G.J. 2005. Principles of design and analyses for the calibration of accelerometry-based activity monitors. *Medicine and science in sports and exercise*, 37:S501-11.

Westerterp, K.R. & Bouten, C.V.C. 1997. Physical activity assessment: comparison between movement registration and doubly-labelled water method. *Zeitschrift für ernährungswissenschaft*, 36:263-267.

Westerterp, K.R. 1999. Physical activity assessment with accelerometers. *International journal of obesity*, 23:45-49.

# Chapter 3: Body composition and television viewing among high school adolescents: the PAHL study

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# Body composition and television viewing among high school adolescents: the PAHL study

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## Abstract

The purpose of this study was to determine the relationship between body composition and TV viewing among adolescents attending high schools in the Tlokwe municipality area of the North West province of South Africa. A cross-sectional study design which is part of the Physical Activity and Health Longitudinal Study (PAHLS) was followed on 154 learners (58 boys and 96 girls) aged 14 years in the Tlokwe municipality area. All the learners underwent anthropometric measurements of height, weight, and two skin folds (triceps and subscapular skinfolds). Percentage body fat (%BF) was calculated from the two skin folds according to Slaughter's *et al.* (1988) equation. Children were classified into three groups (*viz.* normal, overweight and obese) according to the BMI cut-off point suggested by Cole *et al.* (2000). Pearson's correlation coefficient was used to determine the relationship between television viewing and body composition. The results showed respectively high prevalence of overweight and obesity in girls (10.4%; 6.3% respectively) as compared to the prevalence of 5% in boys. With regard to TV viewing, the results show that 54% of the total group watch TV more than two hours a day, while only 11% watched TV less than one hour a day. The results show that the group that watches TV for more than 3 hours had high BMI (21.27kg/m<sup>2</sup>) and body mass (51.54kg) respectively. The group that watches TV for



1-2 hours had lower BMI ( $18.36\text{kg/m}^2$ ) and body mass (44.79kg). There was a significant statistical relationship between BMI and body mass ( $p=0.001$ ). A significant positive relationship between body mass and TV viewing ( $r=0.56$ ;  $p=0.05$ ) in the overweight group was found, whilst in the obese group a strong significant positive relationship was observed between percentage body fat and TV viewing ( $r=0.94$ ;  $p=0.01$ ). It can be concluded that girls were more overweight and obese respectively as compared to the boys. Furthermore, both boys and girls had high percentages of TV viewing for more than two hours a day. In addition, the results indicated that adolescents who watched TV more than 3 hours are heavier and fatter. Therefore, it is recommended that parents and educational heads should encourage periods of daily physical activity. In addition, it is also important that parents play a more positive role in limiting the amount of hours their children spend watching television.

**Keywords:** Sedentary lifestyle, television viewing, body composition, adolescents, habitual physical activity, anthropometry.

## Introduction

Obesity has become a major public health problem among children and adolescents. In the US, a study conducted in 2003-2004 revealed that 26.2% of children aged 2-5 years, 37.2% of children aged 6-11 years, and 34.4% of adolescents of 12-19 years of age were at risk of overweight or obese (Ogden, Carrol, Curtin, McDowell, Tabak & Flegal, 2006; Mendoza, Zimmerman & Christakis, 2007; Ogden, Carroll, Kit & Flegal, 2012). In both epidemiologic and meta-analyses studies, positive associations between television viewing and obesity were reported (Andersen, Crespo, Bartlett, Cheskin, & Prattbl, 1998; Marshall, Biddle, Gorely, Cameron & Murdey, 2004; Gortmaker, Peterson, Wiecha, Sobol, Dixit & Fox, 1999). Furthermore, it was revealed that during puberty (the stage before adolescence), physical activity is drastically in decline, and as such this raises a serious concern for public health which warrants investigation (Lazzer, Boirie, Poissonnier, Petit, Duché, Taillardat, Meyer & Vermorel, 2005).

Television viewing is one of the most easily modifiable causes of obesity among children (Fulton, Wang, Yore, Carlson, Galuska & Caspersen, 2009). Children spend more time watching television and videotapes and playing video games, than doing anything else except sleeping. Two mechanisms by which television viewing contributes to obesity have been suggested: reduced energy expenditure from displacement of physical activity and increased dietary energy intake, either during viewing or as a result of food advertising (Mendoza *et al.*, 2007). Children with reduced exposure to television would significantly decrease their level of adiposity (Robinson, 1999). Reduced physical activity results in reduced total energy expenditure (TEE), favouring positive energy storage. An association between TV viewing and overweight has frequently been observed. These associations were explained by:

- 1) TV viewing causing overweight and obesity by reduced resting energy expenditure;
- 2) replacement of physical activities;
- 3) a higher consumption of unhealthy food items (like sweets, cakes and fast foods); and/or obesity itself increases TV viewing.

Children with high TV-viewing time had a higher fat mass, which is attributed to frequent snacking or consumption of high fat diets during TV viewing. These data suggest that the poor nutritional habits associated with TV viewing may add to overweight in subjects watching a lot of TV. TV viewing time is influenced by different factors, for example the weather, school-systems, family structures and social status (Grund, Krause, Siewers, Rieckert & Müller, 2001).

Studies have found that having a TV in the bedroom, few family rules about TV viewing, and family meals in front of the TV are associated with more TV viewing among youth (Swinburn & Shelly, 2008). The metabolic rate is reduced during TV viewing in obese and normal weight youths. TV watching also reduces energy expenditure and is thus an important risk factor for childhood obesity. Adolescent obesity is a strong risk for diabetes, hypertension, and ischemic heart disease. Recent studies showing a dramatic rise in the rates of obesity in both children and adults in the US are cause for alarm. An increasing number of hours spent watching TV is one mechanism that may underlie these rapidly rising rates (Proctor, Moore, Gao, Cupples, Bradlee, Hood & Ellison, 2003). Strong scientific evidence exists that physical inactivity is associated with substantially reduced physical, mental, and social health among adults and excess body fat is associated with increased risk for several chronic diseases among adults, and undesirable and orthopaedic and psycho-social outcomes among children and youth (Lazzer *et al.*, 2005).

People in industrialized countries are expending less energy both in activities of daily living and at work (Andersen *et al.*, 1998). According to Lazzer *et al.* (2005) approximately half of all obese children and adolescents are likely to become obese adults who are more prone to suffer from chronic diseases than their non-obese counterparts. Obesity is a strong predictor of morbidity, with central obesity associated with insulin resistance, dislipidemia and hypertension; all independent risk factors for cardiovascular disease and features of the metabolic syndrome (Steele, Van Sluijs, Cassidy, Griffon & Ekelund, 2009).

Low levels of moderate to vigorous physical activity (MVPA) and high levels of sedentary behaviour (e.g. television viewing) have been shown to be associated with

obesity, although epidemiologic evidence in this area is not entirely consistent (Nelson, Stzainer, Hannan, Sirard & Story, 2006). It is against this background information that the present study aimed to determine the relationship between body composition and TV viewing among adolescents attending high schools in the Tlokwe local municipality of the North West province of South Africa.

## **Methodology**

### **Research design and ethical aspects**

For the purpose of the present study, a baseline data for 2010 was used. The present research is part of a larger study, in essence, the Physical Activity and Health Longitudinal Study (PAHLS) which is an observational multidisciplinary longitudinal design planned for five years. Prior to the study, permission to conduct the measurements was granted by the District Manager of the Department of Education in Potchefstroom. In addition, the Ethics Committee (*Ethics no: NWU-0058-01-A1*) of the Potchefstroom Campus of the North-West University granted approval for the study.

### **Participants**

The participants of this study comprised a total of 154 learners (58 boys and 96 girls) aged 14 years, from high schools in the Tlokwe Local Municipality of the North West Province of South Africa, and who completed measurements of physical activity during the baseline data collection in 2010. The study is described in detail elsewhere (Monyeki, Neetens, Moss & Twisk, 2012).

### **Measuring instruments for body composition**

Anthropometric measurements of height, weight, skinfold thickness (triceps and sub scapular skinfolds) were measured through the standard procedure described by the International Standard of Advancement of Kinanthropometry (ISAK) (Stewart, Marfell-Jones, Olds & De Ridder, 2011). Height was measured by a stadiometer to the nearest 0.5cm, with the subject standing upright with their head in the Frankfort

plane. Weight was measured by using a portable electronic scale to the nearest 0.1kg. BMI was calculated as weight divided by height squared, and the subjects classified according to the age- and sex-adjusted BMI cut-offs for overweight and obesity – as outlined by Cole, Bellizzi, Flegal and Dietz (2000), and Cole, Flegal, Nicholls and Jackson (2007). The triceps' and subscapular skinfolds were measured to the nearest 0.5mm using a Harpenden Caliper. Percentage body fat was derived from skin fold measurement according to the equation developed by Slaughter, Lohman, Boileau, Horswill, Stillman, Van Loan, and Bembien (1988).

### **Measuring of physical activity**

Physical activity (PA) was assessed by the use of a short form of the International Physical Activity Questionnaire (IPAQ) (CDC, 2002; WHO 2002; WHO, 2009), which is internationally approved for use by adolescents in different settings (WHO, 2002). The IPAQ-short consists of seven (7) items that identify frequency and time spent in walking and other moderate-to-vigorous intensity physical activities, during the seven days prior to the questionnaire's administration, and counts only those sessions that lasted 10 minutes or more. All types of physical activities are included whether they are part of occupation, transportation, household chores or leisure time activity. It also asks about time spent sitting, as an indicator of inactivity. The IPAQ has been tested for reliability and validity in the so-called 12-country validation study (Craig *et al.*, 2003:1388). For the purpose of this study, information from the IPAQ questionnaire based on time spent watching TV was analysed. To determine the time spent watching TV, hours spent watching TV were classified as follows: don't know=0; less than 1 hour=1, 2-3 hours=2 and more than 3 hours=3. The participants were stratified according to their daily TV consumption (mean TV viewing time) in accordance with the Third National Health and Nutrition Examination Survey guidelines (Andersen *et al.*, 1998:939; Bryant, Lucove, Evenson & Marshall, 2007).

## **Test procedures**

The purpose and procedures of the study were explained to both the parents and the children wherein a signed informed consent form was granted. Measurements were conducted following these phases:

Phase I: Physical activity questionnaire was assessed separately from the other test measurements under the supervision of the principal investigator.

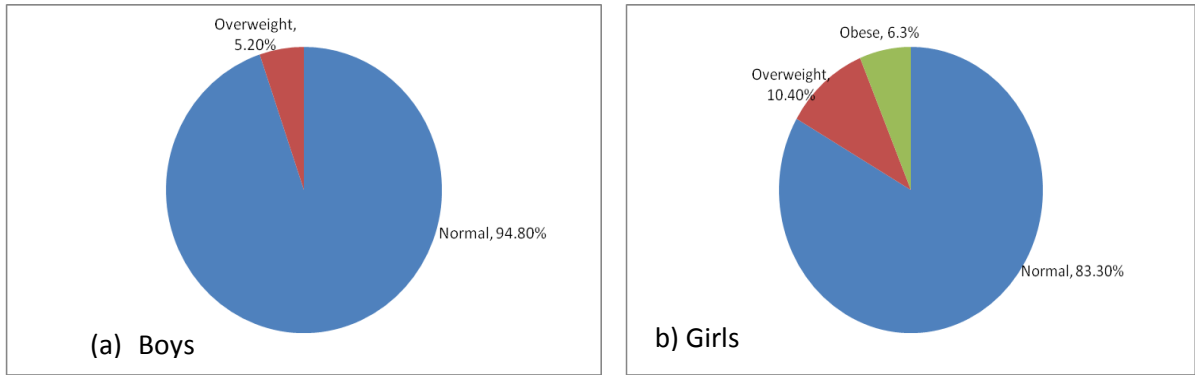
Phase II: Anthropometric measurements of height, weight, triceps and subscapular skinfolds were measured in separate rooms for boys and girls by certified anthropometrists.

## **Statistical Analysis**

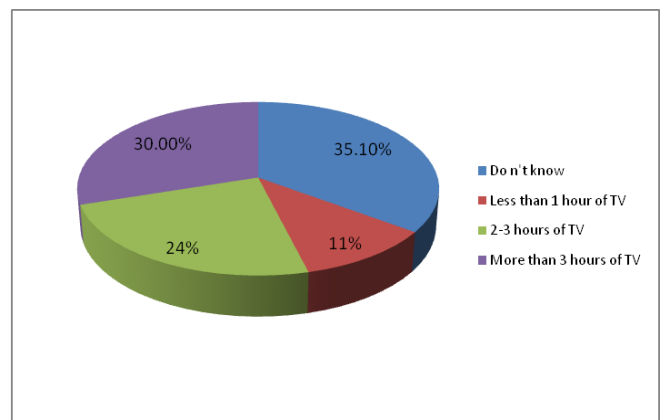
The SPSS Version 17.0 (SPSS Inc., Chicago, I11 2009) statistical programme was used to process and analyse the data. Non-parametric technique was used to calculate the descriptive statistic (*i.e.* means, standard deviations, frequencies) for TV viewing and body composition. In addition, correlation coefficients were calculated to determine the relationship between TV viewing and body composition. Significance level was set at  $p \leq 0.05$ .

## **Results**

Figure 1 (a and b) presents the distribution of children according to their BMI classification by gender. A total of 55 boys which accounts for 94.8% of the population were normal, 3 boys (5.2%) were overweight, and no obese boys were identified in the total population. A total number of 80 girls accounting for 83.3% of the sample were normal, 10 girls (10.4%) were overweight, and 6 girls (6.3%) were obese.



**Figure 1: Prevalence of overweight and obesity for boys and girls**



**Figure 2: Prevalence of TV viewing for the total group**

Figure 2 presents the percentage score for TV viewing for the total group. The results show that 54% of the total group watch TV for more than one hour a day, while only 11% watched TV less than one hour a day.

**Table 2: Percentages of TV viewing of boys and girls**

	<b>Boys (n=58)</b>	<b>Girls (n=96)</b>
	<b>n (%)</b>	<b>n (%)</b>
Don't know	13 (22)	41 (43)
Less than 1 hour of TV	12 (21)	5 (5)
2-3 hours of TV	18 (31)	19 (20)
More than 3 hours of TV	15 (26)	31 (32)
Total	58 (100)	96 (100)

In Table 2, the results show a high percentage of TV viewing by both boys (57%) and girls (52%) respectively. The results show that only five girls and 12 boys indicated that they watched TV for less than an hour a day.

**Table 3: Means and standard deviations of anthropometric measurements according to TV viewing**

<b>Hours on TV</b>	<b>Variables</b>	<b>Mean</b>	<b>SD</b>
Don't Know	Stature	154.29	6.51
	Body mass	49.3	9.64
	BMI	20.63	3.6
	Percentage Body fat	13.2	6.54
1-2 hours	Stature	155.98	8.59
	Body mass	44.79	7.65
	BMI	18.36	2.97
	Percentage Body fat	11.95	6.96
2-3 hours	Stature	151.71	7.33
	Body mass	45.11	11.05
	BMI	19.44	3.76
	Percentage Body fat	12.58	5.63
More than 3 hours	Stature	155.39	6.41
	Body mass	51.54	13.63
	BMI	21.27	5.16
	Percentage Body fat	12.94	6.39



Table 3 presents the descriptive characteristics (mean and standard deviation) of adolescents, classified into 4 groups of hours spent watching TV namely, don't know, 1-2 hours, 2-3 hours, and more than 3 hours. The group that watched TV more than 3 hours was relatively heavier and fatter than the group that do not know how many hours they spent watching TV, and the group that watched TV less than 3 hours.

**Table 4: Correlation matrix for body composition and TV viewing of normal, overweight and obese adolescents**

Variable s	Normal group								Overweight group								Obese group							
	BMI		Body mass		%BF		TV		BMI		Body mass		%BF		TV		BMI		Body mass		%BF		TV	
	r	p	r	p	r	p	r	p	r	p	r	p	r	p	r	p	r	p	r	p	r	p	r	p
BMI	-	-	.86	.001	.01	.90	-.12	.15	-	-	.72	.01	.18	.55	.37	.22	-	-	.93	.01	-.26	.61	.16	.76
Body mass	.86	.001	-	-	.01	0.77	-.13	.15	.72	.01	-	-	.21	.50	.56	.05	.93	.01	-	-	-.08	.88	.11	.84
%BF	.01	.90	.01	.77	-	-	-.01	.85	.21	.50	.18	.56	-	-	.04	0.9	-.26	.61	-.08	.88	-	-	.94	.01

r= correlation coefficient; \*\* p <0.05; BMI= Body mass index; %BF = Percentage body fat

Table 4 presents the correlation matrix for body composition and TV viewing for normal, overweight and obese groups in adolescents. The results show a significant positive relationship between BMI and body mass. No significant relationship was found for body composition parameters and TV viewing in the normal group. A significant relationship was found for body mass and TV viewing in the overweight group. In the obese group a significant relationship was observed for body fat and TV viewing.

## Discussion

The results showed high prevalence of overweight especially in girls, and also relatively high percentages of hours spent viewing TV among boys and girls respectively. Girls were more overweight than the boys, whilst TV viewing was high in both boys and girls. Furthermore, the results show significant relationships between body mass, body fat and TV viewing respectively in the overweight and

obese group adolescents entering high schools in the Tlokwe local municipality of the North West province. Furthermore, the results show that adolescents who watched TV more than 3 hours were heavier and fatter than the other groups.

The relatively high prevalence of overweight and obesity in the present study is in line with the findings on American children and adolescents with 31.8% being overweight and 16.9% obesity (Ogden *et al.*, 2012). It was stated that the prevalence of obesity is high in children who watched TV for more than 4 hours a day (Crespo, Smit, Troiano, Bartlett, Macera & Andersen, 2001). A similar trend was also found in the present study in which adolescents who watched TV for more than 3 hours had higher BMI and percentage body fat than those who watched TV for less hours a day. In the present study, percentage body fat was significantly associated with hours spent in TV viewing, as such these findings are congruent with a study by Andersen *et al.* (1998) in which it was revealed that skin fold thickness increased as the amount of TV viewing increased. In addition, it was also reported that children that spend more time watching TV are less likely to participate in vigorous activity and thus gain an increase in their BMI (Ross & Gilbert, 1985). Significant associations between overweight and obesity and TV viewing in school going girls, as well as with sedentary behaviour (combined TV and computer use) was found (Eisenmann, Bartee & Wang, 2002). Media use may encourage unhealthy food intake and also reduce opportunities for physical activity (Fulton *et al.*, 2009).

It should be noted that this study has some limitations. The nature of the present study was a cross-sectional study; this however proved to be a major limitation as it was based on a specific age category, and previous studies found that BMI and body composition increased significantly as age also increased. Furthermore, the lack of overall total physical activity as well as dietary patterns which were not available for the present study are the limitations to the findings. It is therefore recommended that further studies should include a larger number of subjects, total physical activity as well as dietary practices following a longitudinal design and also cover a wider spectrum of the South African population, not only the Tlokwe local municipality of the North West province.

## **Conclusion**

It can be concluded that the prevalence of overweight exists (especially in girls), and also relatively high hours spent viewing TV was evident in the studied sample. In addition, significant relationships were observed between body composition and TV viewing in overweight and obese adolescents in the Tlokwe local municipality of the North West province. And further, a prevalence of high body composition in adolescents watching TV for more than 3 hours was found. Based on the results of the present study, it is therefore recommended that both parents and educational heads encourage periods of daily physical activity, and parents play a more positive role in limiting the amount of hours their children spend watching television.

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## References

Andersen, R.E., Crespo, C.J., Bartlett, S.J., Cheskin, L.J. & Prattbl, M.T. (1998). Relationship of physical activity and television watching with body weight and level of fatness among children. *American Medical Association*, 279(12), 938-942.

Bryant, M.J., Lucove, J.C., Evenson, K.R. & Marshall, S. (2007). Measurement of television viewing in children and adolescents: a systematic review. *The International Association for The Study of Obesity*, (8), 197-209.

Centers for Disease Control and Prevention. (2002). Barriers to walking and biking to school. United States, 1999. *Journal of American Medical Association*, 288(11), 1343-1344.

Center for Disease Control and Prevention. USA. (2009). Promoting better health for young people through physical activity and sports. Department of Health and Human Services. [online]. [Accessed on 2009 June 20<sup>th</sup>]. Available from: [http://www.cdc.gov/healthyyouth/physicalactivity/promoting\\_health/pdfs/ppar.pdf](http://www.cdc.gov/healthyyouth/physicalactivity/promoting_health/pdfs/ppar.pdf).

Cole, T.J., Bellizzi, M.C., Flegal, K.M. & Dietz, W.H. (2000). Establishing a standard definition for child overweight and obesity worldwide: international survey. *British Medical Journal*, 330,1240-1244.

Cole, T.J., Flegal, K.M, Nicholls, D. & Jackson, A.A. (2007). Body mass index cut offs to define thinness in children and adolescents: International survey. *British Medical Journal*, 335(7612), 194.

Craig, C., Marshall, A.L., Sjostrom, L., Bauman, A., Booth, M., Ainsworth, B., Pratt, M., U., Yngve, A. & Sallis, J. (2003). International physical questionnaire: 12-country reliability and validity. *Medicine and Science in Sports and Exercise*, 35,1381-1395.

Crespo, C.J., Smit, E., Troiano, R.P., Bartlett, S.J., Macera, C.A. & Andersen, R.E. (2001). Television watching, energy intake, and obesity in US children: results from the third National Health and Nutrition Examination Survey, 1988-1994. *Archives of Pediatric Medicine*, 155(3), 360-365.

Gortmaker, S.L., Peterson, K., Wiecha, J., Sobol, A.M., Dixit, S., Fox, M.K. & Laird, N. (1999). Reducing obesity via a school-based interdisciplinary intervention among youth: Plate Health. *Archives of Pediatric Adolescents Medicine*, 153(4), 409-418.

Eisenmann, J.C., Barteel, R.T. & Wang, M.Q. (2002). Physical Activity, TV Viewing, and Weight in U.S. Youth: 1999 Youth Risk Behaviour Survey. *Obesity Research*, 10(5), 379-385.

Faith, M.S., Berman, N., Heo, M., Pietrobelli, M.D., Gallagher, D., Epstein, L.H., Eiden, M.T. & Allison, D.B. (2001). Effect of Contingent Television on Physical activity and Television viewing in obese children. *American Academy of Paediatrics*, 107(5), 1043-1049.

Fulton, J.E. Wang, X., Yore, M.M, Carlson, S.A., Galuska, D.A. & Caspersen, C.J. (2009). Television Viewing, Computer use, and BMI among U.S. Children and Adolescents. *Journal of Physical Health*, 6(Suppl 1), 28-35.

Grund, A., Krause, H., Siewers, M., Rieckert, H. & Müller, M.J. (2001). Is TV viewing an index of physical activity and fitness in overweight and normal weight children? *Journal of Public Health Nutrition*, 4(6), 1245-1251.

Lazzer, S., Boirie, Y., Poissonnier, C., Petit, I., Duché, P., Taillardat, M., Meyer, M. & Vermorel, M. (2005). Longitudinal changes in activity patterns, physical capacities, energy expenditure, and body composition in severely obese adolescents during a multidisciplinary weight-reduction program. *International Journal of Obesity*, 29(1), 37-46.

Marshall, S.J., Biddle, S.J.H., Gorely, T., Cameron, N. & Murdey, I. (2004). Relationships between media use, body fatness and physical activity in children and youth: a meta-analysis. *International Journal of Obesity*, 28, 1238-1246.

Mendoza, J.A., Zimmerman, F.J. & Christakis, D.A. (2007). Television viewing, computer use, obesity, and adiposity in US preschool children. *International Journal of Behavioural Nutrition and Physical Activity*, 4(44), 1-10.

Monyeki, M.A., Koppes, L.L.J., Kemper, H.C.G., Monyeki, K.D., Toriola, A.L., Pienaar, A.E. & Twisk, J.W.R. (2005). Body composition and physical fitness of undernourished South African rural primary school children. *European Journal of Clinical Nutrition*, 59(1), 877-883.

Monyeki, M.A., Neetens, R., Moss S.J. & Twisk J. (2012). The relationship between body composition and physical fitness in 14 year-old adolescents residing within the Tlokwe Local Municipality, South Africa: the PAHL study, *BMC Public Health*, 12, 374.

Mota, J., Ribeiro, J., Santos, M.P. & Gomes, H. (2006). Obesity, Physical Activity, Computer Use, and TV Viewing in Portuguese Adolescents. *Paediatric Exercise Science*, 17, 113-121.

Nelson, M.C., Stzainer, D.N., Hannan, P.J, Sirard, J.R. & Story, M. (2006). Longitudinal and Secular trends in Physical Activity and Sedentary Behaviour During Adolescence. *Pediatrics*, 118:E1627-E1634.

Ogden, C.L., Carroll, M.D., Curtin, L.R., McDowell, M.A., Tabak, C.J. & Flegal, K.M. (2006). Prevalence of overweight and obesity in the United States, 1999-2004. *JAMA*, 295(13), 1549-1555.

Ogden, C.L., Carroll, M.D., Kit, B.K. & Flegal, K.M. (2012). Prevalence of obesity and trends in body mass index among U.S. children and adolescents, 1999-2010. *Journal of the American Medical Association*, 307(5), 483-490.

Procter, M.H., Moore, L.L, Gao, D., Cupples, L.A., Bradlee, M.L., Hood., M.Y. & Ellison, R.C. (2003). Television viewing and change in body fat from preschool to early adolescence: The Framingham Children's Study. *International Journal of Obesity*, 27, 827-833.

Robinson, T.N. (1999). Reducing children's television viewing to prevent obesity. A randomized controlled trial. *American Medical Association*, 282(16), 1561-1567.

Ross, J.G. & Gilbert, G.G. (1985). The National Children and Youth Fitness Study: a summary of findings. *Journal of Physical Education, Recreation and Dance*, 56, 45-50.

Slaughter, M.H., Lohman, T.G., Boileau, R.A., Horswill, C.A., Stillman, R.J., Van Loan, M.D. & Bembien, D.A. (1988). Skinfold equations for estimates of body fatness in children and youth. *Human Biology*, 60, 709-723.

SPSS Inc. (2011). *Statistical Package for Social Sciences Software*. USA.

Steele, R.M., Van Sluijs, E.M.F., Cassidy, A., Griffon, S.J. & Ekelund, U. (2009). Targeting sedentary time or moderate- and vigorous-intensity activity: independent relations with adiposity in a population-based sample of 10-y-old British children. *The American Journal of Clinical Nutrition*, 90(1), 1185-1192.

Stewart, A., Marfell-Jones, M., Olds, T. & De Ridder, H. (2011). *International Standards for Anthropometric Assessments (ISAK)*. National Library of Australia, p.114.

Swinburn, B. & Shelly, A. (2008). Effects of TV time and other sedentary pursuits. *International Journal of Obesity*, 32(1), S132-S136.

World Health Organisation (WHO), (2002). *Global Strategy on Diet, Physical Activity and Health*. 22 May 2004. WHA57.17. Geneva, Switzerland: World Health Organization.

World Health Organization (WHO), (2009). Obesity and physical activity, technical report series.



# **CHAPTER 4: SUMMARY, CONCLUSIONS, LIMITATIONS AND RECOMMENDATIONS**

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## 4.1 SUMMARY

In Chapter 1 the introduction and outline of the problem statement are presented. The first objective of the study was to determine the body composition and TV viewing profiles among high school adolescent boys and girls in the Tlokwe municipality. The second objective was to determine the relationship between body composition and TV viewing among high school adolescent boys and girls in the Tlokwe municipality. Chapter 1 describes the problem, objectives and hypothesis of the study.

Chapter 2 consists of a literature review on the body composition, techniques for measuring body composition, physical activity, techniques for measuring physical activity, research studies on body composition and TV viewing, and recommendations of physical activities for adolescents. From the reviewed literature it was revealed that television viewing is one of the most easily modifiable causes of obesity among children (Eisienman *et al.*, 2002:380; Fulton *et al.*, 2009:30). Literature also revealed the association between having a TV in the bedroom, few family rules about TV viewing, and family meals in front of the TV among youth (Swinburn & Shelly, 2008:S133), and the rapid rising in obesity (Proctor *et al.*, 2003:829). Literature also provided scientific evidence which showed that physical inactivity is associated with substantially reduced physical, mental and social health among children and adults (Lazzer *et al.*, 2005:38). Some studies showed positive associations between television viewing and childhood obesity; children who watched the most television had the greatest increase in triceps' size and sum of skin folds, while those who watched the least television had the smallest gains in body fat (Proctor *et al.*, 2003:832). Some contrasting results were also presented by literature, to wit, that television watching was weakly negatively correlated with physical activity levels, and physical activity during television-watching was lower than non-television time in the sample of children (DuRant *et al.*, 1994).

Literature revealed various methods which can be used to measure body composition and they are as follows:

Underwater weighing, Air-Displacement, plethysmography, skin fold thickness measurement (Norton & Olds, 1996), bioelectrical impedance (Ellis, 2001) or basic measurement of weight and height for calculation of the body mass index (BMI) (Pietrobelli *et al.*, 1998; Hills & Kagawa, 2007:39; ACSM, 2010:58). The literature also indicated various subjective methods of assessing physical activity as observation and questionnaires, and objective measures being motion sensors, calorimetry, and doubly-labelled water (DLW). The chapter ends with the summary.

Chapter 3 was presented in the form of a research article. The literature review, method of research, research design, results, discussion, and conclusion are presented in the article. The title of the article is as follows:

**“Body composition and television viewing among high school adolescents: the PAHL study”**

## **4.2 CONCLUSIONS**

The conclusions drawn from this research are in accordance with the hypotheses set in Chapter 1.

**4.2.1 Hypothesis 1:** A high prevalence of overweight and TV viewing hours among high school adolescent boys and girls in the Tlokwe municipality will be found.

The results show respectively a high prevalence of overweight and obesity in girls (10.4%; 6.3%) as compared to the prevalence of 5% in boys. With regard to TV, the results show that 54% of the total group watch TV for more than two hours a day, while only 11% watched TV less than one hour a day. The results show that the group that watches TV for more than 3 hours had high BMI (21.27kg/m<sup>2</sup>) and body mass (51.54kg). The group that watches TV for 1-2 hours had low BMI (18.36kg/m<sup>2</sup>) and body mass (44.79kg). Hypothesis 1 can therefore be accepted.

**4.2.2 Hypothesis 2:** Significant positive relationship between body composition and TV viewing among high school adolescent boys and girls in the Tlokwe municipality will be found.

There was a statistical significant relationship between BMI and body mass ( $p=0.001$ ). No significant relationship was found for body composition parameters and TV viewing in the normal group. A significant positive relationship between body mass and TV viewing ( $r=0.56$ ;  $p=0.05$ ) in the overweight group was found, whilst in the obese group, a strong significant positive relationship was observed between percentage body fat and TV viewing ( $r=0.94$ ;  $p=0.01$ ). Hypothesis 2 is partially accepted.

### **4.3 LIMITATIONS**

The present study has several limitations which should be noted when interpreting the results. The nature of the present study was a cross-sectional study; this however proved to be a major limitation as it was based on a specific age category, and previous studies have found that BMI and body composition increased significantly as age increases. Furthermore, the lack of overall total physical activity as well as dietary patterns which were not available for the present study are the limitations to the findings. It is therefore recommended that further studies should include a larger number of subjects, total physical activity as well as dietary practices following a longitudinal design and also cover a wider spectrum of the South African population, not only the Tlokwe local municipality of the North West province.

### **4.4 RECOMMENDATIONS**

4.4.1 From the results of this study it would appear that there is a high prevalence of overweight or obesity among adolescents and as such the study recommends that parents and educational heads should encourage their children to periods of daily physical activity. Furthermore, intervention programs to prevent and manage overweight and obesity are recommended.

4.4.2 The results show high prevalence of TV viewing among adolescents. In addition the results show that the children who watched TV more than 3 hours were heavier and fatter than the other groups. It is therefore recommended that parents should play a more positive role in limiting the amount of hours their children spend watching television. Furthermore, adolescents must be provided with skills and knowledge about the negative effect of too much TV viewing.

4.4.3 The results show significant positive relationships between body mass and percentage body fat in both overweight and obese children. The study therefore recommends an urgent need to introduce preventative physical activity programmes geared towards overweight and obese children as well as the normal group so as to manage the development of the observed prevalence.

4.4.4 The cross-sectional nature of the study might have affected the results one way or the other, therefore more studies which follow a longitudinal design method are required.

4.4.5 The use of questionnaires in assessing TV viewing might have limited the present findings. More studies which follow objective methods in assessing TV viewing are needed.

## 4.5 REFERENCES

ACSM. 2010. American College of Sports Medicine. ACSM's Guidelines for Exercise Testing and Prescription. 8<sup>th</sup> ed. Philadelphia (PA): Lippincott Williams & Wilkins, 380p.

Durant, R.H. Baranowski, T., Johnson, M. & Thompson, W.O. 1994. The relationship among television watching, physical activity, and body composition of young children. *Pediatrics*, 94:449-455.

Eisienman, J.C., Bartee, R.T. & Wang, M.Q. 2002. Physical Activity, TV Viewing, and Weight in U.S. Youth: 1999 Youth Risk Behaviour Survey. *Obesity research*, 10(5):379-385.

Ellis, K.J., Bell, S.J., Chertow, G.M., Chumlea, W.C., Knox, T.A., Kotle, D.P., Lukaski, H.C. & Schoeller, D.A. 1999. Bioelectrical impedance methods in clinical research: a follow-up to the NIH technology assessment conference. *Nutrition*, 15:74–880.

Fulton, J.E. Wang, X., Yore, M.M, Carlson, S.A., Galuska, D.A. & Caspersen, C.J. 2009. Television Viewing, Computer use, and BMI among U.S. Children and Adolescents. *Journal of physical health*, 6(Suppl 1):28-35.

Hills, J.O. & Kagawa M. 2007. Body composition assessment in children and adolescents: Implications of obesity. (In Hills A. P., King N. A & Byrne N. M. eds. Children obesity and exercise. London Routledge P. 37–49

Lazzer, S., Boirie, Y., Poissonnier, C., Petit, I., Duche, P., Taillardat, M., Meyer, M. & Vermorel, M. 2005. Longitudinal changes in activity patterns, physical capacities, energy expenditure, and body composition in severely obese adolescents during a multidisciplinary weight-reduction program. *International journal of obesity*, 29(1):37-46.

Norton, K. & Olds, T. 1996. *Anthropometrica*. A textbook of body measurement for sports and health courses. Australia, UNSW Press. pp.80-90.

Pietrobelli, A., Rubiano, F., St-Onge, M.P. & Heymsfield, S.B. 2004. New bioimpedance analysis system: improved phenotyping with whole-body analysis. *European journal of clinical nutrition*, 58:1479–1484.

Proctor, M.H., Moore, L.L., Gao, D., Cupples, L.A., Bradlee, M.L., Hood, M.Y. & Ellison, R.C. 2003. Television viewing and change in body fat from preschool to early adolescence: The Framingham children's study. *International journal of obesity*, 27:827–833.

Swinburn, B & Shelly, A. 2008. Effects of TV time and other sedentary pursuits. *International journal of obesity*, 32 (1):S132 – S136.

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## **APPENDIX A**

### **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,
- ii) Afford the professionals and other interested individuals in these disciplines the opportunity to learn more about the practice of the disciplines in different parts of the continent,
- iii) Create an awareness in the rest of the world about the professional practice in the disciplines in Africa.

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Three copies of original manuscript and all correspondence should be addressed to the Editor-In-Chief:

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Centre for Bio kinetics, Recreation  
and Sport Science, University of Venda for  
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## PREPARATION OF MANUSCRIPT

Manuscripts should be type written in fluent English (using 12-point Times New Roman font and 1½ line-spacing) on one side of white A4-sized paper justified fully with 3cm margin on all sides. *Guidelines for Authors* 317

In preparing manuscripts, MS-Word, Office 98 or Office 2000 for Windows should be used. Length of manuscripts should not normally exceed 12 printed pages (including tables, figures, references, etc.). For articles exceeding 10 typed pages US\$ 10.0 is charged per every extra page. Longer manuscripts may be accepted for publication as supplements or special research reviews. Authors will be requested to pay a publication charge of US\$ 350.0 to defray the very high cost of publication. The pages of manuscripts must be numbered sequentially beginning with the title page. The presentation format should be consistent with the guidelines in the publication format of the American Psychological Association (APA) (4th edition).

Title page:

The title page of the manuscript should contain the following information:

Concise and informative title.

Author(s)' name(s) with first and middle initials. Authors' highest qualifications and main area of research specialisation should be provided.

Author(s) institutional addresses, including telephone and fax numbers.

Corresponding author's contact details, including e-mail address.

A short running title of not more than 6 words.

#### Abstract

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.

#### Text

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

#### *Introduction*

The introduction should start on a new page and in addition to comprehensively giving the background of the study should clearly state the problem and purpose of the study. Authors should cite relevant references to support the basis of the study. A concise but informative and critical literature review is required.

#### *Materials and Methods*

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.

#### Results

Findings should be presented precisely and clearly. Tables and figures must be presented separately or at the end of the manuscript and their appropriate locations in the text indicated. The results section should not contain materials that are appropriate for presentation under the discussion section. Formulas, units and quantities should be expressed in the *systeme 318 Guidelines for Authors internationale (SI)* units. Colour printing of figures and tables is expensive and could be done upon request authors' expense.

#### Discussion

The discussion section should reflect only important aspects of the study and its major conclusions. Information presented in the results section should not be repeated under the discussion. Relevant references should be cited in order to justify the findings of the study. Overall, the discussion should be critical and tactfully written.

### *References*

The American Psychological Association (APA) format should be used for referencing. Only references cited in the text should be alphabetically listed in the reference section at the end of the article. References should not be numbered either in the text or in the reference list.

Authors are advised to consider the following examples in referencing:

Examples of citations in body of the text:-

For one or two authors; Kruger (2003) and Travill and Lloyd (1998). These references should be cited as follows when indicated at the end of a statement: (Kruger, 2003); (Travill & Lloyd, 1998).

For three or more authors cited for the first time in the text; Monyeki, Brits, Mantsena and Toriola (2002) or when cited at the end of a statement as in the preceding example; (Monyeki, Brits, Mantsena & Toriola, 2002). For subsequent citations of the same reference it suffices to cite this particular reference as: Monyeki et al. (2002).

Multiple references when cited in the body of the text should be listed chronologically in ascending order, i.e. starting with the oldest reference. These should be separated with semi colons. For example, (Tom, 1982; McDaniels & Jooste, 1990; van Heerden, 2001; de Ridder at al., 2003).

### *Reference List*

In compiling the reference list at the end of the text the following examples for journal references, chapter from a book, book publication and electronic citations should be considered:

Examples of journal references:

Journal references should include the surname and initials of the author(s), year of publication, title of paper, name of the journal in which the paper has been published, volume and number of journal issue and page numbers.

For one author: McDonald, A.K. (1999). Youth sports in Africa: A review of programmes in selected countries. *International Journal of Youth Sports*, 1(4), 102-117.

For two authors: Johnson, A.G. & O'Kefee, L.M. (2003). Analysis of performance factors in provincial table tennis players. *Journal of Sport Performance*, 2(3), 12-31.

For multiple authors: Kemper, G.A., McPherson, A.B., Toledo, I. & Abdullah, I.I. (1996). Kinematic analysis of forehand smash in badminton. *Science of Racket Sports*, 24(2), 99-112.

Examples of book references: *Guidelines for Authors* 319

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:

For authored references: Amusa, L.O. & Toriola, A.L. (2003). *Foundations of Sport Science* (1st ed.) (pp. 39-45). Mokopane, South Africa: Dynasty Printers.

For edited references: Amusa, L.O. and Toriola, A.L. (Eds.) (2003). *Contemporary Issues in Physical Education and Sports* (2nd ed.) (pp. 20-24). Mokopane, South Africa: Dynasty Printers.

For chapter references in a book: Adams, L.L. & Neveling, I.A. (2004). Body fat characteristics of sumo wrestlers. In J.K. Manny and F.O. Boyd (Eds.), *Advances in Kinanthropometry* (pp. 21-29). Johannesburg, South Africa: The Publishers Company Ltd.

Example of electronic references:

Electronic sources should be easily accessible. Details of Internet website links should also be provided fully. Consider the following example:

Wilson, G.A. (1997). Does sport sponsorship have a direct effect on product sales? *The Cyber-Journal of Sport Marketing (online)*, October, 1(4), at <http://www.cad.gu.au/cjasm/wilson.html>. February 1997.

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Manuscript accepted for publication may be returned to the author(s) for final correction and proofreading. Corrected proofs should be returned to the Editor-In-Chief within one week of receipt. Minor editorial corrections are handled by AJIPHERD.

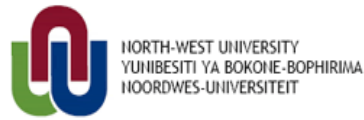
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## APPENDIX B



School of Biokinetics, Recreation and Sport  
Science  
Private Bag x6001,  
Potchefstroom  
2520  
South Africa  
Tel: +27 18 299 1790  
Fax: +27 18 299 1808  
E-mail: andries.monyeki@nwu.ac.za  
25 January 2010

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)

Activity, Sports and Recreation, NWU-Potchefstroom

Dr Hanlie Moss

Leader of Niche Area for Physical

## APPENDIX C



School of Biokinetics, Recreation and Sport Science  
Private Bag x6001,  
Potchefstroom  
2520  
South Africa  
Tel: +27 18 299 1790  
Fax: +27 18 299 1808  
E-mail: andries.monyeki@nwu.ac.za

10 March 2010

### INFORMATION LETTER TO THE PARENTS <http://www.nwu.ac.za>

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 result 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 forms 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)

.....

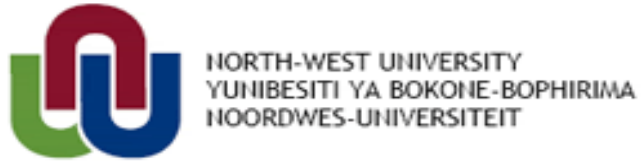
(Signature of Parent/Guardian)

.....

(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: .....  
Surname first names

Sport: .....

Date of Birth:			
	Day	Month	Year

Test Date:			
	Day	Month	Year

Box height: .....

Gender: M  F

	<i>ID</i>	<i>Site</i>	<i>Trail 1</i>	<i>Trail 2</i>	<i>Trail 3</i>	<i>Mean/ Median</i>
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



### 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.**