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The effect of a ten month physical activity intervention programme on body composition of 9–13 year-old boys

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Abstract

Excessive body fat is one of the main contributing factors in many health related health debilitating diseases, such as diabetes, obesity, hypertension and coronary arterioscleroses. The objective of this study was to determine whether a ten month physical activity intervention (PAI) programme could alter the body composition of 9–13 year old boys. A total of 322 (173=experimental group (EG) and 149=control group (CG)) from two primary schools in Gauteng province of South Africa were studied. Body composition measures were assessed by body mass index and percentage body fat using the protocol of International Society for Kinanthropometry (ISAK, 2001). Body mass index (BMI) which was calculated as body mass/stature² (kg/m^2) was used to predict obesity. Percentage body fat was determined according to the formula developed by Slaughter, Lohman, Boileau, Horswill *et al*. (1988). Descriptive statistics, pre-test and post-test comparisons were done by dependent *t*-test using Statistica software. Statistical significance was set at $p<0.05$ and practical significant levels were set at *ES* $\geq$0.8. Slight decrease in percentage body fat was found among boys in the EG as compared to those the CG after the ten month of PAI. The CG showed a practical significant increase of 4.21 (pre-test =16.28; post-test =20.49) (*ES* $\geq$ 0.2) in percentage body fat. It was evident from these findings that the participation in the PAI had beneficial health outcomes. Therefore, strategies for the inclusion of physical activity programmes in schools and after-school community physical activity programmes are recommended.

Keywords: Body composition, BMI, fat percentage, school boys, physical activity intervention.

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Introduction

Childhood obesity is becoming a public health concern worldwide (WHO, 2000; Burke, Beilin, Simmer, Oddy, Blake, Doherty, Kendall, Newnham, Landau & Stanley, 2005). Obesity therefore, is found to be associated with excessive body fat (Malina, Bouchard & Bar-Or, 2004) which is one of the main contributing factor to many related health threatening hypo-kinetic diseases, such as diabetes

mellitus, obesity, hypertension, respiratory diseases, psychological disorders, coronary arterioscleroses and mortality (Ford, Mokdad & Ajani, 2004; Janssen, Katzmarzyk, Boyce, King & Pickett, 2004; Burke *et al*., 2005; Fritz, Stovell, Sydney & Merrill, 2005; Gance-Cleveland, Harris & Ward-Begnoche, 2005; Voûte & Valentin, 2005). A study by Sallis, Condon, Goggin, Roby, Kolody and Alcaraz (1993) revealed that a decrease of physical activity amounted to 50% and 75% of an increase in overweight in children between the ages 6 to 18 years. The decrease in physical activity is found to be associated with obesity epidemic (Fox, 2004). It is been suggested that regular physical activity has a positive influence on body composition as well as a positive effect on controlling weight loss (Steinbeck, 2001; Malina *et al.,* 2004). Furthermore, the literature revealed that regular physical activity has significant health benefits, such as (a) reducing chronic disease risks factors including coronary heart diseases, obesity, hyperlipedemia, hypertension and type II diabetes (Treiber, Strong, Rensman & Gruber, 1989; Meyers, Strikmiller, Webber & Berenson, 1996; Summerfield, 1998) (b) increasing bone density and bone mass, especially in children as they are still growing and developing new bone cells each day (Meyers *et al.*, 1996; Summerfield, 1998; Van Mil, Goris & Westerterp, 1999) (c) resulting in a significant improvement in cardiovascular endurance, muscular strength, muscular endurance and flexibility (Colchino, Zybet & Basch, 2000) (d) reducing anxiety levels and improving self image and moods of children (Summerfield, 1998) (e) as well as cognitive and mental ability and consequently academic performance and concentration levels (Summerfield, 1998).

Physical activity is regarded as an important factor which influences the use of energy (WHO, 2000). A decrease in physical activity results in a lowering of energy output and an increase in body mass, hence body fat (Trudeau & Shephard, 2005; Deheeger *et al.*, 1996). In contrast, regular physical activity improves the muscle-fat-ratio which results in a healthy physical appearance (Leupker, 1999). Therefore, physical activity is important for all children and not only obese children, while adolescence is the critical period for participation in physical activity (Van Mil, Gorris & Westerterp 1999).

Martinez (2000) revealed significant negative correlation between body mass index (BMI) and physical activity. Parsons, Power and Manor (2005) also reported that the correlation between BMI and physical activity changes with age. Physical activity therefore protects the body against obesity (Parsons *et al.*, 2005). Schools present opportunities for reducing the risks of diabetes, since no other institution has as much contact time with children (Baranowski, Cullen, Nicklas, Thompson & Baranowski, 2002). Moreover, schools can implement environmental changes that affect available foods, physical education, class curricula, and the acceptability of healthy behaviors (Healthy Active Kids South Africa, 2007; The Healthy Study Group, 2010). Although some school-based interventions have had effects on overweight or obesity (Foster, Sherman,

Borradaile, Grundy, Vander, Veur & Nachmani, 2008; James, Thomas, Cavan & Kerr, 2004; Baranowski *et al.*, 2002; Gortmaker, Peterson, Wiecha, Sobol, Dixit, Fox, 1999), most particularly those involving large cohort (Caballero, Clay, Davis, et al., 2003; Luepker, Perry, McKinlay, et al., 1996) have not (Katz, 2008). South Africa like many other countries lack formal teaching of Physical Education in schools and the implementation of its Life Orientation programme has many problems, as such kids have limited opportunities to be physically activity. A study by Sallis, Chen and Castro (1995) reported slight effects of school-based health promotion programmes on adiposity or body weight. Additionally, in the study by Sallis, Chen and Castro (1995) significant group differences for boys at intermediate measurements yielded an intervention effect, but it is not clear as to whether the same trends will be applicable to boys attending primary schools in Gauteng province of South Africa. The objective of this study therefore, was to determine whether a ten-month physical activity intervention (PAI) will substantially alter body composition of 9–13 year old South African school boys.

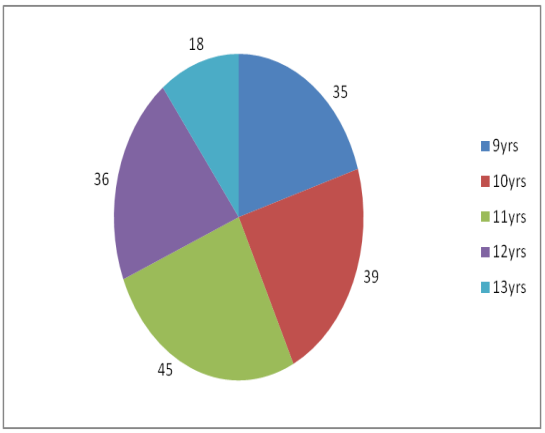
Materials and Methods

Subjects

Two groups consisting of 173 (experimental group; School 1) and 149 (control group; School 2) boys respectively, between the ages of 9 and 13 years drawn from the southern parts of the Gauteng province of South Africa participated in this study. The two schools were situated approximately 7km apart and have comparable socio-economic backgrounds. The group from school 1 participated in the exercise intervention which consisted of a 30-minute session of physical activity twice a week during school hours (Figure 1). The group from school 2, i.e. the control group, did not take part in the PAI (Figure 2). The aim of the study was explained to the children and their parents during a briefing session as well as with the aid written requests. Only the children whose parents completed and signed the informed consent form were allowed to participate in the study. The Ethics Committee of the North-West University approved the study.

Anthropometry

Measurements of anthropometrical data were done by qualified anthropometrists with guidance from a Level IV anthropometrist (*JHdeR*). Anthropometric data were collected according to the standard protocol of International Society for the Advancement of Kinanthropometry (Norton & Olds, 1996). The various measurements taken included body mass, stature, triceps, subscapular and calf skinfolds. The apparata used for the measurements were a stadiometer for stature (to the nearest 0.1cm); with subjects in the Frankfort position. Body mass was measured with an electronic scale (Precision Health Scale®) to the closest 0.1kg.



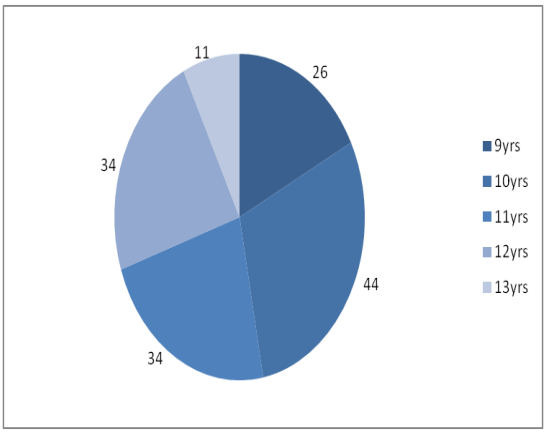


Figure 1: Distribution of experimental group by age

Figure 2: Distribution of control group by age

Skinfold measurements were done with a Harpenden® skinfold caliper with constant pressure of 10g/mm² to the closest 0.2mm. Body mass index (BMI) which was calculated as body mass/stature² (kg/m^2) was used to predict obesity based on the cut-off points suggested by Cole, Bellizzi, Flegal and Dietz (2000). Percentage body fat was determined according to the formula used by Slaughter *et al.* (1988).

Physical activity intervention programme (PAI)

The experimental group participated in a structured 10 month PAI. Each tested subject attended two 30-minute exercise sessions per week, defined as activity to raise the heart rate to 130 beat or more per minute (ACSM, 2000). Each lesson was compiled by using the important components that were to be tested during this study. Each lesson therefore consisted of warm-up with stretching exercises, speed, strength, balance and a cool down exercises. The intervention was conducted and supervised by a trained Biokineticist, who was employed at school one (1) as a Physical Education teacher.

Statistical analysis

Descriptive statistics (means and standard deviations) were calculated for all body composition measurements. The pre-test, post-test comparisons were determined by an independent *t*-test. Effect size (ES) was used to calculate the practical significance (Steyn, 2005; Thomas, Nelson & Silverman, 2011). Cohen set the following guidelines for the interpretation of the practical significance, namely: 0.2 or less show a small ES, about 0.5 reflects a moderate ES and 0.8 or more indicates a large ES. All the statistical analyses were done with the aid of Statistica software (Statsoft, Inc. 2004).

Results and Discussion

No significant change was observed in BMI for the experimental group over a 10 month intervention though a tendency toward decreases was observed (Figure 3). The observed tendency in the present findings are supported by what is reported in several other studies that regular participation in physical activity is associated with decreased BMI (Sallis *et al.,* 1995; Martinez, 2000; Parsons *et al.,* 2005). A study by Abbott and Davies (2004) revealed that time spent in vigorous and hard activity correlated significantly with percentage body fat in 5–10.5-year-olds. With regard to control group BMI was almost stable across the age, except a slight non-significant increase at age 12.

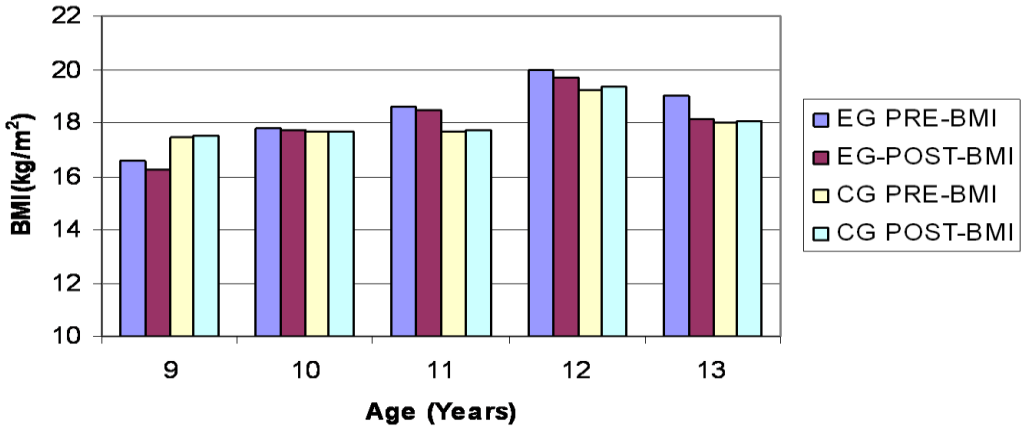


Figure 3: Distribution of BMI for experimental and control groups by age

In the experimental group no significant changes in percentage body fat were observed after ten-month of PAI programme, though some trend toward a decrease of 0.32 (pre-test =20.68; post-test 20.36) at age 12 and a decrease of 1.03 (pre-test =18.39; post-test=17.36) at age 13 were observed (Figure 4). These findings are consistent with the findings by Malina *et al.* (2004) and Abott and Davies (2004) that regular physical activity is associated with a decrease in body fatness. Physical activity plays an important role in the total fat oxidation (utilization) and fat balance especially during adolescence since the "fat stores" in the body are in the final stage of development (Rowland, 1990; Burniat, Cole, Lissau & Poskitt, 2002). In addition, Malina *et al*. (2004) stated that engagement in regular physical activity is associated with a decrease in body fat and enhancement of the positive energy balance.

In the control group percentage body fat shows an increasing trend across the ages with a small practical significant (ES $\geq$ 0.2) and an increase of 4.21 (pre-test = 16.28; post-test = 20.49) at age 9. Though no significant increases were found in the other age groups the following trends were observed: an increase of 2.68

(post-test = 17.16; pre-test =19.84) at age 10; 2.84 (post-test =16.91; pre-test =19.75) at age 11; 1.62 (post-test =18.77; pre-test = 20.39) at age 12 and 2.31 (post-test =14.48; pre-test =16.79) at age 13. Since this category did not participate in any physical activity such trends towards elevated percentage body fatness are not surprising (Steinbeck, 2001; Fox, 2004). However, the tendency toward elevated body fatness in the control group raises a serious concern since research has shown that overweight/fatness during childhood tend to persist into adulthood (Burniat *et al.*, 2002). As such tackling overweight/fatness at childhood will assist in combating associated health threatening hypokinetic diseases such as diabetes mellitus, hypertension (Gance-Cleveland *et al.*, 2005; Voûte & Valentin, 2005).

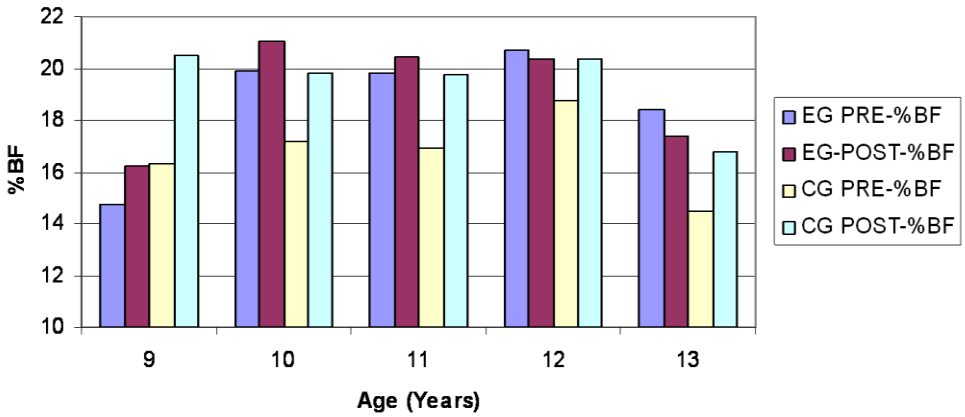


Figure 4: Distribution of % body fat in experimental and control groups by age

The findings of the present study should be interpreted in the light of a number of limitations: Firstly, the relatively small sample size from two selected schools around Gauteng province, South Africa might limit the generalizations of the results to other populations of South African boys with similar socio-economic contexts. Secondly, since the boys were not accustomed to regular physical activity they were probably poorly motivated to put in their best effort during the exercise sessions. Thirdly, the children could only participate in two PAI sessions of 30 minutes duration per week. PAI of longer duration and greater frequency would probably have yielded more significant results. However, this was not feasibly in view of the children's commitments to school work. Further intervention studies involving large number of subjects and longer PAI duration which cover a wide spectrum of the South African population are necessary. Besides the stated limitations the present study provides valuable baseline information regarding the importance of PAI in modifying body composition levels in primary school children.

Conclusions and Recommendations

From the present findings it can be concluded that a ten-month physical activity intervention programme though not significant did play an important role in decreasing BMI and % body fat measures in physically active children. The control group on the contrary showed practically significant increase in % body fat. The increase in percentage body fat in the control group is a public health concern because the children may later be faced with health risk factors later in life. Given the outcomes of the present study, it is therefore, recommended that policy makers in the Department of Education should harness the information and use it as a basis for re-introducing compulsory Physical Education in South African primary school curriculum.

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