Body mass index and level of physical activity among primary school children in Pretoria, South Africa

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Abstract

The purpose of the study was to determine the body mass index (BMI) and levels of physical activity among primary school children in Pretoria North, South Africa. A total of 1039 primary school children from grade 3 to 7 at Tshwane townships, suburbs, and informal settlements participated in the study. Six primary schools were selected to participate in the study. A questionnaire was used to collect data on physical activity, and anthropometric measurements were used to calculate BMI. The results showed that 24.2% of the children were overweight and 18.2% were underweight. The majority of those who were overweight were from the townships (82.0%) and 26.0% of those who were underweight were from the informal settlements. The majority of girls did not participate in physical activities after school (47.1%), during school (21.9%), and 86.8% of the children had low levels or did not participate in vigorous activities such as sport. This study found low levels of physical activity amongst primary school learners, which could have contributed to the high prevalence of overweight. Some children, especially from the informal settlements, were found to be underweight, which is in line with a dual burden of malnutrition amongst this population.

Keywords: Primary school children; overweight; underweight; physical activity; BMI.

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Introduction

Obesity is a complex condition, often coexisting with underweight in developing countries. It is affecting virtually all ages and socioeconomic groups (WHO, 2010). According to Ogden et al (2014), obesity has doubled in children and quadrupled in adolescents in the past 30 years, with South Africa (SA) seeing a sharp rise over the years (WHO, 2010). Recent studies estimate that the prevalence of childhood obesity and overweight is more than 15% in SA, and starts as early as six years with boys having a lower prevalence than girls (Rossouw et al., 2012). These studies highlight the emerging obesity problem among children in South Africa.

According to Kruger et al (2006), obesity is associated with low socioeconomic status, gender, physical inactivity and is more common among black South Africans. Studies show that there are health benefits of living an active life, especially from an early childhood. According to the US Department of Health (2008), health benefits of increasing physical activity (PA) levels include increased levels of cardio-respiratory, muscular fitness, reduction in obesity and lowered stress levels. Despite these documented benefits, population's levels of PA continue to decline as children grow up (Mollentze, 2006).

Mutargh and Murphy (2011), report that children who walk or cycle to school have higher step counts than those who travel to school using cars or buses, accounting to increased level of PA. The Department of Education in SA has implemented physical education (PE) as part of the curriculum in all public schools; however, children are included in sporting codes according to their ability to outshine others as the end-result of each sport is winning a cup in inter-school competitions. Often "chubby" children are left out of any sport as teachers tend to use "athletic" children to participate in the different sporting codes, therefore excluding other children defeats the purpose, and may explain the poor participation of children in PA. Studies in SA report a progressively declining level of PA in urban areas due to improved access to transportation (which takes children to school) and children living sedentary lifestyle, which includes sitting, watching TV and video games while indulging in fast food (McDonald, 2007; Fox et al., 2010; Colley et al., 2011).

Walters et al., (2011) reports that early intervention programs especially among children aged 6 -12 years, have a positive impact on their body mass index (BMI). Currently, there is a lack of community interventions aimed at reducing obesity and related chronic diseases among children in Tshwane. However, before establishing the need for these interventions, baseline information is needed on the current situation. Therefore, this study aimed to determine the BMI and levels of PA among primary school children in Pretoria, South Africa.

Methodology

Study design

A quantitative approach using a cross-sectional survey design was used. Permission to conduct this study was obtained from the University of Limpopo Ethics Committee and the National Department of Education. Also, permission was granted by sub-district offices as well as school governing bodies for each participating school.

Study population and sample

This study was conducted in Akasia, Soshanguve, and Ga-Rankuwa, which are each situated ± 40km north of Pretoria. Two schools were selected from townships, suburbs, and informal settlements. A total of six primary schools (two from each area) were selected to participate in the study. In each area, two schools were randomly selected from the list of schools provided by the sub-district office. The researchers selected learners to participate in the study from different grades using stratified random sampling technique. Initially, all children from the selected grades (i.e. grades 3 to 7) from each participating school were given letters explaining the purpose of the study and a parental consent form. The letters requested parental consent for their children to participate in the study. A list of the names of the learners who returned the consent form and assented to participate in the study was compiled for each grade; the names of the learners were assigned a number and entered into a random number generator to ensure that each learner had an equal chance of being included in the study. Using Epi Info software, Sample size was calculated using the formula:

$n = (Z^2 \times P (1 - P))/e^2$

Where Z = value from standard normal distribution corresponding to desired confidence level (Z=1.96) at a 5% margin of error and with a confidence level of 95%, with a population of 46100. The minimum recommended sample size for the survey was 998 learners. The number was increased to 1039 to allow for non-response.

Instruments

A structured researcher administered questionnaire was used to collect data. The questionnaire consisted of the socio-demographic profile of the learners and PA questionnaire adopted from existing questionnaires. To increase content and face validity, the questionnaire was given to experts to check before it was piloted on ten learners who did not take part in the main study. The questionnaire was adjusted based on the input of pilot study, some words that children left out because they did not understand were changed to more local words. Questions on attitude and knowledge were tested separately for reliability using the alpha method, and the reliability was high ($\alpha = \pm 0.091$).

Anthropometric measures were used to calculate BMI which was calculated using the formula: Weight/height^{2}for estimating body composition as previously recommended (Kerr et al., Schreiner., 1995). Children's height was measured in a standing position using a stadiometer. Measurements of weight in children were done with electronic bathroom scales. The time at which the measurements were made was recorded because diurnal variations in weight may occur (Davies et al., 2001). Using the BMI chart for children: underweight was scored as equal to all those who fell less than 5th percentile: normal weight scored as equal to 5th to <85th percentile; overweight and obese scored as equal to ≥ 85th percentile and these charts differ for girls and boys, and according to height (CDC, 2005).

To measure PA, the Physical Activity Questionnaire for older children (PAQ-C) was adopted and used. PAQ-C is a self-administered, 7-day recall instrument used to assess general levels of physical activity throughout the primary school year for learners up to 14 years of age (Kowalski et al., 1997). In this study, PA were measured against WHO-referenced

recommendations of PA, where, learners who participated in PA less than three times a week, were scored as "Low PA", meaning they fell below the WHO-Referenced Recommendations of PA; whilst those who participated three or more times in PA were scored as "High PA", meaning that they met the requirements for WHO-Referenced Recommendations of PA.

Data collection

Bearing in mind that language was a barrier, especially for those children from the townships and informal settlements, the questionnaire was translated into their home language (Setswana) and learners were assisted in completing the questionnaire.

Data Analysis

Data were coded and loaded into SPSS 22.0 for analysis. Descriptive statistics were used to calculate the frequencies of categorical data. For age, the mean and standard deviation were calculated. The Chi-square test was used to calculate associations between the sociodemographic data, BMI, and the levels of PA.

Results

The results in Table 1 shows that from a sample 0f 1039, most of the learners were girls (60.6%) and resided in a township/suburb (67.8%). There was no significant difference in gender distribution according to the place of residence. The mean age of the earners was 10.6 years, and sd= 1.76. Most learners (60.7%) were aged 11 – 13 years and those who were residing in informal settlements were significantly younger than those in townships ($p< 0.05$). Also, 18% of the learners were underweight, and 24.5% were overweight, with 26% underweight children residing in the informal settlement and 29.7% of overweight children were from townships/suburbs. There is a significant difference in BMI according to the place of residence ($p=.000$) as shown in Table 1.

Table 1: Socio-demographic profile of learners by residence

Variables		Total (n=1039)	Informal settlement N= 335	Township and suburbs N=704	P-value
Gender	Boys	409(39.4)	138(41.2)	271(38.5)	0.222
	Girls	630(60.6)	197(58.8)	433(61.5)	
Age group	5-7 years	55(5.3)	35(10.4)	20(2.8)	0.000*
	8-10 years	353(34.0)	149(44.5)	204(29.0)	
	11-13 years	631(60.7)	151(45.1)	480(68.2)	
BMI	Underweight	187(18.0)	87(26.0)	100(14.2)	0.000*
	Normal weight	597(57.5)	202(60.3)	395(56.1)	
	Overweight	255(24.5)	46(13.7)	209(29.7)	

*b represents p< .05

Furthermore, more girls (29.1%) were overweight compared to boys (17.1%), and the proportion of children with overweight increased with increasing age groups, (9.1%; 21.3%; 27.7%) respectively. Also, children who had low PA (25.4%) were more overweight compared to those who participated in PA more frequently (21.6%), there was also a significant association between BMI and PA levels (p= 0.019), age groups and gender (Table 2).

Table 2: BMI classification by socio-demographic profile of respondents

Socio-demographic variables		Underweight n(%)	Normal weight n(%)	Overweight n(%)	p-value
Gender	Boys (n=409)	74(18.1)	265(64.8)	70(17.1)	0.000*
	Girls (n=630)	113(17.9)	332(52.7)	185(29.4)	
Age group	5 – 7 years(n=55)	16(29.1)	34(61.8)	5(9.1)	0.001*
	8 – 10 years(n=353)	76(21.5)	202(57.2)	75(21.3)	
	11 – 13 years(n=631)	95(15.1)	361(57.2)	175(27.7)	
PA levels	low PA (n=803)	155(19.3)	444(55.3)	204(25.4)	0.011*
	High PA (n=236)	32 (13.6)	153(64.8)	51(21.6)	

The results also showed that, out of the 1039 learners, only 34.6% were watching TV more frequently and there is no statistical difference in the frequency of watching TV according to gender (p = 0.171) (Table 3). The results also showed that the learners were not participating in PA, although this was significantly higher for girls than boys. For PA during school, the majority of both boys and girls had low PA, although more girls had high PA during school while boys had high PA after school (Table 3).

Table 3: Level of physical activity of learners by gender and by residence,

Physical activity items		Boys N=409 n(%)	Girls N=630 n(%)	p-value	Informal settlement N=335	Townships /Suburb N=704	p-value
Watching	No TV (n=338)	141(34.5)	197(31.3)	0.171	142(42.3)	196(27.8)	
TV	Less frequent(n=341)	136(33.2)	205(32.5)		95(28.4)	246(34.9)	0.000*
	More Frequent(n=360)	132(32.3)	228(36.2)		98(29.3)	262(37.3)	
PA after	Low activity (n=785)	294(71.9)	491(77.9)	0.016*	262(78.2)	523(74.3)	0.097
school	High activity (n=254)	115(28.1)	139(22.1)		73(21.8)	181(25.7)	
PA during	Low activity(n=822)	339(82.9)	483(76.7)	0.009*	291(86.9)	531(75.4)	0.000*
school	High activity(n=217)	70(17.1)	147(23.3)		44(13.1)	173(24.6)	

p<0.05; low activity=less than three times a week and does not meet the WHO-referenced standards for PA:

high activity=3 or more times a week and meets the WHO-referenced standards for PA

Table 4 shows that children of all ages frequently watched TV, but that it is significantly higher among those 5-7 years (p=0.011). The majority of children in the 5-7 years and 8-10 years age groups had low PA during and after school compared to those at 11-13 years. The majority of children in all groups had low PA in vigorous sport, although high PA increased significantly with increasing age.

Table 4: Level of physical activity of learners by age

PA items		Age			p-value
		5-7 N=55	8–10 N=353	11–13 N=631	
Watching TV	No TV	19(34.5)	146(41.4)	173(27.4)	0.011*
	Less frequent	11(20.0)	103(29.2)	227(36.0)	
	More Frequent	25(45.5)	104(29.4)	231(36.6)	
PA after school	low Activity (n=785)	50(90.9)	285(80.7)	450(71.3)	0.000*
	High Activity (n=254)	5(9.1)	68(19.3)	181(28.7)	
PA during school	Low activity (n=822)	54(98.2)	278(78.8)	490(77.7)	0.011
	High Activity (n=217)	1(1.8)	75(21.2)	141(22.3)	
Vigorous Sport	Low Activity (n=902)	54(98.2)	323(91.5)	525(83.2)	0.000*
	High Activity (n= 137	1(1.8)	30(8.5)	106(16.8)	

*p< .05; low activity= less than three times a week and does not meet the WHO-referenced standards for PA: high activity = 3 or more times a week and meets the WHO-referenced standards for PA.

Discussion

The results of our study revealed that close to a quarter of children were overweight and 18% of children were underweight in Tshwane North. This is despite the efforts by the government to improve food security by introducing feeder schemes at schools and child support grants. We found that more children from the informal settlement were underweight while more of those from the townships/suburbs were overweight. According to Pampel et al., (2012) people with higher socioeconomic status (SES) in developing countries are likely to be overweight and obese because of what they eat. This is what we found in our study, where more children from townships/suburbs were overweight. Although this is not unique to Tshwane North, several studies report co-existence of both overweight and underweight in some provinces of South Africa, and this varies significantly according to the place of residence (Rossouw et al., 2012; Meko et al., 2015; Monyeki et al., 2015). Most interventions tend to address overweight and underweight separately, and some simply concentrate on one aspect instead of addressing both concurrently because both forms of malnutrition exist among primary school children. There is, therefore, need to design programs that address both underweight and overweight within the same school as both forms of malnutrition are common. In our study, underweight children were mainly from the informal settlement, which is low SES area. This implies that the type of settlement should be taken into consideration when designing interventions aimed at addressing malnutrition.

While more children from informal settlements were found to be underweight and physically inactive, it was interesting to find that some of them were overweight too, which confirms the coexistence of undernutrition and overnutrition in communities. Reasons for obesity for all children was significantly linked to low levels of PA, as found in this study. However, poor nutritional status could also lead to children indulging in unhealthy foodstuffs. Access to

unhealthy foodstuff could be due to the influence of marketing and easy availability at a lower cost, as reported in other studies in South Africa (Steyn et al., 2011; Kettner et al., 2013).

Furthermore, this study revealed that children generally had low PA during and after school and the majority were less involved in vigorous sports such as soccer, netball, and volleyball. Low levels of PA among children significantly impact on escalating prevalence of childhood obesity in South Africa (Lambert et al., 2006; Reddy et al., 2008; Baard et al., 2014; Sloan 2015). In this current study, the majority of children had low PA, meaning, they also fell below WHO-referenced recommendations for PA. These results imply that children are not leading an active lifestyle as they should, therefore missing the opportunity to prevent obesity at an early age. We found that more girls than boys were not participating in any PA during and especially after school. Studies report that girls are more overweight and also are less physically active than boys (Fuemmeler et al., 2012; Micklesfield et al., 2013; Noh et al., 2014). Renzhaho and Vignjevic (2011), suggest that some cultures allow girl children to be chubby or overweight for them to be termed "cute," this, in turn, influence parent's decisions to overfeed girl children while boys' readiness to lead the family "tree" depends on how physically fit they are. This is worsened by the quest of parents to protect girl-children from possible abuse if they play outside the house, further making them more sedentary (Mowan, 2010). Though barriers to PA were not explored in this study, it is a known fact that crime in townships of SA is very high and girls are most at risk of being sexually abused, forcing parents to be extra careful when it comes to girl children, and prefers to keep them indoors.

Studies show that levels of PA decline as one grows older, in this study, however, there was an inverse correlation, where children aged ≤10 years were found to be less frequently active compared to children over 10 years of age (Agras et al., 2004; Waring et al., 2007; Kuhnis et al., 2013). The study found that 45% of children at 5-7 years of age watched TV more frequently than older children, meaning, they were sedentary and could be at risk of being overweight as they grow older. These days, opportunities for children to walk to school have been replaced by improved access to transport, such that children are picked up by transport closer to their homes than it was a case year ago. We also found that fewer learners were involved in vigorous sport, also, when it comes to competitive sport, children are in fact chosen to participate based on their ability to perform and possibly win trophies, which is why only a few children reported participating in a vigorous sport such as soccer and netball. The focus at schools is selecting an elite team that will win the school's trophies, rather than addressing obesity prevention by promoting PA. Also, the idea of physical education (PE) being compulsory at schools does not imply that children are practically engaged in PA, it remains to be a period that is teaching-based, or other educators would use it for other activities it was not meant for. Perhaps, PE classes could be revamped to reinforce all types of PA, so that they can be appealing to children. O'Reilly et al., (2001) suggest that children should enjoy PE especially when the emphasis is placed on learning through participating in creative physical activities that are fun-based.

While current interventions fail to have a lasting effectiveness in reducing obesity among primary school children; some studies report successful results, especially programs that

combine physical and psychological health are implemented (Kriemler et al., 2010; Ar-yuwat et al., 2013). It is important to design a comprehensive school-based multi-component physical activity intervention, which, together with current compulsory PE can improve PA and fitness levels of children. Given the fact that underweight also is a significant factor among primary school children, therefore, programs need to have an intervention plan to address underweight together with an overweight intervention plan.

Study limitations

The study was conducted mainly during learner's breaks and Life orientation classes, which made it difficult to cover more learners per day, so, data collection took longer. Also, some learners did not bring back parental consent forms on time, therefore, missing the opportunity to be included in the study.

Conclusion

These results show that South Africa still presents with the dual burden of under/overweight, especially in townships/suburbs and informal settlements; and therefore, there is a need for designing interventions that should tackle both reductions of underweight and overweight. However, there are currently interventions that only cover these burdens individually, rather than dually as they present within the same community. Also, the fact that girls than boys; older learners than younger ones and township/suburbs than informal settlement learners were found to be more overweight signals the need for tailored interventions that incorporates these characteristics. Further studies need to be conducted to evaluate the impact of feeder system and social grants, which most these children receive for mainly nutritional support, because of BMI outcomes reported in this study.

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