Body Composition Analysis of Pupils in Urban Schools in Central Uganda

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Abstract

A pre experimental research was conducted to analyse the body composition of 1929 pupils aged 6 to 9 years in central Uganda. Anthropometric measures (height and weight) were taken and Body Mass Index (BMI) was computed. Pupils were classified into respective weight categories using WHO (2007) CDC –BMI for sex–age growth charts. The results showed that out of the 901 boys 92% had normal weight, 5% were underweight, 2 % were overweight and 1% was obese. Of the 1028 girls, 78.5% had normal weight, 3.1% were underweight, 11.6% were overweight and 6.8% were obese. The results also revealed significant gender difference with boys having lower mean BMI scores than girls (using $p \leq 0.05$). The study concluded that underweight, overweight and obesity are prevalent of among Ugandan children and this requires putting in place strategies that promote physical activity and appropriate nutritional habits in schools and communities.

Key Words: body composition, BMI, pupil

1.1. Introduction

Body composition is the relative proportion of body fat and fat-free tissue in the body (ACSM, 2005). Body fat or adipose tissue is found beneath the skin and around major organs like the heart while fat-free mass or lean body mass comprises of muscles, bones and organs. Body composition analysis is the physical test that measures the proportion of these body components in a person (WiseGeek, 2013). Several laboratory and field tests have been used in this analysing. However although laboratory tests provide more accurate results than field tests, the latter have been used extensively because of their affordability and feasibility for large groups of subjects (Rowland, 1996; Goss et al, 2003; Rosser, 2005). Body Mass Index (BMI) is most widely used field test since it is the cheapest and easiest to administer (Topendsports, 2013). BMI is effective in screening weight categories that can lead to health problems although it cannot be used to distinguish between muscle weight and weight associated with fat (The Sports Fitness Advisor, 2007 and Shaw et al, 2007). BMI is computed from a score obtained from the body weight in kilograms divided by the square of height in meters (kg/m^2). Individual scores are later plotted on the BMI-for-age growth charts for either girls or boys to obtain a percentile ranking and classify a child as either underweight, normal weight, overweight or obese.

World Health Organisation [WHO] (2007) classified a child as underweight when his or her body weight is below the 5^{th} percentile. A normal or health child has a body weight ranging between the 5^{th} and less than the 85^{th} percentile. If the child's body weight exceeds the 85^{th} but is less than the 95^{th} percentile that child is classified as overweight. And a child with the BMI equal or above the 95^{th} percentile is obese. An underweight child has less than the desirable body fat and this has a negative impact on health. According to WiseGeek (2013), low body fat lessens the ability to cushion organs such as the heart, liver and kidney; results in the body failing to store vitamins A, D, E and K and increases the risk of osteoporosis.

In contrast, overweight and obesity result from having undesirable body composition with higher than normal amount of body fat. Overweight strains the cardiovascular system and increases the risk of diseases such as hypertension. Overweight also puts stress on the joints, causes discomfort and increases the risk of injury (Honeybourne, Hill & Moors, 2002). Obesity on the other hand has been identified as a disease in its own right and a major risk factor for chronic diseases. WHO (2010) reported that 44% of the diabetes, 23% of the ischaemic heart disease and between 7% and 41% of certain cancers are attributed to overweight and obesity.

In addition, overweight and obese people tend to suffer psychological maladjustment that leads to poor relationships and awkward physical movement which often results in increased anxiety, depression and low self esteem (Bussesen & Kushner, 2002 ; WHO, 2009). Both overweight and obesity are the fifth leading risk for global deaths responsible for at least 2.8 million deaths each year (WHO, 2010). Miller, et al. (2010) acknowledged the influence of genetics on body composition but confirmed that lifestyle may counteract these effects. The lifestyle changes that have contributed greatly to body composition changes include decreased physical activity and poor nutritional habits (Piatkowska, 2010; WHO, 2011). Poor nutritional habits have resulted from the increase in worldwide industrialisation and market globalisation that have led to consumption patterns shifting away from traditional, local foods like vegetables, fruits, legumes, roots and tubers to refined and processed foods, high in salt and saturated fats (WHO, 2011). Such diets are responsible for the increase in overweight and obesity.

With respect to physical activity, Marchione (2005) noted a steady decline in physical activity in developed and developing countries and linked it to the increased prevalence overweight and obesity. Formal education, increased use of motorised transport, urbanisation and the use of communication technology in many contemporary leisure time activities have all led to inadequate engagement in physical activity (Onywera et al., 2010). According to Natukunda (2007), Ugandan children are also experiencing such physical activity transition. NASPE (2004) noted that formal education nowadays involves long hours of sitting and engaging in cognitive activities and at the same time it marginalizes subjects like Physical Education that help children keep physically active. Nsibambi et al. (2005) attributed this trend in education to the Ugandan society which demands good academic grades at the expense of children's psychomotor development. Moreover, the opportunity of exercising by walking among many urban pupils has been denied because of the increased availability and affordability of motorised transport to and from school (Mallo, 2004 & Onywera, et al., 2010). Anecdotal data also revealed that in Uganda, many urban parents prefer to take their children to schools that provide transport. In addition, motorcycles commonly known as boda-boda are a common, affordable and convenient mode of transport used by schoolchildren in middle and low income groups.

Regarding leisure activities, television other screen-based entertainment and communication devices like mobile phones and internet have dominated the leisure time of many contemporary people (Owen, Healy, Howard & Dunstan, 2012). Natukunda (2007) wrote that nowadays many children in Uganda engage in passive indoor activities such as Television watching, board games and playing cards and cited three reasons for this scenario. First, the children's parks or public playgrounds in many urban areas have been turned into shopping centres resulting in lack space to play from. Secondly, many parents restrict their children from outdoor activities for fear unsafe neighbourhood. Lastly, some parents are obsessed with keeping their children clean or protecting them from getting dirty as they play. Unfortunately, Fahey, Insel and Roth (2003) lamented that when children are inactive they usually carry such habits into adulthood.

Physical inactivity has been linked it to the global increase in non communicable diseases and conditions. Goon (2006) confirmed that such diseases and conditions are lifelong problems that begin during pediatric years and surface clinically during adulthood. National Center for Physical Activity and Disability [NCPAD] (2008) also noted that when a child is physically active the rate of natural degeneration that often comes with middle age and beyond and leads to development of such diseases is reduced. It should be noted that these diseases and conditions not only have a substantive impact on an individual's health but also the strain the national economy in terms of treating and managing them.

Nevertheless, these diseases can be controlled when surveillance programmes that involve analysis of body composition are conducted and appropriate intervention strategies are put in place. WHO (2010) emphasised establishing and strengthening initiatives for surveillance in every country. And in many developed countries tests have been conducted and the findings have used to influence policy and practice regarding engagement in physical activity. Unfortunately, in Uganda there is hardly any surveillance done regarding physical inactivity. Thus, appropriate intervention and preventive strategies have been hindered due to scarcity of data. The study therefore, analysed the body composition status of pupils and provided baseline information that is useful in designing measures and avert future threats to children's health. The study was guided by the following objectives (1) to determine the body composition status of pupils in central Uganda using the WHO (2007) age-sex specific BMI percentiles (2) to compare the body composition status of boys and girls.

1.2. Method

The study population consisted of 1929 urban pupils in day and boarding schools aged six to nine years (901 boys and 1028 girls). The sample was selected from two districts in Central Uganda using stratified random sampling according to age, type of school and gender. Wakiso and Mukono were purposively selected since they are respectively the second and third most urbanised districts in Uganda after Kampala District (Wikipedia, 2010). Kampala District the most urbanised part of Uganda was not selected because it did not have boarding schools which formed part of the study population.

A pre-experimental research design was used to analyse body composition. Trained personnel directly measured and recorded the weight and height of each pupil in order to compute individual BMI scores. Approval for data collection was granted by the Ministry of Education and informed consent was obtained from the head teachers of the 17 sampled schools. The study involved only pupils who were willing to participate. After emptying their bowels, each pupil was required to stand on the scale barefoot wearing only sports attire. The pupil being tested made minimal or no movements with the hands kept by the side and the head erect. The weight was taken using calibrated scales to the nearest 0.5kilograms and recorded on the data entry form.

Height was measured to the nearest 0.5 centimeter using calibrated stadiometers. Every pupil stood barefoot against a stick on which the measuring tape was taped with his or her feet parallel to each other. The researcher made sure that the head was erect and the heels, buttocks and shoulders were touching the stick which was placed against a wall. The chin of the pupil was held up to ensure that its position appeared perpendicular to the measuring tape. The top most part of the pupil was determined using a ruler that touched the head and the measuring tape. The reading was taken and recorded on the data entry form. Data was analysed according to gender using SPSS version 15. Frequencies, percentages, means and standard deviations were computed for all the measures. And a t-test for independent groups was calculated to establish whether there were significant gender differences.

1.3. Results

1.3.1. Characteristics of the Subjects

Anthropometric data was collected from 901 (46.7%) boys and 1028 (53.3%) girls. The age and gender distribution of the study sample is shown in Table 1.

Table 1: Number of pupils according to age and gender

Age (years)	**Boys**		**Girls**			
	Number	***%***	**Number**	***%***	**Total**	***%***
6	130	*14.4*	229	*22.3*	359	*18.6*
7	243	*27*	249	*24.2*	492	*25.5*
8	269	*30*	287	*27.9*	556	*28.8*
9	259	*28.6*	263	*25.6*	522	*27.1*
Total	901	*46.7*	1028	*53.3*	1929	*100*
Mean ± SD Height (m)	1.26 ± 0.08		1.24 ± 0.08			
Mean ± SD Weight (kg)	27 ± 0.05		26.1 ± 0.03			
Mean ± SD BMI	16.21 ± 2.05		17.90 ± 2.92			

Table 1indicates that mean height for boys was higher (1.26±0.08) than that for girls (1.24±0.08) and hence they are taller than girls. The study findings also show that boys weighed heavier than girls since their mean score (27± 0.05) was higher than that of girls (26.1 ± 0.03). In contrast, girls recorded higher mean and standard score for BMI (17.90 ± 2.92) than boys (16.21 ± 2.05). When the t-test for independent groups was computed, the results revealed significant gender differences. Girls had a significantly ($p=0.000$; $p \leq 0.05$) higher mean compared to boys. Thus the null hypothesis which postulated that there would be no significant difference in BMI between boys and girls was rejected.

1.3.2. Body Composition Status of Pupils

To determine the body composition status of the boys and girls that participated in the study, individual scores were categorised according to percentile norms set by WHO (2007) CDC-BMI for sex-age growth charts percentiles. The results are shown in Table 2.

Table 2 Body Composition Status of Pupils by Gender

Gender	Boys (n = 901)		Girls (n = 1028)		Combined (n = 1929)	
	Number	*Percent (%)*	Number	*Percent (%)*	Number	*Percent (%)*
Underweight	45	*5*	32	*3*	77	*4*
Normal weight	829	*92*	807	*78*	1636	*85*
Overweight	18	*2*	119	*12*	137	*7*
Obesity	9	*1*	70	*7*	79	*4*

The findings revealed that boys were taller (1.26± 0.08) than girls (1.24 ± 0.08). Secondly, the boys weighed heavier (27 ± 005) than girls (26.1 ± 0.03).

1.3.3. The Body Composition Status of Boys

Table 2 and Figure 1 indicate that the majority of boys (829, 92%) had normal weight. However, there were underweight (45, 5%), overweight (18, 2%) and obese (9, 1%) boys.

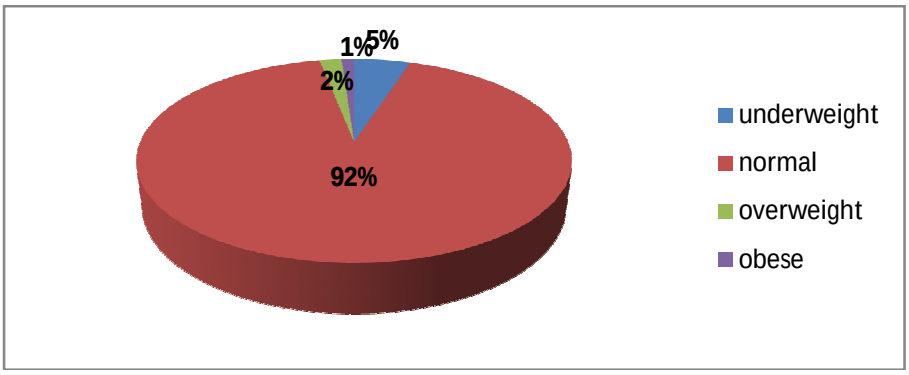

Figure 1: The weight status of boys

These results also reveal that underweight was more prevalent than overweight and obesity among boys.

1.3.4. The Body Composition Status of Girls

Table 2 and Figure 2 reveal that the majority (807, 78%) of girls had normal weight. In addition, there was also prevalence of underweight (32, 3%), overweight (119, 12%) and obesity (70, 7%) among the girls.

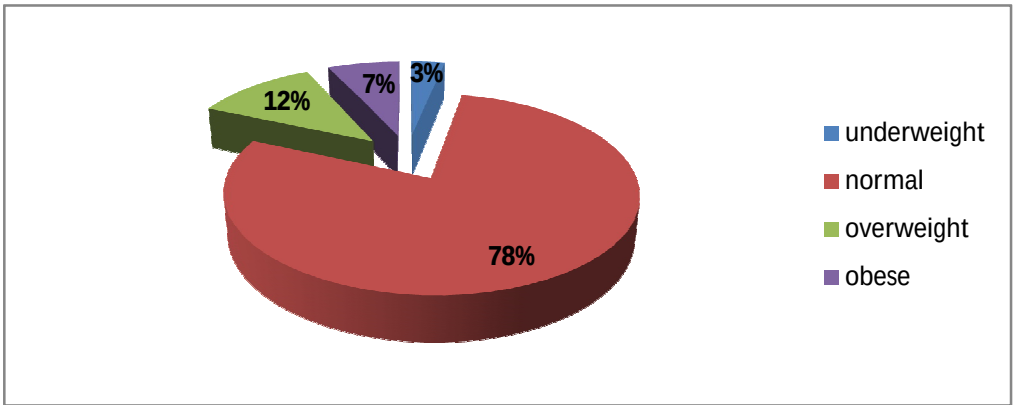

Figure 2: The weight status of girls

The study findings further reveal that unlike boys, overweight and obesity were more prevalent than underweight among girls.

1.3.5. The Body Composition Status of Boys and Girls

The results show that out of 1929 pupils, 1636 (85%) had normal weight, 71 (4%) were underweight, 137 (7%) were overweight and 79 (4%) were obese. The data is illustrated in Table 2 and Figure 3.

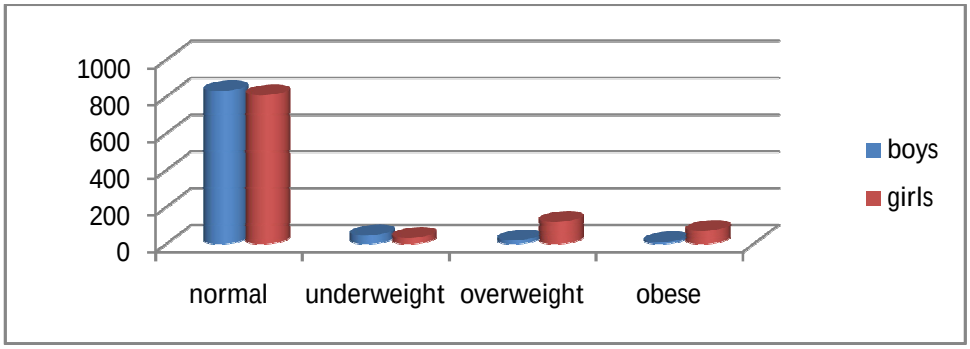

Figure 3: The weight status of pupils

The body composition status of boys and girls was combined and compared and the results are presented in Figure 3. The findings show that although the majority of pupils had normal weight there were slightly more boys (43%) with normal weight than girls (42%). Secondly, of the 77 (4%) underweight pupils, the percentage of boys (2.5%) was higher than that of girls (1.5%). Thirdly, of the 137 (7%) overweight pupils, there were more cases of overweight among girls (6.2%) than boys (0.9%). Lastly, 79 (4%) of the total population were obese. And obesity was more prevalent among girls (3.5%) than boys (0.5%).

1.4. Discussion

The study provided information on the body composition profiles of pupils in Wakiso and Mukono districts in central Uganda. This baseline information can be used to justify the need for devising appropriate intervention strategies for apparent sedentary pupils. Guthold, et al. (2009) also confirmed that such data helps in determining appropriate intervention measures and prevent or control threats to the health of a nation. The findings of the study revealed that girls were shorter and weighed less than boys. Malina, et al. (2004) also noted that there are small gender differences in size among the preadolescent children.

Furthermore, the results indicated differences in body composition among pupils in central Uganda since girls recorded significantly higher BMI scores than boys. These results are supported by Rosser (2005) who noted that the difference in BMI between girls and boys are due to girls' greater body fat. Similarly, Shaw, et al (2007) accounted for the gender differences in body composition among prepubertal children to girls having more body fat than boys which translates to higher BMI scores. This difference could also justify why boys who have less body fat and more lean mass weighed heavier than girls.

WHO (2010) associated high BMI that often leads to overweight and obesity to increased risk of non communicable diseases. The findings indicated that there is prevalence of overweight and obesity among the pupils in central Uganda with more cases of among girls than boys. This finding supports Nabiruma (2013) who reported that there is an increase in childhood obesity in Uganda and attributed it to unregulated eating and an alarming reduction in physical activity. Nabiruma (2013) explained that a typical urban child in Uganda engages in activities that do not require a lot of physical exertion such as watching TV, doing a lot of homework and engaging in indoor games. This predisposes them to high risk of acquiring non communicable diseases. The results of this study also revealed that there are cases of underweight among the pupils. The findings also showed that the cases of underweight were more among boys than girls. The finding is consistent with Goon (2006) study that reported prevalence of underweight among Nigerian children with the percentage of boys higher than that of girls. It is well known that underweight demonstrates that malnutrition exists. And WHO (2010) confirmed that many children in low and middle income countries are underweight because they are vulnerable to inadequate nutrition during pre-natal, infant and young stage.

Thus, the findings of the study reveal that underweight and overweight and obesity coexist among the children. The WHO (2010) report stated that it is common to find obesity and under nutrition existing side by side in the same country and same community in low- and middle- income countries. The Ministry of Health [MOH] (2103) also acknowledged the co-existence of over and under nutrition in Uganda and attributed this phenomenon partly to the rapid transition in nutritional habits and reduced physical activity. According to Uganda Demographic and Health Survey [UDHS] (2006), 38% of the children in Uganda are underweight and this is linked to malnutrition. One of the reasons why malnutrition exists among pupils is that according to the national policy, parents are expected to provide meals for their children at school. Thus, there is no school feeding scheme in public schools leading to many pupils in such schools forgoing lunch (Acham, 2014). Malnutrition and subsequent underweight is associated with poor school achievement as it affects the intelligence of a child and renders him or her unproductive. Such an effect may stretch up to adulthood according to UDHS (2006).

From this study it is evident that Uganda is facing a double burden of disease with simultaneous occurrence of malnutrition and non-communicable disease risk factors like overweight and obesity. Nabadda (2002) confirmed that Uganda is experiencing epidemiological transitions where prevalence of hypertension, type 2 diabetes and cancer are increasing although communicable diseases are still a problem. Unfortunately, the country's budget is more inclined towards fighting communicable diseases like malaria and HIV/AIDS at the expense of this rapid surge of non communicable diseases. Therefore, policies that target prevention of malnutrition and overweight and obesity and promote good nutritional habits and active lifestyle need to be put in place. Such policies should target schools and communities.

With respect to nutritional habits, the government should strengthen nutrition education in communities. Parents need to be taught how to prevent under and over nutrition among underweight and overweight children respectively. There is need to put in place School Health Policy that include among others implementing school feeding programmes to ensure provision of at least one healthy meal in public schools. To the underweight pupils, this meal will increase the caloric intake and to the overweight it may regulate the consumption of unhealthy foods that contribute to excess calorie intake.

To ensure that pupils are physical active in schools quality Physical Education should be taught (NASPE, 2004). This involves adequate allocation of teaching time accompanied by appropriate content that includes aerobic activities known to be important in weight management. Pupils should also be taught activities they can engage in individually during free time at school and after school. This will promote individual active play which is likely to make them remain active when they grow up. To this effect, Nabiruma (2013) recommended that schools to provide longer break periods to allow pupils to engage in free time active play activities at school. She also recommended that schools acquire bigger playgrounds for outdoor activity. In addition, parents need to educated about the importance of children engaging in active outdoor physical activity so that they support them in this endeavour.

Unfortunately, Natukunda (2007) observed that lack of space to play from is a limiting factor to for outdoor activity among many urban residents. This problem can be handled through an inter-ministerial approach whereby different ministries such as Local Government and Urban Planning ensure that space for public parks are reclaimed or new areas are designated which can be used by children and adults. Public health activitists, local and religious leaders and the media may be used to educate the population about the dangers of physical inactivity and the need for changing such a lifestyle.

1.4. Conclusion

Based on the findings of the study, it can be deduced that the majority of pupils aged between six and nine years in Mukono and Wakiso districts of central Uganda had normal healthy weight. Unfortunately, the study also revealed simultaneous occurrence of underweight, overweight and obesity among children, typical of low income countries. The risk factors for undesirable weight status identified in this study were nutrition and physical inactivity. And this provides the basis for planning intervention strategies that can safeguarded against preventable diseases and conditions. The strategies include setting up environments at school and community levels that promote behavioral change in nutritional habits and physical activity patterns.

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