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PHYSICAL ACTIVITY, INCLUDING ACTIVE COMMUTING, AND HEALTH STATUS OF RURAL SCHOOL CHILDREN IN SOUTH AFRICA

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ABSTRACT

Physical activity is considered a key preventative measure for various diseases, such as diabetes and cardio-vascular disorders. The majority of South Africans studied in various regional cross sectional surveys, suggest that most young people fail to meet recommended minimum physical activity standards. The main objective of this study was to ascertain the physical activity patterns and health status of rural schoolchildren. A comparative and correlational cross-sectional study design was used to assess the physical activity levels and health status of 162 rural schoolchildren. The participation levels in light and moderate to vigorous physical activity were 44.6% and 55.4% respectively. Walking to and from school was the most prevalent physical activity reported. Thirty-eight percent (38%) of the children were hypertensive. More than 50% of the children participated in health-enhancing physical activity. The low physical inactivity prevalence was most likely a result of their habitual activity patterns, which included active commuting to and from school.

Keywords: Physical activity; Active commuting; Walking; Rural schoolchildren; Health status.

INTRODUCTION

Overweight, obesity and high blood pressure are major contributing factors to various chronic diseases, such as Type 2 diabetes and cardiovascular disorders (CVD) (Celermajer & Ayer, 2006; Prospective Studies Collaboration, 2009; Köchli *et al*., 2019). The number of overweight and obese young people are rapidly rising in low and middle income countries and the incidence rates in South Africa (SA) is currently comparable to those of developed countries more than a decade ago (Armstrong *et al*., 2006). According to the WHO/Strategic Advisory Group Experts, almost half of SA adult population live with hypertension (Peltzer & Phaswana-Mafuya, 2013) while approximately 25% percent of children aged five years are hypertensive (Monyeki & Kemper, 2008).

Physical inactivity is considered a major role player in the global obesity and high blood pressure problems (Koolhaas *et al*., 2017; Köchli *et al.*, 2019). Interventions to reduce levels of overweight and obesity and blood pressure consequently focus on increasing energy expenditure as a means of restoring energy balance (Slingerland *et al*., 2012). The US Department for Health and Human services recommends that children aged 6 to 17 years should participate in 60 minutes of moderate-to-vigorous physical activity (MVPA) on a daily basis, which can be accrued in a variety of settings throughout the day (US Department for Health and Human Services, 2008). The majority of South Africans studied in various regional cross-

sectional surveys, fail to meet recommended minimum physical activity (PA) standards (Uys *et al*., 2016).

In developing countries, especially those in Africa, activity patterns for adolescents in rural areas are different from those in urban areas. According to the South African National Household Travel Survey (Statistics South Africa, 2014), most learners, who attended pre-school, primary and high schools, Adult Basic Education and Training (ABET) and literacy classes walk to reach educational institutions. This is also true for the Overberg region of the Western Cape in South Africa (WCSA) where a substantial number of children walk between 2–6km to and from school daily. Walking to school or using any other form of active school transport, such as cycling, constitutes an important component of the everyday activities in which children participate (Slingerland *et al*., 2012). Although active school transport has been recommended as a source of continuous moderate activity, it has been largely ignored in surveys of physical activity (PA). Previous research mainly focussed on active transport in developed nations (Mandic *et al.*, 2016), such as Canada (Larsen *et al*., 2009) and Australia (Timperio *et al*., 2006), while little information is available on rural school children in South Africa.

PURPOSE OF RESEARCH

The purpose of this cross-sectional study was to ascertain the physical activity patterns (including walking to and from school), selected anthropometric characteristics and blood pressure of rural schoolchildren in the Western Cape, South Africa (WCSA).

METHODOLOGY

Ethical clearance

The Senate Higher Degrees Committee of the University of the Western Cape approved the methods and ethics of the research. The registration number of the project is 05/0/14.

Participants

The population from which the sample was drawn consisted of all the 14-16-year-old boys and girls from a rural high and primary school in the Overberg region of the WCSA. These schools were selected as they were attended by a substantial number of children who walked long distances to and from school. The names of all the qualifying children were obtained from school registers. Boys and girls were listed separately and 100 boys and 100 girls were randomly selected for participation in the study. The final sample comprised of 162 children (boys=72; girls=90).

Physical activity

The Exercise, Recreation and Sport Survey (ERASS) (Merom & Bauman, 2004) were adapted, piloted and used as a self-administered questionnaire to obtain an estimate of the prevalence of habitual and sufficient participation in health-enhancing physical activities (HEPA). The adaptation involved the inclusion of HEPA relevant to Southern Africans, particularly those common among rural children, such as carrying heavy bags, chopping and carrying firewood. Screening questions focused on all physical activities done over a 12-month period.

Participants further had to report on the type of activities they partook in, as well as the regularity of their engagement with the activities over the past 12 months.

A second set of questions, which specifically focussed on active commuting to and from school and sedentary behaviour, such as watching TV and playing computer games, were included. The estimates that HEPA is based on, are the frequency and intensity of the activity. Using the energy expenditure compendium of Ainsworth *et al*. (1993), each of the activity types is assigned to either recreation or light physical activities (RLPA), which are activities that require less than 3.5 METs, or to moderate-vigorous physical activities (MVPA), which are activities that require at least 3.5 METs or more. ERASS provides useful health-related information about PA as long as it is consistent in its measurement over time (Merom & Bauman, 2004).

Anthropometry

All subjects underwent a series of anthropometric measurements, including body weight, standing height, and subscapular and triceps skinfold thickness in accordance with the standard procedures of the International Society for the Advancement of Kinanthropometry (ISAK). Body Mass Index (BMI) was calculated for each subject, and the age-dependent BMI cut-off points recommended for overweight and obesity were used to determine whether a child was overweight or overweight and obese (Cole *et al*., 2000).

Blood pressure (BP)

BP was measured using an automatic blood pressure monitor (Microlife BP 3BT0-A) with an appropriate cuff, covering two-thirds of the upper arm. The procedure was performed while the participant was in a sitting position with the arm at the level of the heart and after a 5-minute rest.

Participants were considered to be pre-hypertensive when their systolic blood pressure (SBP) or diastolic blood pressure (DBP) levels for their respective age-sex-height group were $\geq 90^{th}$ and below the 95^{th} percentile and hypertensive if their SBP or DBP levels for their age-sex-height group were $\geq 95^{th}$ percentile as recommended by the National High Blood Pressure Education Program Working Group on hypertension control in children and adolescents (Falkner & Daniels, 2004).

Data analysis

Descriptive statistics (mean and standard deviation) were used to characterise and describe the sample. An independent samples t-test was used to establish gender differences. The level of significance for all measures was set at $p<0.05$. Pearson's Product Moment correlation coefficients were performed to determine possible associations between BMI, blood pressure and physical activity.

RESULTS

Physical activity

The prevalence of participation in health-enhancing physical activities (HEPA) is depicted in Table 1.

***Table 1*. PREVALENCE OF 12-MONTHS PARTICIPATION IN VARIOUS TYPES OF PHYSICAL ACTIVITY (n=159)**

	N	Percentages All	Boys	Girls
RLPA	71	44.7	25.0	32.2
MVPA	88	55.3	66.7	45.9

RLPA=Recreation or light physical activities MVPA=moderate-to-vigorous physical activity

The participation levels in RLPA and MVPA were 44.7% and 55.3% respectively. Active commuting to and from school was the most prevalent physical activity reported by the respondents. Of all the children walking to and from school, 42.8% walked more than 2km and 31% more than 3km. The physical activities most prevalent for boys, excluding walking, were rugby (54.8%), athletics (26.4%), cycling (13.9%), and working out in the gym (13.9%), while netball (25.3%), carrying heavy shopping bags (18.4%), and athletics (17.2%) were most prevalent for girls.

Anthropometry and blood pressure

Anthropometric and BP characteristics for boys and girls are presented in Table 2. Significant gender differences were recorded for height, BMI, all skinfolds (as indices of fat distribution) and systolic blood pressure. No significant gender differences were found for weight.

***Table 2*. DESCRIPTIVE STATISTICS OF RURAL BOYS AND GIRLS AGED 14-16 YEARS**

Variables	Total Group n=162	BOYS n=72	GIRLS n=90
Age (yrs)	15.10±0.77	15.2±0.80	15.1±0.75
Weight (kg)	51.10±9.38	50.5±7.56	51.5±10.63
Height (cm)	162.00±0.08	165.1±0.08*	158.6±0.06*
BMI (kg/m^2)	19.56±3.23	18.48±1.91*	20.42±3.78*
Triceps Skinfold (mm)	10.82±5.02	6.92±1.90*	13.94±4.53*
Subscapular Skinfold (mm)	10.22±4.91	6.49±1.73*	13.20±4.57*
Sum of Skinfolds (mm)	21.04±9.88*	13.40±3.57*	27.14±9.04*
BP (mmHg)	n=115	n=50	n=65
Systolic BP	122.8±12.71	126.1±13.05*	120.4±11.95*
Diastolic BP	72.7±9.52	74.4±10.42	71.3±8.57

* Significant difference $p<0.05$ between boys and girls BMI=Body Mass Index BP=Blood Pressure

Thirty-eight percent (38%) of the children were classified as hypertensive as they had SBP or DBP levels, which were $\geq 95^{th}$ percentile for their age-sex-height groups. This is in accordance with the National High Blood Pressure Education Program Working Group on hypertension control in children and adolescents (Falkner & Daniels, 2004). For the total sample, only 6.2%

of learners were overweight, while 12.5% were obese. Obesity was more prevalent in girls (Table 3).

Table 3. **OBESITY STATUS OF RURAL CHILDREN AGED 14-16 YEARS COMPARED TO INTERNATIONAL REFERENCE DATA***

Children	Overweight	Obese
Boys 14 yrs	0.0% (BMI=>22.6)	0.0% (BMI=>27.6)
Boys 15 yrs	3.6% (BMI=>23.3)	0.0% (BMI=>27.6)
Boys 16 yrs	0.0% (BMI=>24.4)	3.0% (BMI=>28.9)
Girls 14 yrs	0.0% (BMI=>23.3)	0.0% (BMI=>26.6)
Girls 15 yrs	2.6% (BMI=>23.9)	2.6% (BMI=>29.1)
Girls 16 yrs	0.0% (BMI=>24.4)	6.9% (BMI=>29.4)

*(Cole *et al*., 2000:1244) BMI=Body Mass Index

Table 4. **CORRELATION BETWEEN SELECTED CARDIOVASCULAR RISK FACTORS AND PHYSICAL ACTIVITY (PA) LEVELS AND PHYSICAL MEASURES**

Physical measures	Systolic BP r	Diastolic BP r	PA Levels r
Weight	0.26**	0.01	-0.08
Height	0.17	0.11	0.08
BMI	0.21*	0.18	-0.15
Sum of Skinfolds	-0.04	-0.16	-0.24**
Systolic BP	–	–	0.05
Diastolic BP	–	–	0.03

Significant correlation * $p<0.05$ ** $p<0.01$ BMI=Body Mass Index BP=Blood Pressure

DISCUSSION

Physical activity

The major objective of the current research was to establish the PA patterns (including walking to and from school), selected anthropometric characteristics and BP of rural schoolchildren in the Western Cape. Research focussing on the reduction of overweight in children often focuses on increased energy expenditure through physical activity to restore energy balance. In schools, this is often achieved through physical education and sports programmes. Most (55.3%) of the rural school children participated in sufficient levels of HEPA. Moderate to vigorous HEPA was more prevalent among boys, while no or relatively light PA was more prevalent among girls. The high levels of sufficient PA among the rural children found in this study are encouraging, especially since it is substantially higher than the South African national PA

levels. However, it is still a public health concern that approximately 44.7% of the children engaged in only relatively light PA, which is insufficient and with no proven health benefits.

Active commuting (walking) to school can constitute a major part of the PA levels of children in both developed and developing nations (Slingerland *et al*., 2012). The geographical location of rural children in South Africa relative to their schools, compel them to walk long distances to and from school on a daily basis. The habitual mode of commuting to and from school for almost 77% of participants in the current study was walking, while 23.3% made use of motorized transport. Walking distances varied with most children (57.2%) walking less than 2km. However, a large number of children (31.4%) walked more than 3km to and from school, five days per week.

Sports participation (organised and unorganised) levels were also high, with more than 50% of the children reporting regular participation. Besides walking and athletics, boys and girls are different in what constitutes most of their HEPA days. For boys, greater proportions of HEPA days were due to rugby, cycling and gym activities, while for girls, it was netball and carrying heavy shopping bags. Rugby and netball are the most common sporting activities in the region.

Anthropometric characteristics

Body composition of rural schoolchildren in this study varied with age and gender. Girls had significantly higher values for BMI compared to boys, while boys were taller. This most likely could be attributed to the maturational process. Some literature suggests that, at the beginning of puberty, maturation is associated with gender differences in muscle and fat mass, as well as with relative fat distribution, with girls gaining more subcutaneous fat and boys more muscle mass (Bénéfice *et al*., 2001). None of the boys was either overweight or obese, while 11.1% and 3.3% of the girls were overweight and obese, respectively.

Blood pressure

The relatively high prevalence of hypertension reported in this study is recognised as a major public health problem. The increasing prevalence of hypertension in Africa is ascribed to a multitude of factors, which include urbanisation, smoking, unhealthy diets containing excess salt and fats, physical inactivity and an alarming rise in the incidence of overweight, and obesity among children (Noubiap *et al*., 2015). It is important to note that, blood pressure in this study was measured during regular school hours over a period of one week. In studies of 24-hour BP recordings, it was found that blood pressure varied throughout the day, with many children having daytime readings above the reported normal range for casual blood pressure (Batisky, 2012). The differences in prevalence rates could also be related to differences in study designs, definition of hypertension, observer effect, and/or sample age range, but could also be ascribed to ethnic differences in blood pressure.

Boys had higher mean systolic and diastolic blood pressure levels than the girls, except for a slightly higher diastolic blood pressure score for girls at the age of 14 years. This is likely due to the greater stature of the boys at all ages. According to Anderson and Haraldsdottir (1995), heavier and/or taller children tend to have higher blood pressure levels in comparison to lighter and/or shorter children of the same age. This study found that both SBP and DBP were positively associated with age and height. However, DBP showed a negative association with age, in girls. These findings emphasise that height and age offer more precision in the detection of high blood pressure in children and adolescents and are supportive to the

recommendations of the updated report of the National High Blood Pressure Education Program Working Group on Hypertension control in children and adolescents (Falkner & Daniels, 2004). A significant ($p<0.05$) relationship was found between weight, BMI, and systolic blood pressure (Table 4). The risk of hypertension in children increases across the entire range of BMI values and is not defined by a simple threshold effect. Among all factors analysed, BMI was most strongly associated with hypertension.

Although no significant correlation was found between BP and PA, the prevalence of hypertension was the highest among the RLPA participants (43.3%) compared to the MVPA group (37.7%). This inverse relationship between physical activity and the development of hypertension, although not statistically significant, is consistent with the literature on blood pressure (O'Donovan *et al*., 2014). The high prevalence rate (37.7%–43.3%) of hypertension across activity levels reported in this study is a matter of concern, as hypertension is a risk factor for heart disease and stroke, as well as a major public health problem.

The sample used in the study is limited to one part of the Overberg region and it is therefore not representative of the entire rural community. Furthermore, only selected health risk factors were assessed in this study. The cross sectional approach makes it difficult to establish cause and effect associations between PA and CVD risk factors.

CONCLUSION

Overall, the majority of rural schoolchildren in the Overberg region of the WCSA engaged in sufficient HEPA. This study showed an inverse relationship between body mass and PA which suggest that PA positively effects body composition of schoolchildren, which is a known risk factor for diseases, such as diabetes and CVDs.

The high prevalence of hypertension among the rural children, especially boys, is a serious health concern and needs further investigation. The relatively high incidence of hypertension is noticeably higher than the 20-25% reported in the literature for South African children (Monyeki & Kemper, 2008; Kagura *et al.*, 2018). It should be noted that blood pressure readings are influenced by various factors and should be interpreted with the necessary caution.

In conclusion, the results from this study demonstrate the positive impact of physically active lifestyles on the body composition and BP of rural boys and girls. PA was also found to have a positive impact on the hypertensive state of rural girls but not boys. The findings suggest that habitual PA, which could include active commuting to and from school and sports participation, can enhance body composition and health of adolescents.

A cursory overview of the literature on the status of Physical Education (PE) globally, suggests that the subject is non-existent in many parts of the world especially in developing regions, while some national governments proposed either the removal of the subject from the curriculum or a reduced curriculum time allocation (Hardman & Marshall, 2001). Furthermore, the recreational alternatives brought about by advances especially in computer technology have also become strong competitors for the free time of children.

Urbanisation has become one of the major barriers affecting access to active lifestyles. In developing countries, the vast numbers of people moving into urban areas are often inadequately accommodated, both physically and economically and they are huddled together in crowded informal settlements, which provide limited or no opportunities for physical recreation activities (Travill, 2003). Active commuting to and from school is one of the few remaining options for children to engage in some form of PA. Communities and schools should

motivate and agitate for safe roads and routes to schools, which would encourage and allow for walking to schools safely.

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