African Journal for Physical, Health Education, Recreation and Dance (AJPHERD) Volume 20(2:1), June 2014, pp. 323-342.

Physical activity and health in children: How much do we know?

M.A. MONYEKI

Physical Activity, Sport and Recreation Focus Area, North-West University, Potchefstroom 2520, South Africa. E-mail: andries.monyeki@nwu.ac.za

(Received: 05 August 2013; Revision Accepted: 31 May 2014)

Abstract

Globally, physical inactivity is a major public health concern to human life. In modern times, technological advances, mechanization and automation have radically reduced human physical activity. Surely, it has been found that physical inactivity has significant relationship with overweight or obesity in children and adults alike. The aim of this study was to provide an overview of physical activity and health in children. The specific objective of this study was to examine these research questions regarding the physical activity and health of the South African children: Are South African children active or fit enough?; Why are children not physically active/fit?; Is it necessary for children to be physically active/fit? Is there a need for health-related physical activity and Physical Education programmes in the school curriculum? In addressing these questions numerous sources such as Science Direct, Sport Discus, PubMed, EBSCOHost, MEDLINE, Sabinet, Google Scholar, books, journals as well as government documents were consulted. From the reviewed sources it was evident that South African children nowadays are not as active or fit enough compared to generations of children in the past three decades. Literature indicated the prevalence of both underweight and overweight in children, with high increase in the prevalence of overweight. The most inactive children were reported to be found in urban areas, whilst rural children are found to be more active. Numerous epidemiological studies on physical activity and non-communicable diseases of lifestyle indicated that inactivity was associated with a number of non-communicable diseases of lifestyle such as obesity which is amongst other linked to high percentage body fat, hypertension, type II diabetes, low self-esteem. Evidence is available regarding the benefits of regular participation in physical activity which amongst others include cognitive development, good performance in physical fitness, hence sports, social conducts; management of body weight, blood pressure, glucose level, asthma, etc. Epidemiological findings have indicated numerous challenges regarding physical inactivity and its negative effect on health and economy. Given the epidemic of physical inactivity and its negative outcomes on health and well-being, it is imperative to include physical education as a compulsory subject in the curriculum and emphasise the general advocacy on physical activity and health.

Keywords: Physical activity, health-related fitness, epidemiology, overweight, non-communicable diseases.

How to cite this article:
Monyeki, M.A. (2014). Physical activity and health in children: How much do we know? *African Journal for Physical, Health Education, Recreation and Dance*, 20(2:1), 323-342.

Introduction

South Africa is a country of numerous paradoxes. South Africa deservedly celebrated the success of hosting the 2010 Soccer World Cup, and recently the AFCON 2013, but the reality is that South Africa most definitely is not yet winning the fight against epidemics of physical inactivity and overweight among the children (McQuaide, 2008). Consequently, both physical inactivity and overweight are found to be associated with quadruple burden of diseases–a combination of poverty-related infectious diseases, lifestyle-related non-communicable diseases (NCDs) and violence-related trauma, thus creating a vicious circle (Nickolic, Stanciole & Zaydman, 2011). NCD is a medical condition or disease which by definition is non-infectious and non-transmissible among people, accounting for millions of death globally each year. NCDs are sometimes mischaracterised as diseases of the affluence because people have the notion that as people get richer, they indulge in unhealthy lifestyles thus giving rise to these diseases. But in actual fact NCDs affect people from different stratums (The NCD Alliance, 2011).

The Lancet series of 2012, it was reported that the world now has the largest cohort of 1.8 billion young people in history of which 1.5 billion are from developing countries (Patton, Coffey, Cappa, Currie et al., 2012). It was further indicated that young people are confronted with numerous challenges like insufficient physical activity and unhealthy diet which may lead to an array of negative physical changes such as high blood pressure and overweight/obesity, which can trigger NCDs like cardiovascular diseases, diabetes, and cancers in adulthood (World Bank, 2011). It is projected that by 2030 (*Figure 1*), developing countries will have eight times more deaths attributed to NCDs than developed countries (Nickolic et al., 2011).

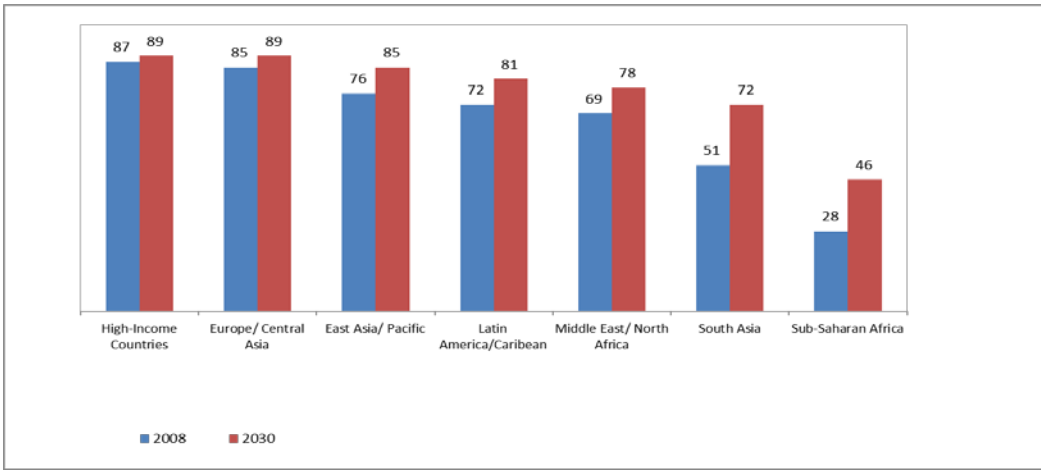

Figure 1: Percentage of total deaths attributed to NCDs, All ages (Adapted from Baldwin & Amato, 2012)

In Baldwin and Amato (2012) fact sheet, it was reported that NCD-related mortality is occurring at earlier ages in developing countries: 29 percent of NCD-related deaths in developing countries occur before age 60, compared with 13 percent in developed countries. For example, Engelgau et al. (2011) revealed that the average age of the first-time heart attack sufferer in South Asia is 53, six years younger than the world average. NCDs are now affecting more people who are in their prime economically productive years, and these deaths are frequently preceded by years of disability.

Four diseases namely cardiovascular diseases, cancers, diabetes, and chronic respiratory diseases, are responsible for the majority of NCD-related illness and death. These four, along with mental illness, will cost the developing world $21 trillion over the next two decades (Bloom et al., 2011). In the report by Statistics South Africa in 2005 for the period 1997 to 2003 regarding the national cause-of-death, it was revealed that 20% of deaths in the 35–64 year age group was attributed to chronic lifestyle diseases (Statistics South Africa, 2005). Norman et al. (2007) in a study on comparative risk-assessment study concerning the factors that contribute to deaths in South Africa, reported high blood pressure to be ranked second, tobacco smoking third, alcohol abuse fourth, high body mass index (BMI) fifth, high cholesterol seventh, diabetes eighth and physical inactivity ninth. Steyn (2007) reported that South African health services spent R8 billion per annum involving direct and indirect costs related to lifestyle diseases such as heart disease and stroke.

According to the World Bank, more than half of the NCDs burden could be avoided through health promotion and prevention initiatives (World Bank, 2011). Relying solely on treatment options to combat NCDs is very costly, particularly in developing countries where governments and health infrastructures are unprepared to respond to this growing problem. For example, the report by Statistics South Africa of 2008 (Statistics SA, 2009) indicated that one third (11.2 million) of the total population of 48.7 million South African received social grants which indicates that a large percentage of the population are exposed to poor socioeconomic condition. A focus on strengthening protective factors and earlier investment in prevention of NCDs among young people is therefore essential (Baldwin & Amato, 2012). According to Bloom et al. (2011), educating young people about what constitutes nutritious food and an active lifestyle and then enabling them to consume a healthy diet, take part in sports activities, and live in a safe and sustainable environment, are the potential means to save billions of rands/dollars in spending on chronic diseases. Booth and Gordon (2000) alluded that we know of no single intervention with greater promise than physical exercise to reduce the risk of virtually all chronic disease simultaneously. As such, a focus on adolescence is important because it is regarded as the time during which NCDs risk behaviours manifest themselves

and solidify; the longer they go unaddressed, the harder they are to change (Khan, Kaneda, Baldwin & Amanto, 2012).

It is against this background that this article aimed to review available literature on physical activity and health of South African. The specific objective of this study was to examine these research questions pertaining the physical activity and health of the South African children: Are South African children active or fit enough?; Why are children not physically active/fit?; Is it necessary for children to be physically active and fit?; Is there a need for health-related physical activity and Physical Education programmes in the school curriculum?.

In addressing the objectives of this study various sources such as Science Direct, Sport Discus, PubMed, EBSCOHost, MEDLINE, Sabinet, Google Scholar, books, journals as well as government documents were consulted. As such relevant information that address the objectives were synthesised and presented.

What is physical activity?

Physical activity as an umbrella term is defined as "any bodily movement produced by skeletal muscles that result in energy expenditure (Caspersen, Powell & Christenson, 1985; Caspersen, Nixon & Durant, 1998; Biddle, Sallis & Cavill, 1998). This broad term means that physical activity includes all forms of activity, such as walking or cycling for everyday journeys, active play, work-related activity, active recreation such as physical exercise in the gymnasium, dancing, gardening or competitive sport. *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 involves repetitive bodily movements done to improve or maintain one or more components of physical fitness" (Caspersen et al., 1985; Caspersen et al., 1998; 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). *Sport* is a sub-set of physical activity that involves structured competitive situations guided by rules, although it is often used in a wider context to include both exercise and leisure-time activities. Some fitness components are related to sports performance while others are considered health-related fitness outcomes (Livingstone, Robson, Wallace & McKinley, 2003). *Health-related physical fitness (HRPF)* 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 (HRPF) components include cardiovascular endurance, muscular endurance or strength, body composition and flexibility, which, to varying extents, reflect genetic inheritance and gender, as well as levels of physical activity (Livingstone et al., 2003; Kemper, 2011).

Physical activity epidemiology is a specific branch of behavioural epidemiology. The term *epidemiology* is derived from the Greek words *epidemia* ("on people") and *-ology* ("to study"). Despite the existence of several definitions of epidemiology a modern-day definition of *epidemiology* is the study of the distributions and determinants of diseases and disability in a population (Mausner & Bahn, 1974; Dishman, Washburn & Heath, 2004).

What is health?

Health does not represent merely the absence of diseases, but can be defined in many ways, in part because health can be related to physical, mental, emotional, social, and spiritual aspects of our lives (Bouchard & Katzmarzyk, 2010). According to Maimonides (1990) *"anyone who lives sedentary life and does not exercise .... even if he eats good foods and take care of himself according to proper medical principles – all his days will be painful ones and his strength shall wane....."*. Many people think of good health as the absence of sickness or disease. This may in part be true, but it does not give the whole picture. According to Nieman (1998), good health might be better defined as the presence of "*sufficient energy and vitality to accomplish daily tasks and active recreational pursuits without undue fatigue*". As such people who are generally healthy and physically active tend to contract infectious disease less often, and they tend to be able to fight off infectious disease better than individuals who are sedentary (Jackson, Morrow, Hill & Dishman, 2004).

The double burden of under- and over- nourishment in South African children

South Africa is faced with the double burden of the co-existence of under- and over-nutrition either in the same household, family or community. Underweight and obesity are among the top ten leading risk factors for the global burden of disease (WHO, 2002). Bradshaw et al. (2006) reported that South Africa has a high prevalence of both infectious diseases related to under-nutrition and of non-communicable diseases (NCDs) related to obesity and over-nutrition. The number of overweight or obese children has doubled since 1990 in Africa. Overweight or obesity is defined as an abnormal or excessive fat accumulation to the extent that it may have adverse effects on the health and well-being of the individual (WHO, 2011). Obesity refers to excess total adipose tissue in the body, usually expressed as fat weight or percentage of body fat (Bouchard & Katzmarzyk, 2010).

Some research findings estimated that globally, about 43 million children under the age of 5 years were overweight, and 35 million of these were living in developing countries (De Onis, Garz, Onyango & Borgi, 2010; Rossouw, Grant & Viljoen, 2012). It is therefore imperative to indicate that no one is exempted

from the upsetting effects of one or more chronic diseases. According to Booth and Gordon (2000), if an individual does not suffer directly from chronic disease, they mostly likely suffer indirectly as a result of the stress of care given to others, the death of family members or friends, and/or increased health costs.

In South Africa overweight or obesity in children and adolescents are on the increase, and the prevalence varies with, age, gender and population group (Mukuddem-Petersen & Kruger, 2004; Rossouw et al., 2012). A study by Mamabolo et al. (2011) involving township adolescents in the North West Province indicated that 8.1% of the children were overweight/obese and the prevalence in girls was higher compared to boys (χ^2 =6.08, p=0.048). Research findings from Mpumalanga reported overweight and obesity prevalence in boys and girls to be reaching 20%-25% in late adolescent girls (Kimani-Murage et al., 2010). The South African Primary Schools Anthropometric Survey and The Health of the National Study, estimated an increase in overweight to be from 1.2% to 13% and obesity from 0.2% to 3.3% over a period from 1994 to 2004 (Rossouw et al., 2012).

Malnutrition on the other hand is found to be another contributing factor to the double burden of disease in South African children and adolescents. In a study by Monyeki (2006), on the Ellisras rural children, stunting was 6%, wasting 3% and underweight 6%. A paradoxical long-term consequence of stunting is the possible existence of a link with fatness or obesity (Sawaya & Roberts, 2003).

Epidemiological studies on physical activity and chronic diseases of lifestyle

Epidemiological studies have established that physical inactivity increases the incidence of unhealthy conditions like sedentary behaviour, smoking, excessive alcohol use, food with high saturated fat, junk food, almost all of which are considered risk factors for chronic diseases (Booth & Gordon, 2000). Sedentary lifestyles as a component of inactivity is the most common cause of morbidity and mortality coronary heart disease, stroke, obesity, hypertension, type II diabetes, allergies and several cancers, and are close to over taking tobacco as the leading cause of preventable death (Mokdad, Marks, Stroup & Gerberding, 2004). Intentional physical activity is linked to protective effect against these non-communicable diseases and has been widely reported in people of all ages (Strong et al., 2005; Jonker et al., 2006; Ruitz et al., 2007; Ortega et al., 2011).

It has been reported that low muscular strength and cardiorespiratory fitness in adults are strong predictors of both cardiovascular and all-cause mortality than any other established risk factors (Myers et al., 2002). In the AVENA study, results showed significant associations between cardiorespiratory fitness and plasma lipid profile (Mesa et al., 2006), inflammatory status (Warnberg, 2006) and abdominal adiposity (Ortega *et al.*, 2011). In a review study by Monyeki and

Kemper (2007), it was reported that physical fitness is the maintenance of basic body functions to get through day-to-day activities around the home and work place. Cardiorespiratory endurance or the body's capacity to use oxygen efficiently is often considered the most important health-related component of physical fitness (Malina, 1996).

The Ellisras Longitudinal Study examining a group of 7-9 years old children reported gender and age differences in motor performance in which girls performed better than boys in flexibility, plate tapping and balance whilst boys outperformed girls in the strength test of standing broad jump (Monyeki et al., 2001). Furthermore, in 2003 findings in the Ellisras sample revealed the prevalence of stunting to be 6% for boys and girls and wasting to be 7% in boys and 5% in girls. Additionally, findings from this study showed lower physical fitness regarding muscle power, flexibility and balance among the undernourished children (Monyeki et al., 2003).

In 2005, a research study investigating body composition and physical fitness of undernourished South African rural primary school children showed that the normal nourished children performed significantly better than undernourished children in sit and reach and plate tapping, while children with a high body mass index (BMI) or sum of skinfolds (SSF) were less able to execute the bent arm hang activity for longer time. They were also slow runners in 1600m (Monyeki et al., 2005). Further, in this study it was reported that high BMI in the undernourished population should be interpreted as a measure of muscle mass rather than the well-known fact of an indication of fatness. This was due to the fact that the undernourished children in the study with relatively high BMI were able to jump further and sprint faster (Monyeki et al., 2005). Monyeki et al. (2007) indicated that physical fitness that requires a high energy flux over a short period of time was affected by malnutrition associated with muscle wasting, whereas having a low weight appeared to be the more crucial factor for a good fitness performance in malnourished sample.

Overweight and obesity during childhood and adolescence can give rise to lack of confidence, negative self-perception and depression (Israel & Ivanova, 2002; Doak, Visscher, Renders & Seidel, 2006). In a study by Monyeki, Pienaar, Mamabolo and Temane (2009), it was reported that overweight and obesity significantly influence scholastic and athletic competency, physical self-concept and social acceptance.

In the baseline data of five years Physical Activity and Health Longitudinal Study (PAHLS), it was reported that 35.9% of the total participants were underweight and 13.7% overweight. Boys were more underweight (44%) than girls (30.7%) (Monyeki, Neetens, Moss & Twisk, 2012). The prevalence of overweight was 8% in boys and 17.3% in girls. The results showed that children

with high physical fitness had lower odds ratio (OR) for being overweight than children with low physical fitness. Furthermore, it was found that overweight girls with low physical fitness performed worse than the boys in physical fitness (Monyeki et al., 2012).

Are South African children active/fit enough?

Physical inactivity is the fourth leading risk factor for global mortality (WHO, 2011). At least 60% of the world's population fail to complete the recommended amount of physical activity required to induce health benefits, with high levels of inactivity found in virtually all developed and developing countries. Findings from the First Youth Risk Behaviour Survey in South Africa (Reddy et al., 2003), reported that PA levels among South African children have declined over the past decades and fewer than half of children and adolescents aged 5 to 17 are sufficiently active to obtain optimal growth and development (Figure 2).

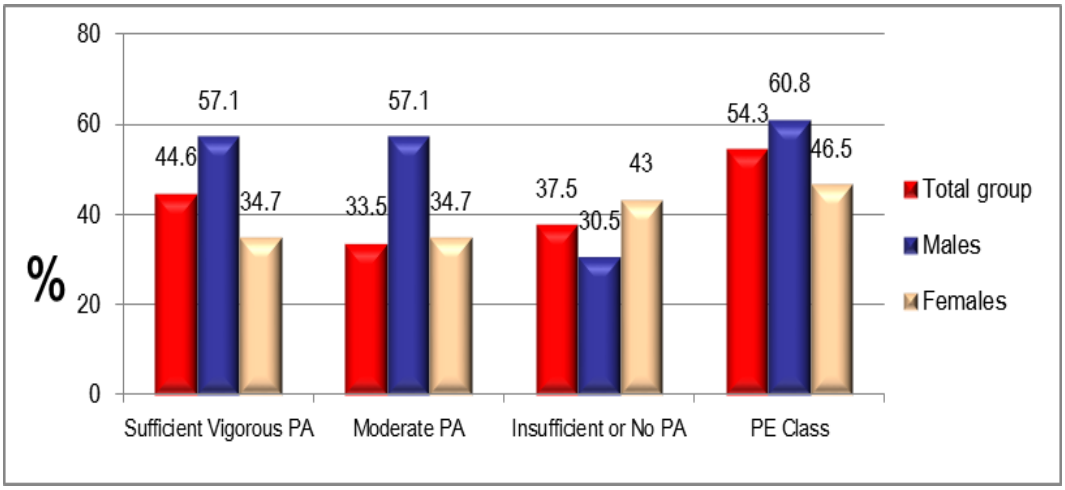

Figure 2: Results on physical activity for the first Youth Risk Behaviour Survey in South Africa (Adapted from Reddy *et al.*, 2003)

Additionally, it was revealed that more males (57.1%) than females (34.7%) participated in sufficient vigorous physical activity. The results also showed that learners who engaged in vigorous activity during an average physical education class (such as soccer, running, rugby, netball, basketball or cricket) was 52.8%. Significantly, more males (60.8%) than females (46.5%) engaged in vigorous activity during an average physical education class.

In rural Ellisras children, Monyeki et al. (2005) reported that physical activity levels are high since in this rural area walking is the primary mode of transportation because of lack of resources to pay for commercial transportation.

The study on the anthropometric and physical fitness of youth soccer players from a township area in Potchefstroom showed that the U-12, U-14 and U-16

players performed poorly in endurance run. Senior players were more advanced in dribbling and juggling with the ball than players at the low classification levels of participation. All players performed very low with regard to estimated VO_2max when compared to the norm (Monyeki, Amusa, Goon & Toriola, 2010). Based on this study it was suggested that it takes at least 10 years for an athlete to achieve excellent performance (Monyeki et al., 2010).

Why are children not physically active / fit?

Children today are believed to be less physically active compared to previous generations due to increased time devoted to sedentary activities in recent decades (Rey-Lopez, Vicente-Rodriguez, Biosca & Moreno, 2008), due to factors such as lack of parental support, lack of time, interest and motivation, environmental and social factors. It is assumed that the decline in physical activity from childhood through adolescence will persist into adulthood (Anderson, Hagströmer & Yngve, 2005; Nelson & Gordon-Larsen, 2006; Telema & Yang, 2000). There is a need for strategic intervention in ensuring that the inactivity is reversed (Kemper, 2011). As such in making the intervention possible, a quotation from Anthony Brandt that *"Other things may change us, but we start and end with family"* is deemed relevant in the context of constraints to participation in physical activity.

Barriers associated with inactivity amongst others are:

Lack of parental support: In a review of 29 studies by Sallis, Prochaska and Taylor (2000), in children, 38% of the findings showed significant positive relationship between parental physical activity and child activity levels. International researchers revealed that overweight or obesity in childhood and adolescence dramatically increased when both parents are overweight or obese (Li *et* al., 2007).

Lack of time, interest and motivation: A study by Tumussiime (2004) on Rwandian students revealed the constraints for not participating in physical activity as, *'I want to do other things with my time and there are other interesting things to do'*. In a more recent study by Shirinde, Monyeki, Pienaar and Toriola (2012), on 15 to 16 year-old children attending farm schools in Alma-Vaalwater area, it was reported that 'lack of time', 'to do work/school work' and 'lack of skills' as the three dominant barriers for participating in regular physical activity.

Environmental and social factors: Environmental factors in one way or the other play a significant role in the prevalence of overweight or obesity as well as physical inactivity. A study by Lennox, Pienaar and Coetzee (2007) on adolescents reported that, *'lack of money and family responsibilities'* were

barriers to participation in physical activity. Shirinde et al. (2012) indicated *'lack of available opportunities'* as a barrier to physical activity participation. A study by Tumussiime (2004) on Rwandian students revealed the barriers for not participating in physical activity as *'I do not have right equipment to exercise'*. Lack of proper Physical Education in school curriculum was found to be a barrier for physical activity participation in schools (Naicker, 2008). An increase in the use of cars for short journeys has also been associated with declining physical activity level (WHO, 2011). In rapidly growing large cities of the developing world, physical inactivity is a particular problem. Evidence suggests that inactivity is linked to population growth, increased poverty, increased levels of crime, high-density traffic, low air quality, and lack of parks, sidewalks and sports / recreation facilities (WHO, 2011). Additionally, lack of awareness about the values of physical activity, national programs of PA, the will or skills of participants are also contributing barriers to participation in physical activity.

Is it necessary for children to be physically active / fit?

Physical Activity on Growth and Development: Physical activity contributes to normal growth and development as well as health and well-being across the lifespan (Borms, 1986; Hills, King & Armstrong, 2007). It should be noted that during the first 5 years of life, changes in health and motor-related fitness are influenced by growth and maturation (Malina, Bouchard & Bar-Or, 2004; Hills et al., 2007). As such, it is difficult to isolate the specific aspects of regular physical activity on health and fitness status from inherent adjustments in growth and development during childhood (Hills, 1995). Meredith and Dwyer (1991) alluded that during childhood and adolescence, nutrition and physical activity influence the growth and development of numerous body tissues, including body fat, skeletal muscle tissue and bone.

It has been reported that during puberty physical activity can maximise peak bone mass (PBM) (Kohrt et al., 2004; Borer, 2005; Vicente-Rodriguez, 2006; Miles, 2007). It has been suggested that desirable patterns of habitual physical activity if established during the early years of life and sustained across the lifespan may provide the greatest likelihood to impact on mortality and longevity (Paffenbarger, Hyde, Wing & Hsieh, 1986; Hills et al., 2007).

Effects of Physical Activity on Body Composition: Physical activity is thought to increase lean body mass by increasing the mass of skeletal muscle. It has been highlighted that structural changes also take place in the muscle whereby they increase in capillary density and also the potential for glycogen storage (Miles, 2007). Physical activity can also modify body composition favourably by reducing fat mass even when an exercise programme produces no loss in body weight, and enhance substantial reductions in abdominal subcutaneous and visceral fat (Mesa *et al.*, 2006; McArdle, Katch & Katch, 2007). A study by

Broeder *et al.* (1997) has shown that 12 weeks of both resistance and endurance training can produce significant decreases in fat mass and percentage body fat. Theoretically, 30 minutes of moderate physical activity per day is equivalent to approximately 1500kcal/week, which translates to a loss of 2.1% or 1.8% body fat for men and women, respectively (Elder & Robberts, 2007 as cited in Miles, 2007).

Effects of Physical activity on the NCDs: Physical activity plays an important role in the prevention of a range of non-communicable diseases (NCDs) across the lifespan. Furthermore, physical activity plays important roles in the promotion of social and psychological well-being, and assists in the development and adoption of healthy behaviour (WHO, 2011). The health benefits associated with a physical active lifestyle in children include weight control, lower blood pressure, improved psychological well-being (Strong et al., 2005; Mciza, Goedecke & Lambert, 2007; Kemper, 2011), and a predisposition to increased physical activity in adulthood hence increased life expectancy and decreased risk of cardiovascular disease (CVD).

Physical Activity on Psycho-social factors: Organised physical activity has repeatedly been shown to be associated with numerous physical, mental, and social benefits (Findlay, Garner & Kohen, 2009). For instance, children who participate in sports have been shown to be at lower risk for obesity (Atlantis, Barnes & Singh, 2006; Tremblay et al., 2011), less likely to engage in risky health behaviours (Pate et al., 1995), have higher self-esteem (Marsh, 1995; Tremblay et al., 2011) and are more accepted by peers (Chase & Dummer, 1992) than those who do not participate in sports.

Is there a need to have physical activity and health-related fitness programme in the school curriculum?

Research has revealed a significant positive relationship between participation in physical activity or health-related physical fitness and academic performance (Blom, Alvarez, Zhang & Kolbo, 2011). Shephard (1997) reported that children who engaged in Physical Education had higher scores in mathematics. In a study by Blom et al. (2011) statistically significant positive correlation between fitness and standardized scores in Language Arts and Maths and significant negative relationship with school absences controlled for gender, race, and socioeconomic status were found. Physical Education contributes to children's confidence and self-esteem; enhances social development by preparing children to cope with competition and collaboration. It is increasingly being used as a tool in development, including recovery from trauma and conflict; and encouragement for school attendance and retention (ICSSPE, 2012).
It was reported that better self-esteem or self-image (Nelson & Gordon-Larsen, 2006; Kirkcaldy, Shephard & Siefen, 2002) and body image (Brown & Evans,

2002) are associated with high levels of physical activity (Trudeau & Shephard, 2008). From a review by Trudeay and Shepherd (2008), it was established that many studies have linked school sport or physical activity programmes with other psychological outcomes, such as school satisfaction and social connectedness, regardless of ethnic group. According to Libbey (2004) both school connectedness and school satisfaction are regarded as important factors in preventing drop-out from school.

Recommendations based on the reviews in this study are:

- Children should be encouraged to take a bold step by regularly engaging in physical activity at least 60 minutes a day, three times a week and see positive changes that can be incurred through physical activity *"magic tablet"* in their life;
- Parents should act as role models with regard to drastically reducing TV viewing time and engaging regularly in physical activity with their children;
- Parents should support their children to participate in sport;
- The government should take a bold step in re-introducing Physical Education in schools and ensure that it enjoys at least two (2) hours of teaching time per week. The Department of Basic Education should realise that Education is not all about Mathematics and Science, but about all-round development of well-balanced children as a means of building a healthy active nation. The Department of Higher Education and Training should also ensure that tertiary institutions produce well trained physical educators. The implementation of these suggestions will help the South African government to meet the Millennium Goal on NCDs as well as the UNESCO's and WHO's focus on developing healthy lifestyle;
- Government should promote and encourage active lifestyle among children by creating conducive environment;
- The Department of Health also has an important role to play. The department should include a clause in the National Health Plan which will serve as an incentive to parents to encourage their children's participation in regular physical activity across life span;
- The Department of Sport and Recreation in South Africa in collaboration with the Department of Basic Education should be commended for the introduction of magnificence Wednesday sport in schools, but the sustainability of this programme should be scrutinised and monitored properly; and
- More advocacy campaigns are required at communities, schools, private sectors and government levels to implement awareness programmes on the needs and benefits of regular participation in physical activity. Efforts should be made at all public and private schools to have a weekly ***KEEP ACTIVE*** programmes.

Conclusions

From these reviews it can be concluded that physical activity plays a major role in promoting an individual health and well-being. Inactivity is often associated with substantial number of non-communicable diseases leading to severe economic burden. Physical activity is an umbrella term encompassing numerous activities, which ultimately result in numerous health benefits. It was also clear from the studies reviewed that South African children are inadequately active. Inactivity was found to be associated with a number of constraints such as lack of parental support, non-conducive environment, too much screen time (TV), and lack of Physical Education in schools. It also became clear that regular participation in physical activity is beneficial to growth and development as it decreases fatness and helps in the prevention and management of NCDs. Furthermore, physical activity and health-related physical fitness are beneficial to cognitive development, academic performance, character building, reduction in disruptive behaviour and social development as well as drop-out from educational programmes.

Acknowledgements

Part of this article is derived from my inaugural address at the North-West University (Potchefstroom Campus) on the 11th April 2013. The inputs of following persons; Emeritus Professor Han C.G. Kemper, Professor Jos Twisk (Vrije Universiteit, Amsterdam, The Netherlands), and Dr Lando Koppes (TNO, The Netherlands); and Emeritus Professor Gert L. Strydom (School of Biokinetics, Recreation and Sport Science, North-West University); Professor Abel L. Toriola (Head of the Department of Sport and Rehabilitation and Dental Sciences, Tshwane University of Technology); and Professors Marlene Viljoen and Awie Kotze (former and current Dean of Faculty of Health Sciences, North-West University), are acknowledged. I also give thanks and recognition to both MRC and NRF for their financial support over the years.

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

References

Anderson, C.B., Hagströmer, M. & Yngve, A. (2005). Validation of the PDPAR as an adolescent diary: effect of accelerometer cut points. *Medicine and Science in Sports and Exercise*, 37(7), 1224-30.

Atlantis, E., Barnes, E.H. & Singh, M.A.F. (2006). Efficacy of exercise for treating overweight in children and adolescents: A systematic review. *International Journal of Obesity*, *30*(7), 1027-1040.

Baldwin, W. & Amato, L. (2012). Fact Sheet: Global Burden of Noncommunicable Diseases http://www.prb.org/Publications/Datasheets/2012/world-population-data-sheet/fact-sheet-ncds.aspx. Retrieved on 20 February 2013.

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.

Blom, L.C, Alvarez, J., Zhang, L. & Kolbo, J. (2011). Associations between health-related physical fitness, academic achievement and selected academic behaviors of elementary and middle school students in the State of Mississppi. *Journal of Research*, 6(1), 28-34.

Bloom, D.E., Cafiero, E.T., Jané-Liopis, E., Abrahams-Gessel, S., Bloom, L.R., Fathima, S., Feigl, A.B., Gaziano, T., Mowafi, M., Padya, A., Prettner, K., Rosenberg, L., Seligman, B., Stein, A.Z. & Weinstein, C. (2011). The Global Economic Burden of Noncommunicable Diseases. Geneva: World Economic Forum.

Booth, F.W. & Gordon, S.E. (2000). Waging war on modern chronic diseases: Primary prevention through exercise biology. *Journal of Applied Physiology*, (88), 774-787.

Borer K. T. (2005). Physical activity in the prevention and amelioration of osteoporosis in women: interaction of mechanical, hormonal and dietary factors. *Sports Medicine*, (35), 779–830.

Borms, J. (1986). Children and exercise: An overview. *Journal of Sports Science*, 4, 3-20.

Bouchard, C. & Katzmarzyk, P. (Eds) (2010). *Physical Activity and Obesity* (2nd ed.). Champaign, IL: Human Kinetics.

Bradshaw, D., Schneider, M., Norman, R. & Bourne, L.T. (2006). 'Mortality patterns of chronic diseases of lifestyle in South Africa. In K. Steyn, J. Fourie & N. Temple (Eds.), *Chronic Diseases of Lifestyle in South Africa* (pp. 58–64). Tygerberg: Medical Research Council.

Broeder, C. E., K. A. Burrhus, Svanevik, LS, Volpe J & Wilmore. (1997). Assessing body composition before and after resistance or endurance training. *Medicine and Science in Sports Exercise*, 29(5), 705-12.

Brown, R. & Evans, W.P. (2002). Extracurricular activity and ethnicity: creating greater school connection among diverse student populations. *Urban Education*, (37), 41-58.

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.

Chase, M.A. & Dummer, G.M. (1992). The role of sports as a social status determinant for children. *Research Quarterly for Exercise and Sport*, (63), 418-421.

De Onis, M., Garz, C., Onyango, A.W. & Borgi, E. (2010). Global prevalence and trends of overweight and obesity among preschool children. *American Journal of Clinical Nutrition*, (92), 1257-1264.

Dishman, R.K., Washburn, R.A. & Heath, G.W. (2004). Physical Activity Epidemiology. Champaign, IL: Human Kinetics.

Doak, C.M., Visscher, T.L.S., Renders, C.M. & Seidel, J.C. (2006). The prevention of overweight and obesity in children and adolescents: A review of interventions and programmes. *Obesity reviews, (*7), 111–136.

Elder, S.J. & Roberts, S.B. (2007). The effects of exercise on food intake and body fatness: A summary of published studies. *Nutrition Reviews*, (65), 1-19.

Engelgau, M.M., El-Saharty, S., Kudesia, P., Rajan, V., Rosenhouse, S. & Okamoto, K., (2011). *Capitalizing on demographic transitions: Tackling Non-communicable Diseases in South Asia*. Washington, DC: World Bank. http://www.worldbank.org/sarncdreport. Accessed on 21 February 2013.

Findlay, L.C., Garner, R.E. & Kohen, D.E. (2009). Children's organized physical activity patterns from childhood into adolescence. *Journal of Physical Activity and Health*, (6), 708-715.

Foster, C. (2000). *Guidelines for Health-Enhancing Physical Promotion Programmes.* Tampere, Finland: The UKK Institute for Health Promotion Research.

Gregory, J. & Lowe, S. (2000). *National Diet and Nutrition Survey: Young People Aged 4–18 Years, Vol. 1. Report of the Diet and Nutrition Survey*. London: The Stationery Office.

Hills, A.P. (1995). Physical activity and movement in children: its consequences for growth and development. *Asia Pacific Journal of Clinical Nutrition;* (4), 43-45.

Hills, A.P., King, N.A. & Armstrong, T.P. (2007). The contribution of physical activity and sedentary behaviours to the growth and development of children and adolescents: implications for overweight and obesity. *Sports Medicine*, (37), 533-545.

ICSSPE (2012). Position Statement developed by the International Council of Sport Science and Physical Education http://www.icsspe.org/sites /default/files/ICSSPE_ Position_Paper_on_ Betting_2010.pdf, [downloaded, 20 February 2013].

Israel, A.C. & Ivanova, M.Y. (2002). Global and dimensional self-esteem in preadolescent and early adolescent children who are overweight: Age and gender differences. *International Journal of Eating Disorder*, 31(4), 424–429.

Jackson, A.W., Morrow, J.R., Jr., Hill, D.W. & Dishman, R.K. (2004). *Physical Activity for Health and Fitness* (Updated Edition). Champaign, IL: Human Kinetics.

Jonker, J.T., De Laet, C., Franco, O.H., Peeters, A., Mackenbach, J. & Nusselder, W.J., (2006). Physical activity and life expectancy with and without diabetes. *Diabetes Care*, 29(1), 38–43.

Kemper, H.C.G. (2011). *Fitte Kinderen, Sportieve tieners*. Amsterdam: Elsevier Gezondheidszorg.

Kemper, H.C.G. (2011). *Fitte kinderen, sportieve tieners. Over de invloed van bewegen en sport op de gezondheid van jongeren*. Amsterdam: Elsevier Gezondheidszorg.

Khan, L., Kaneda, T., Baldwin, W. & Amanto, L. (2012). Data Issues in the Study of Non-Communicable Disease Risk Factors Among Youth in Low and Middle Income Countries. Poster Presentation at the Population Association of America Conference. New Orleans, Louisiana, USA. April 2013.

Kimani-Murage, E.W., Kahn, K., Pettifor, J.M., Tollman, Stephen M.D., Dunger, B., Gómez-Olivé, X.F. & Norris, S.A. *(*2010). The prevalence of stunting, overweight and obesity, and metabolic disease risk in rural South African children. *BMC Public Health*, (10), 158.

Kirkcaldy, B.D., Shephard, R.J. & Siefen, R.G. (2002). The relationship between physical activity and self-image and problem behaviour among adolescents. *Sociology and Psychiatry Epidemiology*, 37, 544-550.

Kohrt, W. M., Bloomfield, S. A., Little, K. D., Nelson, M. E. & Yingling, V. R. (2004). American College of Sports Medicine Position Stand: Physical activity and bone health. *Medicine and Science in Sports and Exercise*, 36(11), 1985-1996.

Lennox, A., Pienaar, A.E. & Coetzee, M. (2007). Barriers, motivators, sport participation and perceptions about physical activity among adolescents living in semi-urban surroundings. *African Journal for Physical, Health, Education, Recreation and Dance, September (Supplement), 289-303*.

Li, Y., Zhai, F., Yang, X., Schouten, E.G., Hu, X., He, Y., Luan, D. & Ma, G. (2007). Determinants of childhood overweight and obesity in China. *British Journal of Nutrition*, 97(1), 210–215.

Libbey, H.P. (2004). Measuring student relationships to school: Attachment, bonding, connectedness, and engagement. *Journal of School Health*, 74, 274-283.

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.

Maimonides, M. (1990). *Three Treaties on Health. Translated by F. Rosner with bibliographies by J.I. Dienstege*. Haifa, Israel: Maimonides Research Institute.

Malina, R.M. (1996). Tracking of physical activity across the lifespan. *Research Quarterly for Exercise and Sport*, 67(3), S48-57.

Malina, R.M., Bouchard, C. & Bar-Or, O. (2004). *Growth, Maturation, and Physical Activity* (2nd ed.). Human Kinetics.

Mamabolo, R.L., van Rooyen, J.M., Schutte, A.E., Monyeki, M.A. & Kruger, H.S. (2011). Association between blood pressure, measures of body composition and lifestyle factors in township adolescents, residing in the North West Province. *South Africa. African Journal for Physical, Health Education, Recreation and Dance*, 17(1), 37-50.

Marsh, P. (1995). Health visitors' knowledge, attitudes and practices in childhood accident prevention. *Journal of Public Health*, 17 (2), 193-199.

Mausner, J. & Bahn, A.K. (1974). *Epidemiology: An Introductory Text*. Philadelphia: Saunders.

McArdle, W.D., Katch, F.I. & Katch, V.L. (2007). *Exercise Physiology: Energy, Nutrition and Human Performance*. Baltimore, MD: Lippincott Williams & Wilkins.

Mciza, Z.J., Goedecke, J.H. & Lambert, E.V. (2007). Validity and reliability of a physical activity/inactivity questionnaire in South African primary schoolgirls. *South African Journal of Sports Medicine*, 19(5), 117-123.

McQuaide, K. (2008). South African children at risk for future diseases: The way forward. *Diabetes Voice*, 53(2), 41-43.

Mesa, J.L., Ruiz, J.R., Ortega, F.B., Warnberg, J., Gonzalez-Lamuno, D., Moreno, L.A., Gutierrez, A. & Castillo, M.J. (2006). Aerobic physical fitness in relation to blood lipids and fasting glycaemia in adolescents: Influence of weight status. *Nutrition and Metabolic Cardiovascular Disease*, 16, 285–293.

Meredith, C.N. & Dwyer, J.T. (1991). Nutrition and exercise: effects on adolescent health. *Annual Review in Public Health*, 12, 309-333.

Miles, L. (2007). Physical activity and health. *British Nutrition Foundation Bulletin*, 32,314-363.

Mokdad, E.J., Marks, J.S., Stroup, D.F. & Gerberding, J.L. (2004). Actual causes of death in the United States, 2000. *Journal of American Medical Association*, 291, 1238-1245.

Monyeki, M.A., Toriola, A.L., Brits, J.S., Monyeki, K.D., Pienaar, A.E. & Kemper, H.C.G. (2001). Age and sex differences in motor performance of school children in Elisras rural area of South Africa. *Journal of Human Movement Studies*, 40, 437-452.

Monyeki, M.A., Kemper, H.C.G., Twisk, J.W.R., Monyeki K.D., Toriola A.L. & Steyn, N.P. (2003). Anthropometric indicators of nutritional status and physical fitness of Ellisras rural primary school children, South Africa. *Medicina Sportivia*, 7(EE3), E94-E104.

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. (2006). *Health and Physical Fitness Status of Rural Primary School Children living in Ellisras, South Africa: The Ellisras Longitudinal Study*. Gezondheid in Beweging (GIB), no.15 (116). The Netherlands: Wagningen: Ponsen & Looijen.

Monyeki, M.A., Koppes, L.L.J., Monyeki, K.D., Kemper, H.C.G. & Twisk, J.W.R. (2007). Longitudinal relationships between nutritional status, body composition, and physical fitness in rural children of South Africa: The Ellisras Longitudinal Study. *American Journal of Human Biology*, 19, 551-558.

Monyeki, M.A. & Kemper, H.C.G. (2007). Is There a Positive Relationship between Physical Fitness and Physical Activity in Children? – A Brief Review, *Journal of Exercise and Physiotherapy*, 3(1), 12-16.

Monyeki, M.A., Pienaar, A.E., Mamabolo, R.L & Temane, M. (2009). Effect of obesity on physical self-concept of urban school children living in Potchefstroom, South Africa. *African Journal for Physical, Health Education, Recreation and Dance (AJPHERD)*, 15(1), 1–14.

Monyeki, M.A., Amusa, L.O., Goon, D.T. & Toriola, A.L. (2010). Physical fitness and anthropometric characteristics of South African youth soccer players in Potchefstrom, South Africa. *Medicina Dello Sport* (September), 63(3), 409-417.

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

Mukuddem-Petersen, J. & Kruger, H.S. (2004). Association between stunting and overweight among 10–15-y-old children in the North West Province of South Africa: The THUSA BANA Study. *International Journal of Obesity*, 28, 842–851.

Myers, J., Prakash, M., Froelicher, D., Do, D., Partington, S. & Atwood, J.E. (2002). Exercise capacity and mortality among men and referred for exercise testing. *New England Journal of Medicine*, 346, 793-883.

Nelson, M.C. & Gordon-Larsen, P. (2006). Physical activity and sedentary behavior patterns are associated with selected adolescent health risk behaviors. *Pediatrics*, 117, 1281-1290.

Nieman, D.C. (1998). *Exercise-health Connection*. Champaign, IL: Human Kinetics.

Nikolic, I.A., Stanciole, A.E. & Zaydman, M. (2011). *Chronic Emergency: Why NCDs Matter*. World Bank Health, Nutrition and Population Discussion Paper.

Norman, R., Bradshaw, D., Schneider, M., Schneider, M., Joubert, J., Groenewald, P., Lewin, S., Steyn, K., Vos, T., Laubscher, R., Nannan, N., Nojilana, B.& Pieterse, D. (2007). A comparative risk assessment for South Africa in 2000: towards promoting health and preventing disease. *South African Medical Journal*, 2(97), 637–641.

Oja, P. & Borms, J. (2004). *Health Enhancing Physical Activity*. Oxford, UK: Meyer & Meyer Sport.

Ortega, F.B., Artero, E.G., Ruitz, J.R., Espana-Romero, V., Jimenez-parvon, D., Vicente-Rodriguez, G., Manios, Y., Beghin, L., Ottevaere, C., Ciarapica, D., Sarri, K., Dietrich, S., Blair, S.N., Kersting, M., Molnar, D., Gonzalez-Gross, M., Gutierrez, A., Sjostrom, M. & Castillo, M.J., on behalf of the HELENA study group (20110). Physical fitness levels among European adolescents: the HELENA study. *British Journal of Sports Medicine*, 45, 20-29.

Paffenbarger, R.S., Hyde, R.T., Wing. A.L. & Hsieh, C-C. (1986). Physical activity, all-cause mortality, and longevity of college alumni. *New England Journal of Medicine*, 314, 605–13.

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. S., Marcus, B. H., Morrie, J., Paffenbarger, R. S., Patrick, K., Pollock, M. L., Rippe, J. M., Sallis, J. & Wilmore, 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(5), 402-407.

Patton, G.C., Coffey, C., Cappa, C., Currie, D., Riley, L., Gore, F., Degenhardt, L., Richardson, D., Astone, N., Sangowawa, A.O., Mokdad, A. & Ferguson, J. (2012). Health of the World's Adolescents: A Synthesis of International Comparable Data, *The Lancet*, 379(9286), 1665-1675.

Reddy, S.P., Panday, S., Swart, D., Jinabhai, C.C., Amosun, S.L. & James, S. (2003). Umthente Uhlaba Usamila - The South African Youth Risk Behaviour Survey, 2002. Cape Town: South African Medical Research Council. Available from: URL:http://www.mrc.ac.za/ healthpromotion/reports.htm [Accessed 21/02/2013].

Rey-Lopez, J., Vicente-Rodriguez, G., Biosca, M. & Moreno, L. (2008). Sedentary behavior and obesity development in children and adolescents. *Nutrition, Metabolism and Cardiovascular Diseases*, 18(3), 242-251.

Rossouw, H.A., Grant, C.C. & Viljoen, M. (2012). Overweight and obesity in children and adolescents: The South African problem. *South African Journal of Science*,108(5/6).

Ruitz, J.R., Ortega, F.B., Gutierrez, A, Meusel, D., Sjöström, M. & Castillo, M.J. (2007). Health-related fitness assessment in children and adolescence: a European approach based on the AVENA, EYHS and HELLENA studies. *Journal of Public Health*, 14, 269-277.

Sallis, J., Prochaska, J. & Taylor, W. (2000). A review of correlates of physical activity of children and adolescents. *Medicine and Science in Sports and Exercise*, 32, 963-975.

Sawaya, A.L. & Roberts, S.B. (2003). Stunting and future risk of obesity: Principal physiological mechanisms. *Cadernos de Saude Publica*, 19 (Suppl. 1), S21-S28.

Shephard. R.J. (1997). Curricular physical activity and academic performance. *Pediatric Exercise Science*, 9, 11-26.

Shirinde, K.S., Monyeki M.A., Pienaar A.E. & Toriola A.L. (2012). Perceived barriers and benefits of participating in physical activity and the levels of physical activity of children attending farm schools. *African Journal for Physical, Health Education, Recreation and Dance*, 18(2), 228-240.

Statistics South Africa (2005). Mortality and causes of death in South Africa, 1997 – 2003. Statistical release PO309.3.http://www.statssa.gov.za/publications/P03093/P03093.pdf. (Accessed 21 February 2013).

Statistics South Africa. (2009). Gross Domestic Product Annual Estimates 1993–2008: Third Quarter 2009. Statistical release PO441. http://www.statssa .gov.za/publications/ P0441/P04413rdQuarter2009.pdf, Retrieved 15 February 2013.

Steyn, C. (2007). All South Africans at risk of dying young, says new report [www.heartfoundation.co.za/doc/releases/SAREPORT]. Retrieved 15 February 2013.

The NCD Alliance (2011). A Focus on Children and Non-Communicable Disease (NCDs). Rembering our future at the UN Summit on NCDs, September 2011, UN Headquarters, New York.

Strong, W.B., Malina, R.M., Blimkie, C.J., 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 Paediatrics*, 146, 732-737.

Telama, R. & Yang, X.L. (2000). Decline of physical activity from youth young adulthood in Finland. *Medicine & Science in Sports & Exercise*, 32 (9), 1617-1622.

Tremblay, M.S., LeBlanc, A.G., Kho, M.E., Saunders, T.J., Larouche, R., Colley, R.C., Goldfield, G. & Gorber, S.C. (2011). Systematic review of sedentary behaviour and health indicators in school-aged children and youth. *International Journal of Behavioral Nutrition and Physical Activity*, 8, 98.

Trudeau, F. & Shephard, R.J. (2008). Physical education, school physical activity, school sports and academic performance. *International Journal of Behavioural Nutrition and Physical Activity*, 5, 10.

Tumusiime, D.K. (2004). Perceived benefits of, barriers and helpful cues to physical activity among tertiary institution students in Rwanda. *Unpublished MSc degree*. CapeTown: University of the Western Cape.

Vicente-Rodríguez, G. (2006). How does exercise affect bone development during growth? *Sports Medicine*, 36(7), 561-569.

Warburton, D.E.R., Whitney, N.C. & Bredin, S.S.D. (2006). Prescribing exercise as preventative therapy. *Canadian Medical Association Journal*, 174(7), 961-974.

Wärnberg, J. (2006). Inflammatory status in adolescents; the impact of health determinants such as overweight and fitness. Unpublished PhD Thesis, Stockholm: Karolinska University.

World Bank (2011). *Growing Danger of Noncommunicable Disease*. Washington, DC: World Bank.

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

World Health Organization (WHO) (2011). Global strategy on diet, physical activity and health. What is overweight and obesity? [homepage on the Internet]. No date [cited 2011 Dec 11]. Available from: http://www.who.int/ dietphysicalactivity/childhood_what/en/index.html.