IOSR Journal Of Pharmacy
(e)-ISSN: 2250-3013, (p)-ISSN: 2319-4219
Www.Iosrphr.Org Volume 3, Issue 4 (May 2013), Pp 60-66

Types of Obesity and Its Effect on Blood Pressure of Secondary School Students in Rural and Urban Areas of Cross River State, Nigeria

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***ABSTRACT**: A study to describe the types of obesity and its effect on blood pressure of secondary students in rural and urban areas of Cross River State(CRS) was carried out. The design of the study was a cross sectional descriptive survey involving the sampling of secondary school students within the age 12-21 in Cross River State, Nigeria. A simple random sampling was used to select four schools from 25 urban and 14 rural secondary schools in Southern Senatorial District of Cross River State. Systematic random sampling was used to draw a sample of 480 senior secondary students from a population of 6130 senior secondary students enrolled in 39 secondary schools in rural and urban areas of the study area. Body Mass Index (BMI) and Hip/Waist Ratio (HWP) were used to classify the different types of obesity in the study area. The result showed that there are different types (abdominal, peripheral, central and mixed types) of obesity among adolescents in the study area with mixed obesity been the highest and that the prevalence of obesity was higher in the urban than in the rural area.*

***KEYWORDS**: waist hip ratio, body mass index, obesity, adolescent, abdominal, peripheral, and gluteal*

I. INTRODUCTION

Obesity which was predominantly in affluent countries is a potential health problem in developing countries despite the poor socio-economic situation (23, 3). In Nigeria, 18% of adolescents are reported to be obese (24). Similarly, there is increasing prevalence of obesity among women of childbearing age. Obesity is also said to be higher in urban than in rural communities (11).In a study conducted in Cross River State, Calabar, Nigeria, the prevalence of obesity in children and adolescents was estimated to be 2.3% to 4.0% (25). It was therefore concluded that Nigeria would experience a rise in the prevalence of obesity in the near future. This implies that there would be an increase in the prevalence of chronic diseases such as cardiovascular diseases and other non-communicable diseases whose trend follows an increased prevalence of obesity (21, 26). Obesity, in children and adolescents, tracts into adulthood, where the link between obesity and disease is well established (25). Hypertension is also very common in obese children and adolescents (19). This has been attributed mainly to the fact that high cardiac output in children is usually due to excessive sodium intake; increased steroid production and alteration in reception for various pressor substances. It is also known that hypertension in obese children is 20 times more common than in non-obese children (13). Other cardiovascular risk factors associated with obesity in children and an adolescent is dyslipidaemia. This is said to be frequent in obese children and is related to increased abdominal fat. Abdominal fat may cause a rise in intra-abdominal pressure, which may result in gastro-esophageal reflux and gastric emptying disturbances (17). This occurs in a minority of obese children (13).Obesity could be classified in several ways; these include age, distribution of fat, nature of fat, body mass index. Accumulation of fat has been classified as mild (excess fat of 20% to 40% Overweight), moderate (41% to 100% overweight), and severe (over 100% overweight) (6)

When the increase in body weight is due to the number of fat cells, it is referred to as hyperplastic obesity. When it is due to enlargement of fatty cells with little or no change in the number of fat cells, it is classified as hypertrophic obesity. Hyperplastic obesity is also referred to as juvenile obesity while hypertrophic obesity is also known as adult obesity (15). Obesity can be classified, according to the distribution of fat, as central or abdominal and peripheral or gluteal. Abdominal obesity is said to be more dangerous and associated with high risk of comorbidity and mortality. Peripheral is generally due to subcutaneous fat while abdominal although partially subcutaneous, involves more of the visceral organs (27).Obesity has also been classified using the age of onset. These include childhood obesity, early childhood, and middle age obesity (7). These are the critical periods of development of obesity. Childhood obesity occurs because of increased risk nutrition during fetal life that may contribute directly to the development of the size, shape and composition of the body of the fetus (7) and also due to the metabolic incompetence of the child to handle macronutrients. .

There is also a relationship between the pattern of intrauterine growth and the risk of abdominal fatness and its comorbidities in later life (2).Early childhood obesity that occurs between the ages of 5-7 years is as a result of adiposity rebound. The tendency for indicators of adiposity such as BMI to fall around the age of one year, and then increase again by around 5th year is referred to as 'adiposity rebound'. It is now evident, that the earlier the rebound the greater the risk of subsequent obesity, although what drives the timing of adiposity rebound remains obscure (5). This is also the period when body mass index begins to increase rapidly. This also coincides with increase autonomy and socialization and so may represent a stage when the child is partially vulnerable to the adoption of behaviours that both influence and predispose the child to the development of obesity (4, 11). It is however, uncertain whether early adiposity rebound is associated with an increased risk of persistent obesity in later life. However, the most important predictor of adult obesity appears to be adolescent weight and changes of BMI during this time (16). The older a child is, when he or she remains overweight, the greater the likelihood that overweight will remain in adulthood (1). Middle age obesity is due to a reduction of physical activity and this usually occurs between the ages of 19 and above in females while in men it occurs from age of 30 years (18). This can also fall within the period of pregnancy and menopause in women (14). Gestational obesity is the obesity that occurs during pregnancy. This is because this is a period associated with increased meals, changed food habits and periods of inactivity, leisure combined with physiological changes that promote increased fat deposition (9). Obesity could also be classified depending on its cause as genetic, hypothalamic, physical inactivity, dietary and endocrine disorders. It has also been classified using its pathogenic mechanism i.e. metabolic or regulatory (6).World Health Organization (2000) has also classified obesity using Body Mass Index as (normal) 18-24.5 (Overweight) 25-29.9, (severe obesity) 30-40, and (super obesity) > 50 for adults. However, as these criteria underestimate obesity in Asians, the international obesity Task Force (IOTF) has proposed the standards for adult obesity in Asia and India as follows. BMI>23= overweight and BMI>25 =obesity (26). This study is therefore aimed at classifying the different types of obesity using BMI and Waist Hip Ratio (WHR) and their effect on Blood Pressure (BP) among rural and urban secondary school students in Cross River State, Nigeria.

II. MATERIALS AND METHODS

The study setting was the Southern Senatorial District of Cross River state. The southern senatorial district of Cross River State has six Local Government Areas (LGAs). This study was based on two of these LGAs i.e. Calabar Municipality and Akpabuyo LGA This study targeted the secondary school students in Calabar Municipality and Akpabuyo LGA. The estimated population for secondary school students in Calabar Municipality was 9804, of which SS1 to SS3 students constituted 4,804. In Akpabuyo, the population of secondary school students was about 3,678 while that of students from SS1 to SS3 was 1,226. Therefore, the targeted population of both Calabar municipality and Akpabuyo was 6130.The study was a cross sectional descriptive survey. Multistage sampling technique was used. The schools were stratified into rural and urban according to their locations. Samples were drawn from the urban and rural schools separately by simple balloting. Four schools were selected from the urban and four from the rural setting; and 480 students were selected from 8 schools using systematic random sampling.

2.6.2 Weight measurement (Kg).

A bathroom scale calibrated from zero to 120Kg was used to measure the weight of the subjects. The scale was checked and corrected for zero error before every measurement. Each subject was allowed to wear only the school uniform for measurement; all shoes and sweaters were removed. The weight was read to the nearest 0.5 Kg.

2.6.3 Waist and hip circumference measurement (cm)

A measuring tape was used to take the waist circumference and the hip circumference. The subject was asked to remove all heavy clothing around the waist (belts and other thick clothing) before the measurement was taken to ensure accuracy. The waist measurement was taken at the midpoint between the lower border of the rib cage and the iliac crest (15).The subject was asked to stand and the measuring tape wrapped round his waist from the zero mark and the reading taken. The hip circumference was taken at maximum level of the gluteal region. Moving the measuring tape to and fro until a highest value was read. This was done to ensure accuracy. The hip/ waist ratio was then calculated from the results.

2.6.4 Height measurement (m)

A suitable and level place was chosen for the wall to be calibrated, so as to avoid variations in the readings. The wall was calibrated using a meter mile, from a point from the ground. The subject was asked to remove shoes and stand up- right by the wall and reading was taken to the nearest 0.5m. The measurements of the weight and the height were used to calculate the BMI, which was used to assess the nutritional status, overweight and obesity.

2.6.5 Measurement of blood pressure (mmHg)

The Sphygmomanometer and Stethoscope were used, the former made–up of a cuff, manometer bulb and pressure pump. The auscultatory method was used to determine the systolic and the diastolic arterial pressures. Subjects were asked to sit on an armchair, relaxed for about fifteen minutes, before this measurement was taken. Excited subjects were excluded from these exercise i.e. hyper-reactive subjects. The blood pressure cuff was inflated around part middle of the upper arm. The bulb of the stethoscope was placed in the cubital fossa just above the antecubital artery. The blood pressure cuff was inflated using the pressure pump to a pressure well above normal, until no sound was heard from the stethoscope. Then the pressure was reduced gradually by releasing the pressure pump slowly. This was done until the first sound was heard. The reading on the manometer when this sound was heard corresponded to the systolic pressure and was recorded immediately. The pressure was further reduced gradually until no sound was heard. Immediately the sound disappeared, the reading on the manometer was recorded and this corresponded to the diastolic pressure. This method allows 10% error (15).

III. RESULTS

3.1. Body mass index (BMI)

Table 1 shows the prevalence of classes of body mass index (BMI) by sex and residence among rural an urban secondary school adolescents in southern senatorial district, CRS. Ighteen percent (18%) of the students (10% males and 7.5%females) were obese, 10.22% of these were in the urban area while 7.3% were in the rural area. The difference in the proportion of male and female students who were obese in the rural and urban areas was statistically significant (p= 0.04). Approximately 5% of the students were underweight (1% in the rural and 4% in the urban area); of these 2% were males and 3% were females. The difference in the proportion of males and females students who were underweight in the rural and urban area was not statistically significant (p= 0.5). In the urban and rural areas, 8.96% and 15.4% of the students respectively had normal weight (6.7% males from the rural area and 3.33% male from the urban area; 8.75% were females from the rural area while 5.63% were females from the urban area). About 15% of the females in the rural area and 14.4% of females in the urban area were overweight while 11.67% of the males in the rural area and 12.92% of the males in the urban area were overweight. The difference in the proportion of males and females of overweight students in rural and urban areas was not statistically significant (p=0.73)

TABLE 1

Prevalence of classes of body mass index by sex and residence among rural and urban secondary school adolescents in Cross River State, Nigeria. (n =480)

Classes of BMI	**Rural (%)**	**Urban (%)**	**Total(%)**
Underweight (BMI<18)			
Male	2(0.42)	5(1.04)	7(1.46)
Female	3(0.63)	12(2.5)	15(3.13)
Subtotal	5(1.04)	17(3.54)	22(4.58)
Normal (BMI≥ 18≤20)			
Male	32(6.66)	16(3.33)	48(10)
Female	42(8.75)	27(5.63)	69(14.38)
Subtotal	74(15.42)	43(8.96)	117(24.38)
Overweight (BMI≥20≤24)			
Male	56(11.67)	62(12.92)	118(24.58)
Female	70(14.58)	69(14.38)	139(30)
Subtotal	126(26.25)	131(27.3)	257(53.54)
Obese (BMI>24)			
Male	25(5.21)	23(4.79)	48(10)
Female	10(2.08)	26(5.42)	36(7.5)
Subtotal	35(7.29)	49(10.22)	84(17.5)
Total	240(50)	240(50)	480(100)

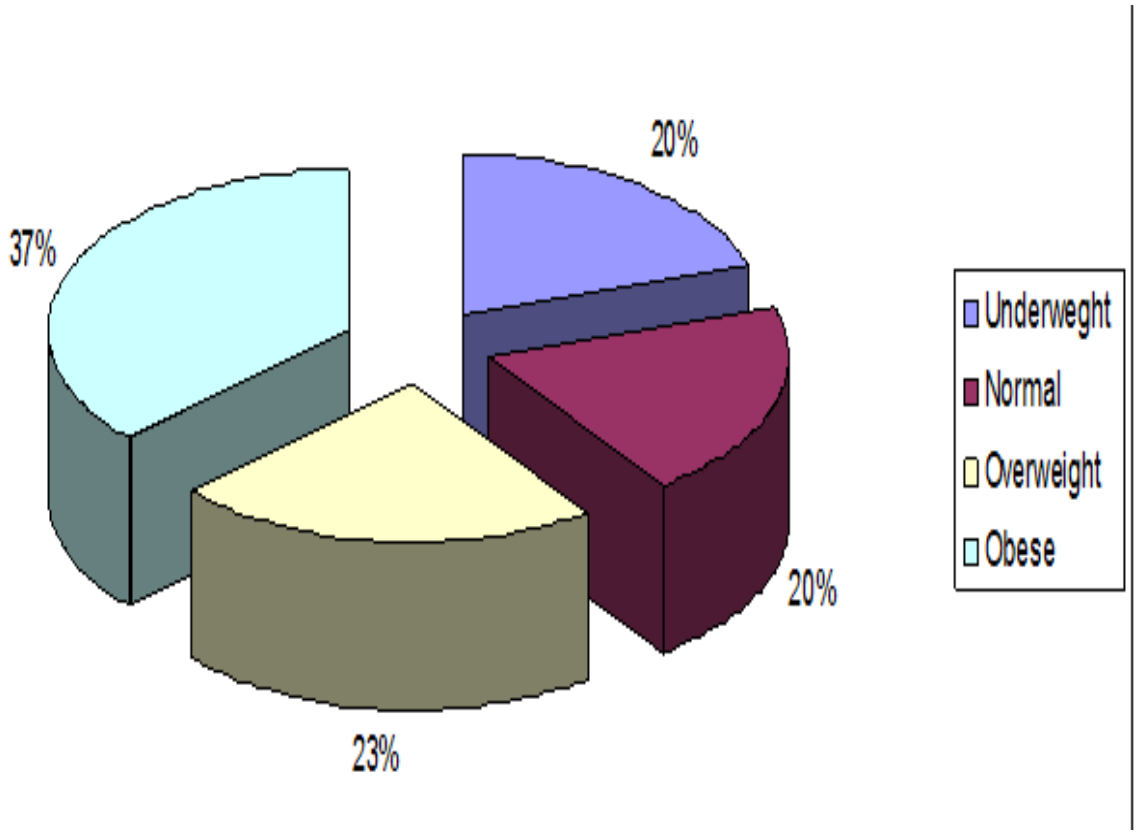

FIG 1 Proportion of students with different classes of BMI and family history of obesity

4.5 Classification of body mass index (BMI)

Fig 2 shows classification of obesity into various types among secondary school adolescents in rural and urban areas in southern senatorial district of CRS. About 7.3% of the obese students had mixed (peripheral and abdominal) obesity; 1.9% and 5.4% of these were in the rural and urban areas respectively, while a total of 2.1% and 0.63% had peripheral and abdominal obesity respectively. About 6.9% had no particular type of obesity (2.3% in the rural and 4.6% in the urban areas).

4.6 Resting blood pressure and obesity

The classes of BMI and resting blood pressure of secondary school adolescents in southern senatorial district, CRS are shown in table 10. The mean diastolic pressure of underweight females and males were 76.4mmHg and 78.8mmHg, respectively while the mean diastolic pressure for obese females and underweight females were 83.5mmHg and 76.4mmHg respectively. Similarly, obese and underweight males had a mean systolic pressure of 126mmHg and 120mmHg respectively. Fig 3 shows classes of BMI and mean systolic pressures by residence of students. The mean systolic pressures of underweight students in rural and urban areas were 120mmHG and 117mmHg respectively. The mean systolic pressure of obese students was 127.7mmHg in the rural area and 123mmHg in the urban area. Fig 4 shows the classes of BMI and mean resting diastolic blood

pressure by

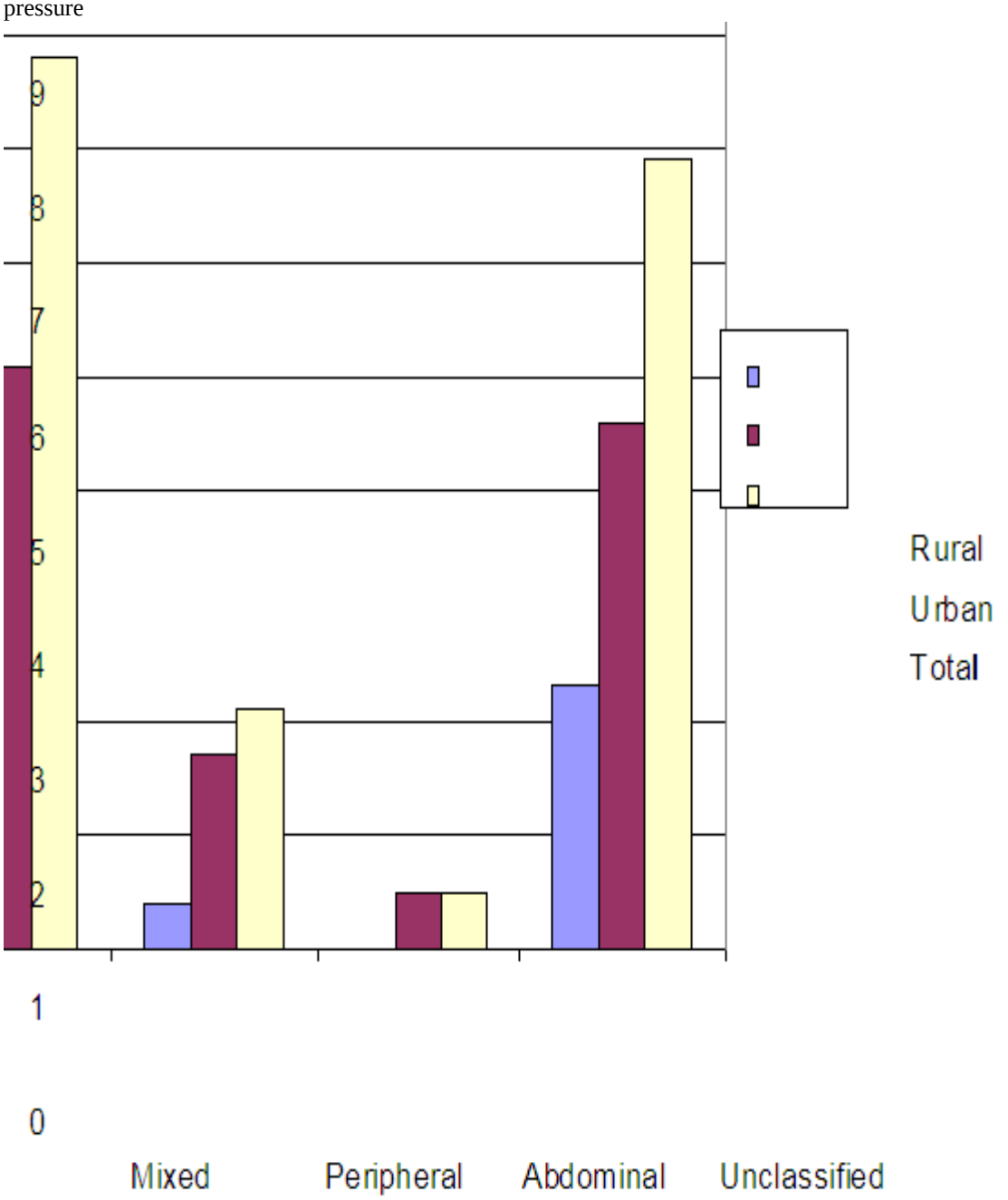

FIG 2: Classification of obesity into various types among secondary school adolescents in rural and urban areas of Southern Senatorial District , CRS.

Waist/hip ratio>0.8 for females and> 0.9 for males Hip/waist ratio >1.02
**Hip/waist ratio >1.02waist/hip ratio.>0.8
***Waist /hip ratio >0.8 Hip/waist ratio <1.02

TABLE 2

Distribution of classes of BMI and mean blood pressure by sex in rural and urban secondary school adolescents in Southern Senatorial District , CRS.

Classes of BMI	**Male**	**Females**
Underweight (BMI<18)		
Diastolic Pressure	78.8	76.4
Systolic Pressure	120.5	118.6
Normal (BMI≥ 18≤ 20)		
Diastolic pressure	77.0	73.8
Systolic pressure	119	117
Overweight (BMI >20 ≤ 24)		
Diastolic pressure	79.3	77.5
Systolic pressure	121.8	119.8
Obese (BMI >24)		
Diastolic pressure	79.5	83.5
Systolic pressure	126.6	123.5

IV. CONCLUSION

Body Mass Index correlates with markers of secondary complications of obesity, including blood pressures, blood lipids and long-term mortality (8, 9, 10, 11). The mean resting blood pressures of students in the different classes of BMI was found to be higher in overweight and obese students than in underweight and normal weight students. This finding is similar to a WHO study that reported that obese children were prone to higher blood pressures than non-obese students (20). The finding is also supported by the fact that hypertension in obese children is 20 times more common than in non-obese children (13). The boys also had a higher mean systolic blood pressure and mean diastolic blood pressure than the girls. This could be because the prevalence of obesity was higher among the boys than in the girls. Since blood pressure increases with increased BMI, there was a higher mean resting blood pressure in the proportion of obese boys than the proportions of obese girls. The mean resting systolic blood pressure of overweight and obese students was within the normal range although there were some variations in the different classes of BMI in rural and urban areas. The mean resting diastolic blood pressure though higher in the urban than in the rural area the resting blood pressure the values were within normal range. This could be explained by the fact that BMI was higher in the urban than in the rural area and mean resting systolic blood pressure and diastolic blood pressures tend to increase with increased BMI. The higher mean systolic blood and diastolic blood pressures observed in urban area than in the rural area is probably due to the higher BMI in the urban area compared to the rural area.

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