PREVALENCE OF OBESITY AMONG ADOLESCENTS IN PRIVATE AND PUBLIC SECONDARY SCHOOLS IN CALABAR METROPOLIS, CROSS RIVER STATE – NIGERIA

Ogar, Emmanuel Ekawu[1], Josepgh Odey Ogabor [Ph.D][2], Grace. A. Mbadi-Oli[3] and Martina Ayibeya Apie[4] [Ph.D]

[1,3]. University of Cross River State (UNICROSS), Calabar.
[2,4]. University of Calabar, Calabar, Cross River State

Corresponding author: Princeemmy77@yahoo.com 07031231205 https://orcid.org/0000-0001-6474-8649

Abstract

Calabar municipality is a capital city of Cross River State, predominantly filled with working class and business people. This study was to investigate the prevalence of obesity among adolescents in private and public secondary schools in Calabar Metropolis of Cross River State, Nigeria. Survey method of research design was adopted for the study. Stratified random sampling technique was adopted to select 400 students (i.e. 200 from private and 200 from public secondary schools) in Calabar Metropolis. Structured questionnaire titled Prevalence of Obesity Among Adolescents (POAD) was used to obtain data. The data obtained were analyzed using Independent t-test statistic. All hypotheses were tested at 0.05 level of significance. The results indicated that significant differences existed between the students of private and public secondary schools as regards genders and BMI in the study area. It was recommended among other things that Private school students most especially the adolescents should be involved in proper fitness programmes to help in improving their health status thereby reducing the risk factors of having obesity related disorders.

Key words: Adolescents, Obesity, Prevalence, Private and Public Genders, BMI.

Introduction

A tremendous need exists today to educate clinicians about obesity. This disorder which results from a complex interplay of environmental and genetic factors, is associated with significant morbidity and mortality. Those afflicted with this disorder, suffers emotional consequences from social stigmatization from friends and in addition to having an increased risk of many medical disorders (Luke, 2012). The multiple social, economic and hereditary factors that contribute to obesity makes treatment of the condition a potential discouraging prospect, particularly for the primary care giver with limited time available to spend with each patient (Luke, 2012). Other obstacle to evaluating and treating obesity include lack of insurance reimbursement for treatment, lack of time for patient education and counseling, skepticism about efficacy and safety of specific medical therapies for obesity, a negative perception that obesity represent lack of willpower or self-discipline, and inadequate training and training mechanisms in the medical management of obesity (Lynniki, Young, Riggs & Davis, 2021). The increased calorie intake could result in larger storage of fat in the adiposities or adipose tissues and this maybe one of the leading causes of increased body weight and obesity among adolescents, i.e. when one consume high amount of energy food, particularly fat and sugar, but don't burn off the energy through exercise and physical activity on a regular basis, much of the surplus energy taken in will be stored by the body as fat in the adipose tissues thereby leading to increased in body weight which can lead to obesity (Rachael, 2019). Also, high sedentary lifestyles among adolescents are strongly associated with obesity. Obesity doesn't happen or occur overnight, it develops gradually over time, as a result of poor diet and lifestyle choices from cradle to young adult, such as eating large amounts of processed or fast food, that is, high in fat and sugar, taking too much of alcoholic drinks, ingesting too many sugary drinks into the system (Heude, 2016). Consistent and regular physical activity protects one against increase in weight while decrease in physical activity promotes obesity. Many people have carrier jobs that involve sitting at a desk for most of the day (Lynniki, et al 2021). They also rely on their cars with AC, rather than walking or cycling

to burn of the stored fats. For relaxation, many people tend to watch TV, browse the internet or play computer games, and rarely take regular exercise, these contribute in a great deal to overweight and obesity (Garnett, 2014).

Obesity is an abnormal accumulation of body fat, usually 20% or more over an individual's ideal body weight. Obesity is the accumulation of excess fat in the subcutaneous tissue and other body parts resulting in individuals being 20% and above heavier than their expected body weight (Mast, 2018).

The prevalence of overweight and obesity is confined not only to adults but also being reported among the children and adolescents of developed as well as developing countries (WHO, 2018). Since, adolescence is a period of transition from childhood to adulthood; It assumed critical position in the life cycle of human beings, characterized by an exceptionally rapid rate of growth (Jain, Bharadwaj & Joglekar, 2017). The prevalence of obesity among adolescents has increased significantly in the developed countries during the past two decades and similar trends are being observed even in the developing world and it has reached levels, possing a significant public health concern (Must, 2017).

The prevalence of overweight and obesity in Calabar municipality are risk factors for many health problems, regardless of a person's age. Children and adolescents in Calabar municipality who are overweight and obese, however, face a greater risk of health problems—including type 2 diabetes mellitus, high blood pressure, high blood lipids, asthma, sleep apnoea, orthopaedic problems and psychosocial problems—than their normal weight peers (Goossens, Braet & Decaluwe, 2017). There is an urgent need to investigate the magnitude of this problem in developing countries such as Nigeria and most especially the study area, which is Calabar Metropolis, and to implement prevention strategies as early as childhood by involving families, schools and the whole community (Ugbong, 2019) .

A study by Eme (2017) on prevalence of overweight and obesity among adolescents in secondary schools in Abia state, Nigeria. The study revealed that more females (51.7%) than males (48.3%) participated in the study. A greater percentage of them were within the ages of 10-14 years and more than half of the respondents (57.5%) were from private schools. The reason for more females than males in the population might be because of more enrolment of the females in education in recent times than males. Most males tend to go into business and apprenticeship than the female folks. The background characteristics in this study were comparable to those used in previous studies (Akinpelu, Oyewole & Oritogun, 2018). The mean age of the respondents in this study (14.56±1.84 years) was similar to the findings of (Adesina, Peterside, Anochie & Akani, 2019) where the mean age of their respondents was 14.25±1.25 years. The prevalence of overweight and obesity in this study was 9.7% and 3.5% respectively. This was lower when compared with the prevalence of overweight (15%) and obesity (5%) in Iranian adolescents (Dorosty, Siassi & Reilly, 2016) and Indian adolescents (11.1% for overweight and 14.2% obese). The possible reasons of higher prevalence of overweight and obesity may be linked to their food habit, westernization and government policies in these countries.

However, in Eme (2017) study, there was a significant ($P<0.05$) higher prevalence of overweight (6.7% and 3.0%) and obesity (2.5% and 1.0%) in females than in males respectively. It can be explained by the fact the male adolescents might be involved in more exercise than their female counterpart. This was lower than the findings of a similar study done at Sagamu by Akinpelu, Oyewole and Oritogun (2018), where the prevalence of overweight and obesity in males (8.1% and 1.9% respectively) and females (8.1% and 2.7% respectively) but higher than the findings of similar studies by (Alabi, 2018) and Izuora, (2017). This might be explained by the time these studies were carried out. Both studies were done earlier. The Waist-Hip Ratio (WHR) of the females (12.8%) had more significantly ($P<0.001$) high health risk than males (3.0%).The implication of this result is that the females might be more predisposed to non-communicable diseases such as diabetes and hypertension later in life. According to Manyanga, (2018), the fitness experts, waist-hip ratio (WHR) helps us track our weight loss progress and also serve as a warning about our estimated health risk for problems related to being overweight such as diabetes, stroke and heart disease.

Sedentary lifestyles have a major impact on the overall health of the global population. Many people worldwide engage in sedentary lifestyles, and the prevalence of relevant non-communicable diseases is on the rise (Kirkby, 2014; Benfice; Okoh et al 2015). It is well known that insufficient physical activity, that is, physical inactivity, has a detrimental effect on health. Physical inactivity is the fourth leading risk factor for global mortality, accounting for 6% of global mortality (Alabi,

2018; Nwadiuto, 2012; Jung, et al 2020). Despite the fact that sedentary behavior poses a comparable risk to health and contributes to the prevalence of various diseases, most physical activity-related education in clinical practice is focused on improving the physical activity levels, with less emphasis on lowering the sedentary behavior. In addition to understanding and informing patients about the health impact of a sedentary lifestyle, healthcare providers of various fields, including clinicians, should reflect upon its significance in policies (Ukegbu et al 2017; Mukhopadhyay et al 2015).

The prevalence of obesity is on the rise in developing countries, especially in urban areas such as Calabar Metropolis. The prevalence of obesity has continued to rise at an alarming rate world-wide to such an extent that it has been described as a global epidemic.

Calabar metropolis has experienced rapid and unplanned urbanization in recent years and there have been changes from local diet to western style of diet as well as change in eating habits which is driven by the explosion of fast food canteens and restaurants or eatries. Consequently, over consumption of refined fast foods (i.e. meat pie, fried/jollof rice, snacks, ice cream, indomie, energy drinks etc) is becoming noticeable among individuals, children/adolescents, groups and families in Calabar Metropolis. The health risk of being overweight and obese have being clearly demonstrated: obesity is a risk factor for diabetes, cardiovascular disease, and most cancers, and it is associated with shortened life expectancy. The study also shows the relationship between body mass index (BMI) and risk of mortality which will really help our adolescents most especially in Calabar Municipality to guild against it. Based on this, one can then ask, what is the prevalence of obesity among adolescents in private and public secondary schools in Calabar Metropolis of Cross River State?

Methods and Materials

In this study, the researcher adopted the survey method of research design to conduct the study. The method was best adopted because surveys are mostly conducted to establish the nature and position of prevailing issues. It is important in the study because it deals with group of different individuals for analysis. It also made it possible to reach out to a larger population and at the same time takes care of those areas under consideration in the study. No other research design can provide this broad capability, which ensures a more accurate sample to gather targeted results in which to draw conclusions and make important decisions. It also helps gauge the representativeness of individuals views and experiences.

The sample for the study was made up of four hundred (400) students randomly selected from both the private and public secondary schools in the study area. Twenty (20) schools were selected from the two Local Government Areas of Calabar Metropolis made up of, ten (10) public and ten (10) private schools. And a total number of 100 males and 100 females in public secondary schools and same number in the private secondary schools. This amounts to a sample size of four hundred (400) students.

The sampling procedure used in this study was stratified random sampling technique. Isangedighi (2018), defined stratified sampling as, it identifies and addresses heterogeneity in the population and this reduces sampling error. It is used when the population contains definite subsets, each of which is distinctly different, though within each stratum and the units are homogeneous.

In the first stage the secondary schools in Calabar metropolis were stratified by school type base on their ownership (private and public schools).

Stage two, forty schools were randomly picked from the two Local Government Areas with twenty schools from each Local Government Area (ten private and ten public schools) out of the 64 schools in the Metropolis. In the third stage, each school was stratified base on their classes from each level of SS2 and SS3 classes because of their age bracket and two arms were selected from each of the class of SS2 and SS3 using simple random sampling. In the fourth stage, five students were randomly selected from each arm making ten students from each of the forty schools to make a total of four hundred [400] students which form the sample size used. This method was used because it enables researchers to obtain a sample population that best represents the entire population being studied.

The instruments used for collection of data were:

1. Questionnaire, titled Prevalence of Obesity Among Adolescents Questionnaire (POADQ). Information was gotten from the students using structured questionnaire. Section “A” of the questionnaire covered demographic data and

anthropometric data while in Section "B" information about their diet, eating habit, and lifestyle e.t.c were obtained. The researcher and four trained assistants visited the selected schools to administer the questionnaire which contains close and open- ended questions.

2. Weight measuring scale(kg)

A bathroom scale calibrated from zero to 120 kg was used to measure the weight of the students. The scale was checked and corrected for zero error before every measurement. Each subject was allowed to wear only the school uniform during measurement, their shoes and other extra wears like sweaters were also removed. The weight was read to the nearest 0.5 kg.

3. Height measurement (m)

A mobile height measurement instrument was used to take the students measurement. The students were asked to remove their shoes and stand upright by the instrument and reading was taken to the nearest 0.5m. The body Mass Index was calculated by using the height and the weight measurement to assess for normal weight, overweight and obesity and was calculated by dividing the weight in kg by the square of the height in meters. Body Mass Index=Weight (kg)/Height (m^2).

Reliability estimate was conducted to determine the consistency of the instrument. The instrument was trial tested on 50 students selected in the area that were not part of the ones sampled for the study. The data collected were analyzed using Cronbach alpha reliability method which gave coefficients that ranged from .73 to .79

The procedure for data analysis depended on each hypothesis. Each of the hypotheses of the study was analyzed using appropriate statistical technique. The researcher compared two groups of students, that is public and private secondary school students and the statistical analysis technique for testing all hypotheses was independent t-test. The entire hypotheses were tested at .05 level of significance.

Results and Discussions

This study investigated the prevalence of obesity among adolescents in private and public secondary schools in Calabar Metropolis of Cross River State, Nigeria. In this section each of the null hypotheses of the study was re-stated, the independent and dependent variables identified as well as describing the statistical analysis technique used to test the hypothesis.

Generally, as presented in Table 1 below, the mean score obtained by the 400 subjects as regards to prevalence of obesity was 15.72 with a standard deviation of 3.38 while the 177 males had a mean score of 14.18 with a standard deviation of 3.37 and the 223 females had a mean score of 16.95 with a standard deviation of 2.84.

Table 1

Mean scores and standard deviations of subjects in the study variables (N=400)

SN	Sub variables	Groups		Mean	SD
1.	Prevalence of obesity	Male	177	14.18	3.37
		Female	223	16.95	2.84
		Total	400	15.72	3.38

In this section the null hypothesis of the study was re-stated, the independent and dependent variables identified as well as describing the statistical analysis technique used to test the hypothesis.

Hypothesis 1:

The hypothesis stated that gender does not significantly influence the prevalence of obesity among adolescents in private and public secondary schools in Calabar metropolis. The independent variable is sex which was categorized into male

and female while the dependent variable is prevalence of obesity. The hypothesis was analyzed using Independent t-test analysis tested at .05 levels of significance. The result of the analysis is presented in Table 2.

The result in Table 2 revealed that the mean score obtained by the 223 female subjects as regards to prevalence of obesity was 16.95 with a standard deviation of 2.84 is greater than the mean score of 14.18 with a standard deviation of 3.37 obtained by the 177 male subjects. The mean difference was statistically significant since the obtained t-value of 8.744 with a p-value of .000 at 398 degrees of freedom met the criteria for significant at .05 level. This shows that female subjects differ significantly from their male counterparts as regards to prevalence of obesity with the females being more prevalence to obesity.

Table 2 Independent t-test analysis of school type and prevalence of obesity

Sex	N	$\bar{X}$	SD	t-value	p-level
Male	223	16.95	2.84	8.744*	.000
Female	177	14.18	3.37		

*Significant at .05 level; p<.05; df=398.

Hypothesis 2

The second hypothesis stated that there is no significant difference between the Body Mass Index (BMI) and obesity in private and public secondary schools in Calabar Metropolis. The independent variable is school type which was categorized into private and public while the dependent variable is BMI of adolescents.

The hypothesis was analyzed using Independent t-test analysis tested at .05 levels of significance. The result of the analysis is presented in Table 3.

The result in Table 3 revealed that the mean score obtained by the 200 subjects from private school as regards to BMI was 28.65 with a standard deviation of 3.23 which is greater than the mean score of 23.87 with a standard deviation of 2.58 obtained by the 200 subjects from public school.

The mean difference was statistically significant since the obtained t-value of 16.413 with a p-value of .000 at 398 degrees of freedom met the criteria for significant at .05 level. This shows that adolescents in private schools in Calabar Metropolis differ significantly from their counterparts in public schools as regards to BMI with those from private school having more BMI.

Table 3: Independent t-test analysis of school type and Body Mass Index (BMI)

School type	N	$\bar{X}$	SD	t-value	p-level
Private school	200	28.65	3.23		
				16.413*	.000
Public school	200	23.87	2.58		

*Significant at .05 level; p<.05; df=398.

Discussion

This section focused on the discussion of findings, which emerged as a result of the present investigation in relation to related theories and previous studies. The presentation was done on the basis of the hypotheses

Gender difference and obesity in public and private schools:

The result in hypothesis one revealed that female adolescents differed significantly from their male counterparts as regards to prevalence of obesity with the females being more prevalent to obesity. The result is in support of the findings of Rachael, (2019) on sex differences in regional body fat distribution from pre to post puberty, the objective of the study was to determine the timing and magnitude of sex differences in regional adiposity from early childhood to young adulthood. Regional fat distribution was measured using dual-energy X-ray absorptiometry (trunk and extremity fat using automatic default regions and waist and hip fat using manual analysis) in 1,009 predominantly white participants aged 5–29 years. Subjects were assigned into pre (Tanner stage 1), early (Tanner stages 2–3), late (Tanner stages 4–5), and post (males ≥20 years and females ≥18 years) pubertal groups. Sexual dimorphism in trunk fat (adjusted for extremity fat) was not apparent until late puberty, when females exhibited 17% less trunk fat than males. By contrast, sex differences in waist fat (adjusted for hip fat) were apparent at each stage of puberty, the effect being magnified with age, with prepubertal girls having 5% less and adult women having 48% less waist fat than males. Girls had considerably more peripheral fat whether measured as extremity or hip fat at each stage. Sex differences in regional adiposity were significantly greater in young adults in private schools than in late adolescence in public schools. Also, the result is in support of the study by Heude, (2016) on Sexual dimorphism in which circumference measures was also apparent from a young age with elevated waist circumference and/or waist-to-hip ratio or lower hip circumferences being reported higher in girls than boys as young as 5–7 years. Also (Garnett, 2014, Mast, 2018, Kirkby, 2014), which their data support this work, demonstrating that females has lower waist and greater hip circumferences from early puberty than their male counterparts.

Prevalence of Body Mass Index of adolescents in public and private schools:

The result in hypothesis two shows that adolescents in private schools differ significantly from their counterparts in public schools as regards to BMI with those from private schools having more BMI. The result agrees with a study by Ifeoma and Nwadiuto, (2012) on weight status of adolescents in public and private secondary schools in Port Harcourt using Body Mass Index (BMI), the mean BMI of females in private schools in the study was significantly higher than that of females in public secondary schools from 11 years of age throughout adolescence. Similar trend was observed by Ukegbu, Onimawo and Ukegbu, (2017), and Mukhopadhyay, Bhadra & Bose, (2015). This is different from NHANES findings in which the BMI of males and females were almost identical in public secondary schools. This difference in the BMI between sexes may be as a result of increased fat mass in females in contrast to males who stabilize their fat mass and enlarge their fat free mass.

According to Benefice, Caius and Garnier (2013), the fact that males were taller than females might also have contributed to their low BMI since height is a denominator in calculating BMI in public secondary schools. The result is also in support with a study by Okoth, Ochala, Onwera and Steyn (2015) on determinants of overweight and obesity in Kenyan adolescents in public and private schools, the study aimed at measuring the determinants of overweight and obesity, namely body mass index (BMI), dietary intake and physical activity levels of students (15-19 years) at public (less affluent) versus private (more affluent) schools in Kisumu East District of Kenya (n=387). A 24-hour dietary recall and 7-day food frequency were conducted with each participant. Physical activity levels were measured using the physical activity questionnaire for

adolescents. A higher percent of overweight adolescents was found at private schools than public schools. Overall, 15.5% of adolescents were overweight or obese (BMI>=25). Students at private schools had significantly higher intakes of all nutrients than those at public schools, except for cholesterol and fibre. Differences between private schools and public schools were particularly high for energy, fat, carbohydrate, and polyunsaturated fats, respectively. Carbohydrates, fruit and vegetables, and fats were negative predictors while meat and eggs and protein were positive predictors of BMI. Physical activity levels were lower at public schools than at private schools. The prevalence of overweight students was highest at private schools as were intake of calories, carbohydrate, and fat, suggestive of increased urbanization of lifestyle and associated rise in NCDs. Determinants of overweight and obesity, namely body mass index (BMI), dietary intake and physical activity levels of students (15-19 years) at public (less affluent) versus private (more affluent) schools in Kisumu East District of Kenya (n=387). A 24-hour dietary recall and 7-day food frequency were conducted with each participant. Physical activity levels were measured using the physical activity questionnaire for adolescents. A higher percent of overweight adolescents were found at private schools than public schools. Overall, 15.5% of adolescents were overweight or obese (BMI>=25). Students at private schools had significantly higher intakes of all nutrients than those at public schools, except for cholesterol and fiber. The prevalence of overweight students was highest at private schools as were intake of calories, carbohydrate, and fat, suggestive of increased urbanisation of lifestyle and associated rise in NCDs. However, private school students did have a significantly higher intake of calories, and fat, indicative of a more urbanized diet. This was also reflected by a higher prevalence of overweight in the private schools, which further reflects the influence of increased socio-economic status. The finding that the prevalence of overweight was higher in these schools than that of the DHS further supports the finding of the strong association of increased affluence with increased BMI status. It also emphasizes the importance of dealing with overweight and its sequalae at a young age to prevent the eventual rise in prevalence of NCDs in adulthood (Okoth, Ochala , Onwera & Steyn, 2015).

Conclusion

Based on the result of the findings, it was concluded that:

1. There were significant differences between adolescents in private secondary schools and public secondary schools in Calabar Metropolis, Cross River State-Nigeria regarding prevalence of obesity.
2. The positive effect of education on obesity can summarily be attributed to greater access to health-related information and improved ability to handle such information by the educated, clearer perception of the risks associated with lifestyle choices and improved self-control and consistency of preferences over time.

Recommendations

1. Private school students most especially the adolescents should be involved in proper fitness programmes to help in improving their health thereby reducing the risk factors of having obesity related disorders.
2. The school should organize physical fitness activities programmes for students in private schools on a regular basis at both senior and junior classes so as to develop good respiratory endurance, body composition and flexibility among others.
3. Parents should encourage their children to make good use of their leisure hours by reducing time-taking in sedentary activities like computer games, watching cartoons and movies. But encourage participation in domestic work. This will help in minimizing sedentary life style of the children.

References

Adesina A.F, Peterside, O, Anochie I, & Akani, N.A.(2019). Weight Status of adolescents in secondary schools in Port Harcourt using BMI. Ital J Pediat; 38:31.

Akinpelu A.O, Oyewole O.O, & Oritogun K.S.(2018). Overweight and Obesity: Does it occur in Nigerian adolescents in an urban community? *Int J Biomed Health Science*; 4:25-38.

Alabi, A.(2018). The relationship between basal blood pressure and body mass index in apparently healthy Nigerian adolescents. Dissertation submitted to West African college of physicians. West African College of Physicians, Lagos State. Chhatwal J, Verma M, and Riar S.K.(2014). Obesity among pre-adolescent and adolescents of developing country (India). *Asian Pacif J ClinNutr*; 13(3):231-235.

Benefice E, Caius N, & Garnier, D. (2013). Cross-cultural comparison of growth, maturation and adiposity indices in two contrasting adolescent populations in rural Senegal (West Africa) and Martinique (Caribbean). *Public Health Nutr*. 7: 479-485.

Cross River State Ministry of Education. (2017).

Dorosty, A.R. Siassi, P.M. & Reilly, S.(2016). Factors associated with early adiposity rebound. A longitudinal study of pregnancy and childhood study team. *Pediatric, 105,118-200.*

Eme, A.S, (2017). Activity, dietrary intake, and weight changes in a longitudinal study of pre-adolescent and adolescent boys and girls. *Pediatrics. 105, E56.*

Garnett, S. P. (2014). Relation between hormones and body composition, including bone, in prepubertal children. America Journal of Clinical Nutrition;80:966–972

Goossens L, Braet C,and Decaluwe V. (2017). Loss of control over eating in obese youngsters. *Behaviour r therapy*; 45(1):1–9.

Heude, B. (2016) Growth curves of anthropometric indices in a general Population of French children and comparison with reference data. *Europe Journal of Clinical Nutrition*; 60:1430–1436.

Isangedighi, A.J. (2018). *Essentials of Research and Statistics in education and social sciences.* Calabar: Antia Printing Press.

Izuora, A.N (2017). Skinfold thickness, body mass index and the prevalence of obesity in school children aged 5 to 18 years in Lagos state, Nigeria. A dissertation submitted to the National Postgraduate Medical College of Nigeria. The National Post Graduate Medical College of Nigeria, Lagos State, Nigeria.

Jain G, Bharadwaj S .K, & Joglekar, A.R.(2017). To study the prevalence of overweight and obesity among school children (13-17 years) in relation to their socio-economic status and eating habits. *Int J. Sci Res Publ*; 2(6):1-4.

Jung, H.P, et al. (2020). Sedentary lifestyle: overview of updated evidence of potential health risks. South Corea. Journal of public health.

Kirkby, J. (2014). Sex differences in resting energy expenditure and their relation to insulin resistance in children (EarlyBird 13). *America Journal Clinical Nutrition*;80:430–435.

Luke, A. D. (2012). Activity energy expenditure and adiposity among black adults in Nigeria and United States. *American journal of clinical nutrition . 75(6),1045-1050.*

Lynniki,L. Young, B.H, Riggs, N.A & Davis, E.E. (2021). The Assessment of the Nutritional Status of the Community. World Health Organization Monograph, Series No. 53, Geneva.

Manyanga, T. (2018). The prevalence of underweight, overweight, obesity and associated risk factors among school-going adolescents in seven African countries. *BMC Public Health*, 14(1), 1–11.http://doi.org/10.1186/1471-2458-14-887.

Mast, M. (2018). Gender differences in fat mass of 5-7-year old children.

Mukhopadhyay, A, Bhadra, M and Bose K (2015). Anthropometric assessment of nutritional status of adolescents of Kolkata, West Bengal. *J. Hum Ecol*. 18: 213-219.

Must, A. (2017). Long term morbidity and mortalty of overweight adolescents. A follow –up of the Harvard Growth study. *New England journal of medicine 3(27), 1350-1355.*

Nwadiuto, C.A. (2012). Socio-economic status and obesity in adult populations of developing countries: A review. Bulletin of World Health Organization, 82, 940-946.

Okoh, M.A., Ochola, S., Onywera, V. & Steyn, N.P. (2015). Determinants of overweight and obesity in Kenyan adolescents in public and private schools. *African Journal for Physical, Health Education, Recreation and Dance*, 21(1:2), 261-272.

Rachael, B.G. (2019). Sex differences in regional body fat distribution from pre to post puberty. Unpublished thesis from university of Enugu, Enugu state Nigeria.

Ugbong, S. E. (2019). Relationship between bioelectrical impedance analysis and body mass index in adolescent urban Nigerians. *West African Journal of Medicine,* 30(2), 99–103

Ukegbu, P.O, Onimawo, I.A & Ukegbu, A.U (2017). Nutritional status and energy intake in Umuahia, Urban, Nigeria. *Pakistan J Nutr*. 6: 641-646. 10.3923/pjn.2007.641.646.

World Health Organization (2018*). Reducing risk, promoting healthy life.* Geneva: World Health Report.