PHS Scientific House
PHARMAHEALTHSCIENCES

International Journal of Pharma Research and Health Sciences

Available online at www.pharmahealthsciences.net

Original Article

Waist Circumference as a Measure to Determine Obesity among Primary School Children in Ogoni, Rivers State

Okoh Peter Done[1], Amadi Michael Anozie[2, *], Benwoke Woroma Ibiwari[2]

[1]Department of Anatomy, Faculty of Basic Medical Sciences, College of Health Science, University of Port Harcourt, Port Harcourt, Nigeria.

[2]Department of Anatomy, Faculty of Basic Medical Sciences, PAMO University of Medical Sciences, Port Harcourt, Nigeria.

ARTICLE INFO

Received: 20 Aug 2020
Accepted: 12 Sep 2020

ABSTRACT

Study of body proportion is useful in investigating nutrition-related disorders that are of clinical and public health concerns such as obesity among individuals in different populations. The aim of this study was to study waist circumference as a measure to determining obesity among primary school children in Ogoni. This study was a cross-sectional survey that made use of 1000 randomly selected school children in Ogoni, Rivers State within the ages of 6 – 12 years divided into 489 males and 511 females drawn from primary schools in Ogoni. Waist circumference was measured with the subject in a standing position and measuring tape placed horizontally around the waist region, corresponding to the superior iliac crest and then crossing the line to indicate the mid axillary line of the body. Measurement was carried out at minimal respiration to the nearest 0.1cm and recorded. Data obtained was subjected to statistical analysis using IBM SPSS version 23. Continuous variables were presented as mean ± SD. Analysis of variance (ANOVA) was done to establish significant differences in the measured parameters according to age group. Age was categorized into four groups (6 – 7, 8 – 9, 10 – 11, ≤12 years). Independent sample t-test was carried out to determine significant difference in the measured parameters between sexes. The confidence interval was set at 95%, therefore $p<0.05$ was considered significant. Result showed that mean WC was 56.5±3.56cm while BMI was 15.21±3.40kg/m². Mean WC for males was 56.70±2.78cm and 58.07±2.10cm for females whereas mean BMI for males and females were 56.70±2.78 and 58.07±2.10 respectively. Mean WC and BMI were found to be higher among females. This variation between sexes was statistically significant ($\rho<0.05$). Across age groups, variation was observed as the parameters increased with increasing age. This variation was statistically significant ($\rho<0.05$). It could be concluded that primary school children in Ogoni are not obese while increase in WC as age increased indicated growth.

Keywords: waist circumference, BMI, obesity, school children, Ogoni.

Corresponding author *
Amadi Michael Anozie
Department of Anatomy, Faculty of Basic Medical Sciences, PAMO University of Medical Sciences, Port Harcourt, Nigeria.
E Mail: michaelamadi27@gmail.com

1. INTRODUCTION

Obesity is a medical condition characterized by an abnormal fat accumulation which is detrimental to health [1, 2]. Excessive intake of energy-dense foods, physical inactivity and genetic susceptibility are known causative factors of obesity [3, 4]. Excess weight is one of the leading causes of morbidity and mortality and is exponentially increasing worldwide [5, 6]. Currently, over half a billion adults are considered obese [2].

Obesity and body fat distribution are associated with several chronic diseases including hyperlipidemia, hyperinsulinemia and hypertension [7, 8, 9, 10]. From a clinical view, estimation of adipose tissue distribution must therefore be considered as important in the evaluation of the patient's cardiovascular risk profile [11]. There are numerous methods of assessing overweight, obesity and fat distribution such as measurements of weight, height, waist, hip, midarm, thigh and calf circumferences and calculations of waist-to-hip ratio, and BMI. For many years, the waist-hip ratio (WHR) was used for evaluation of the body fat distribution. But in some studies, it was reported that waist circumference is more closely associated with the central fat distribution than WHR [11, 12]. Recently, another anthropometric index, waist-to-height ratio (WHtR), was shown to be better correlated with metabolic risk factors [13, 14, 15]. However, the best method for evaluation of the fat distribution is computed tomography. Nevertheless, computed tomography (CT) is impractical as a routine method for measuring because of radiation exposure and high cost [11, 16, 17, 18, 19]. Thus, a practical alternative to CT and magnetic resonance imaging (MRI) is anthropometry. Instruments for measuring the anthropometric dimensions are portable and inexpensive, and procedures are noninvasive and easily applied [20]. The two most commonly anthropometric methods used are body mass index (BMI) and waist circumference (WC).

Body mass index (BMI) is widely used in the diagnosis of overweight and obesity, whereas waist circumference (WC) and indices based on WC–such as waist-to-hip ratio (WHR), and waist-to-height ratio (WHtR)–are employed as surrogate indicators of visceral obesity to predict morbidity and mortality at the population level [21, 22, 23]. These anthropometric indices are used in epidemiological studies for population surveillance of risk factors for chronic disease [24] because they can be easily measured and at a low cost [25].

The use of anthropometric measurements is a well-established practice for many clinical purposes including screening and health risk assessment. This is particularly useful in the paediatric and young populations as these measurements can be used to track growth rate and identify abnormal growth trends. From the period a child is born to the age of maturity, a lot of changes take place. Therefore, waist circumference, height and weight of children are important anthropometric parameters used clinically to enable clinicians to know young individuals who could be at health risk of being overweight or obese. The aim of this study therefore, was to use waist circumference as a measure to determine obesity among primary school children in Ogoni, Rivers State.

2. MATERIALS AND METHODS

2.1 Study Population

Anthropometric data were collected from 1000 randomly selected school children in Ogoni, Rivers State within the ages of 6 – l2 years divided into 489 males and 511 females drawn from primary schools in Ogoni between 2014 - 2016. Subjects were divided into four age groups as follows: 6 – 7 (n =227), 8 – 9 (n=315), 10 – 11 (n =266) and ≤12 years (n=192). All subjects fell within the normal BMI (18.5 – 24.9). Data obtained was subjected to statistical analysis using IBM SPSS version 23. Continuous variables were presented as mean ± SD. Analysis of variance (ANOVA) was done to establish significant differences in the measured parameters according to age group. Age was categorized into four groups Independent sample t-test was carried out to determine significant difference in the measured parameters between sexes. The confidence interval was set at 95%, therefore $p<0.05$ was considered significant.

2.2 Data Collection

Ethical approval was sought and obtained from the University of Port Harcourt Research Ethics Committee through the Department of Anatomy. Letters were sent to heads of primary schools (both public and private) to notify them about the study and our intention to use their school pupils as our subjects, and to also seek their permission.

2.3 Anthropometric Measurements

Before each subject was measured, the BMI (kg/m^2) was taken. This was done by collecting weight of the subject using a weighing scale, and stadiometer, to determine the height. Only subjects within the normal BMI range (18.5 – 24.9) were selected for the study. Waist circumference was measured with the subject in a standing position and measuring tape placed horizontally around the waist region, corresponding to the superior iliac crest and then crossing the line to indicate the mid axillary line of the body. Measurement was carried out at minimal respiration to the nearest 0.1cm and recorded.

Only apparently healthy subjects whose BMI fell within the optimal range were selected for the study therefore, subjects classified as underweight and overweight were excluded.

3. RESULTS AND DISCUSSIONS

Parameters increased as age increased in all subjects (table 2). On comparison, the difference was statistically significant ($\rho<0.05$) (table 4). In table 3, WC and BMI mean values of the male subjects were higher than those of the females and these variations were statistically significant ($\rho<0.05$).

Table 1: Descriptive statistics of the measured parameters in all subjects

Parameter	Mean±SD	Min	Max
Age (years)	9.00±4.54	6.00	12.00
BMI (Kg/m^2)	15.21±3.40	14.08	18.47
WC (cm)	56.5±3.56	51.25	64.70

Table 2: Mean values of parameters across age groups

Age (years)	N	WC (cm)	BMI (Kgm^{-2})
6 – 7	227	52.00±3.46	14.07±2.59
8 – 9	315	54.75±3.51	14.45±2.92
10 – 11	266	59.25±4.58	15.99±6.46
≤12	192	63.50±5.33	17.44±6.15

Table 3: Descriptive statistics of parameters according to sex

Parameters	Sex	N	Mean	SD	t-test			
					Df	t-value	p-value	Inference
Age (years)	M	489	8.57	3.27	398.00	2.22	0.04	Significant
	F	511	9.50	3.12				
BMI (Kg/m^2)	M	489	14.06	6.02	73.72	-2.49	0.01	Significant
	F	511	15.15	4.24				
WC (cm)	M	489	56.70	2.78	80.34	-6.58	0.59	Significant
	F	511	58.07	2.10				

Table 4: Comparison according to age group using ANOVA

Parameters	Sum of Squares	Mean Square	Df	F-value	p-value	Inference
Age (years)	1196.10	598.05	2	24.31	0.00	Significant
BMI (Kg/m^2)	705.24	352.62	2	30.57	0.00	Significant
WC	51054.32	25527.16	2	862.11	0.00	Significant

The present study employed the use of waist circumference as a measure to determining obesity among primary school children in Ogoni, Rivers State, Nigeria. According to the International Obesity Task Force, a BMI of 18.5-24.9 kg/m^2 is classified as the optimal range, 25 to 29.9 kg/m^2 is classified as overweight whereas BMI ≥ 30 kg/m^2 is classified as obese. On the other hand, BMI ≤18.5 kg/m^2 is defined as underweight [26, 27, 28]. Obesity is associated with several risk factors for heart disease and other chronic diseases including hyperlipidemia, hyperinsulinemia, hypertension and atherosclerosis [29]. Unfortunately, the prevalence and incidence of obesity are increasing rapidly in both developed and developing countries [19, 29, 30, 31]. Due to public health significance, obesity trends in children and young adult should be monitored.

A study involving Greek medical students revealed that a high proportion of subjects were overweight (27.6%) or obese (4.3%) [26]. Another study in Slovakia reported that 16% of male and 2% of female medical students had a BMI > 25.0 kg/m^2 [32]. Furthermore, a study carried out among 154 medical students in South Africa adjudged the rates of overweight and obesity as 8.9% and 2.5% respectively for Indian and 19.7% and 4.6% for black students [33].

For health promotion, waist circumference is becoming preferred for determination of adiposity given that this measurement reflects total and abdominal fat accumulation [19, 31, 34].

An investigation carried out among Chinese showed that mean WC values were 77.3 ±9.4 cm in women and 83.3 ±8.3 cm in men [35], among Indians, 77.4 ±12.6 cm in women and 79.6 ±11.4 cm in men [36], while the values were found to be 71.3 cm in women and 79.6 cm in men in a 21-year-old Dutch population [37]. Our study was carried out in a young growing population whose WC and BMI are lower compared to values obtained from studies carried out in adult populations. However, the values obtained from our study were normal for subjects of that age bracket.

Studied parameters exhibited sexual dimorphism as the respective mean values of the female subjects were higher than those of the males. These variations were statistically significant ($\rho<0.05$). This is unlike the findings from some previous studies that showed that mean values of these parameters were higher in males than in females. This could be because our study population was a children population. However, Wells [38] explained that sex variations in body fat deposition are apparent even at the foetal stage, but they become quite marked during puberty. Men's total lean mass and bone mineral mass are greater, while having a lower fat mass than women after adjusting for differences in height; these differences last throughout adult life. Women possess considerably more total adipose tissue than men, and these whole-body sex variations are complemented by major changes in tissue distribution. Sex variations in body composition are mainly due to the action of sex steroid hormones, which control the dimorphisms during pubertal development. In men, reduced free testosterone levels is linked with an increase in fat mass and decrease in muscle mass, and both total and free testosterone levels have an inverse relationship with obesity [39].

Body composition shows consistent and substantial transformation with age. Among the age-related patterns is a reduction in fat-free mass, particularly skeletal muscle, an upsurge in overall adiposity and accumulation of adipose tissue at the middle body. As regards body transformations, age-related loss of muscle mass beginning after early adulthood has been reported [40]. In our study, it was observed that parameters increased as age increased in all subjects. This difference was statistically significant ($\rho<0.05$). Per cent body fat might remain constant or increase with age, but ageing is related to considerable redistribution of fat tissue among depots [41]. Beginning from late middle age till the 80s or later, there is a drop in the volume of subcutaneous fat, and a redistribution of fat from subcutaneous to visceral depots. This age-associated decline in the size of adipose depots is accompanied by the accumulation of fat outside adipose tissue (in muscle, liver and bone marrow), and loss of lean body mass [42]. Our finding agrees with that of the NHANES. Data from NHANES show that waist circumference increases with age, and is higher in older than in younger adults of both sexes up to the age of 70 years [43]. Similarly, in the Baltimore Longitudinal Study of Aging, age-related variations in waist–hip ratio were also reported in all BMI categories studied in both men and women [45]. Lahti-Koski [44] reported changes in WC in a study carried out in Finnish adults over a 15-year period. Mean WC was found to increase by 2.7cm in men and 4.3cm in women. BMI also increased over the period of the study, though the variations were relatively small (1.2% or less per 5-year period) in all but the youngest age category (25–34years), while increases in WC were seen in every age group [45].

Studies have shown that a strong association exists between the development of childhood obesity and its prevalence in adulthood. Children who do not present this disease stand a good chance of staying within normal weight in adulthood [46]. Thus, children with an early obesity predispose a prevalence of this disorder during adult stages [47]. According to pharmaceutics, obesity has got treatment options which could be either lifestyle interventions such as changes in diet and physical activity, or pharmacological [48].

4. CONCLUSION

Primary school children in Ogoni, Rivers State belong to a young growing population. Our findings show that these school children are not obese. Increases in WC and BMI as age increased indicated growth. This study can be used as reference for possible evaluation of body composition and fat distribution of primary school children in Ogoni, Rivers Sate. This could find use in clinical practice and epidemiological studies.

5. REFERENCES

1. Navaneelan T, Janz T. Adjusting the scales: obesity in the Canadian population after correcting for respondent bias. Statistics Canada Catalogue; 2014.https://www.150.statcan.gc.ca/n1/pub/82-624-x/2014001/article/11922-eng.htm (Accessed on 3rd June 2019).
2. WHO. Factsheet: World Health Organization; c 2020. Obesity and Overweight.http://www.who.int/mediacentre/factsheets/fs311/en/(Accessed on 7th August 2020).
3. Mathieu P, Lemieux I, Després J. Obesity, inflammation, and cardiovascular risk. Clin Pharmacol Ther 2010; 87:407–16.
4. Mendis S, Puska P, Norrving B. Global Atlas on cardiovascular disease prevention and control. Geneva: Switzerland; 2011.
5. Blouin C. The economic impact of obesity and overweight. Quebec: Institut National De Sante Publique Du Quebec; 2014.
6. Murray C, Ng M. Nearly one-third of the world's population is obese or overweight, new data shows. Institute of Health Metrics and Evaluation; 2014. http://www.healthdata.org/news-release/nearly-one-third-world%E2%80%99s-population-obese-or-overweight-new-data-show (Accessed on 7th August 2020).
7. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. Br Med J 2000; 320: 1240-3.
8. Symonides B, Jedrusik P, Artyszuk L, Grybos A, Dzilinski P, Gaciong Z. Different diagnostic criteria significantly affect the rates of hypertension in 18-year-old high school students. Arch Med Sci 2010; 6: 689-94.
9. Delavari A, Kelishadi R, Forouzanfar MH, Safaei A, Birjandi F, Alikhani S. The first cut off points for generalized and abdominal obesity in predicting lipid disorders in a nationally representative population in the Middle East: The National Survey of Risk Factors for non-communicable diseases of Iran. Arch Med Sci 2009; 5: 542-9.
10. Kostulski A, Pawelczyk T, Rabe-Jablonska J. The risk of significant body weight gain and abdominal obesity during short term treatment with olanzepine. Arch Med Sci 2009; 5: 259-66.
11. Pouliot MC, Despres JP, Lemieux S. Waist circumference and abdominal sagittal diameter: best simple anthropometric indexes of abdominal visceral adipose tissue accumulation and related cardiovascular risk in men and women. Am J Cardiol 1994; 73: 460-8.
12. Fredriks AM, van Buuren S, Fekkes M, Verloove-Vanhorick SP, Wit JM. Are age references for waist circumference, hip circumference and waist-hip ratio in Dutch children useful in clinical practice? Eur J Pediatr 2005; 164: 216-22.
13. Ashwell M, Gibson S. Waist to height ratio is a simple and effective obesity screening tool for cardiovascular risk factors: analysis of data from the British national diet and nutrition survey of adults aged 19-64 years. Obes Facts 2009; 2: 97-103.
14. Lee CM, Huxley RR, Wildman RP, Woodward M. Indices of abdominal obesity are better discriminators of cardiovascular risk factors than BMI: a meta-analysis. J Clin Epidemiol 2008; 61: 646-53.
15. Hsieh SD, Yoshinaga H. Waist/height ratio as a simple and useful predictor of coronary heart disease risk factors in women. Int Med 1995; 34: 1147-52.
16. Taylor RW, Jones IE, Williams SM, Goulding A. Evaluation of waist circumference, waist-to-hip ratio, and the conicity index as screening tools for high trunk fat mass, as measured by dexa in children aged 3-19 y. Am J Clin Nutr 2000; 72: 490-5.
17. Lee RC, Wang Z, Heo M, Ross R, Janssen I, Heymsfield SB. Total-body skeletal muscle mass: development and crossvalidation of anthropometric prediction models. Am J Clin Nutr 2000; 72: 796-803.
18. Hill JO, Sidney S, Lewis CE, Tolan K, Scherzinger AL, Stamm ER. Racial differences in amounts of visceral adipose tissue in young adults: the CARDIA study. Am J Clin Nutr 1999; 69: 381-8.
19. Valsamakis G, Chetty R, Anwart A, Banerjee AK, Barnett A, Kumar S. Association of simple anthropometric measures of obesity with visceral fat and

the metabolic syndrome in male Caucasian and Indo-Asian subjects. Diabet Med 2004; 21: 1339-45.
20. Karakaş P, BozkIr MG. Anthropometric indices in relation to overweight and obesity among Turkish medical students. Arch Med Sci 2012; 2: 209-13.
21. Zazai R, Wilms B, Ernst B, Thurnheer M, Schultes B. Waist circumference and related anthropometric indices are associated with metabolic traits in severely obese subjects. Obes Surg 2014; 24: 777–82.
22. Leitzmann MF, Moore SC, Koster A, Harris TB, Park Y, Hollenbeck A. Waist circumference as compared with body-mass index in predicting mortality from specific causes. PLOS One 2011; 6: e18582
23. WHO. Waist circumference and waist-hip ratio. Report of a WHO Expert Consultation, Geneva: World Health Organization; 2008.
24. WHO. Physical status: the use and interpretation of anthropometry. Report of a WHO Expert Committee. WHO Technical Report Series 854. Geneva: World Health Organization; 1995. http://www.who.int/childgrowth/publications/physical_status/en/ (Accessed on12th June2016).
25. Mueller WH, Wear ML, Hanis CL, Emerson JB, Barton SA, Hewett-Emmett D et al. Which measure of body fat distribution is best for epidemiologic research?, Am J Epidemiol 1991; 133: 858–69.
26. Bertsias G, Mammas I, Linardakis M, Kafatos A. Over - weight and obesity in relation to cardiovascular disease risk factors among medical students in Crete, Greece. BMC Public Health 2003; 3:3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC140012/(7th Aug 2016).
27. WHO. Obesity: preventing and managing the global epidemic. Report of a WHO Consultation (WHO Technical Report Series 894). Geneva: World Health Organization; 2000. https://www.who.int/nutrition/publications/obesity/WHO_TRS_894/en/ (Accessed on 27th 2015 September).
28. WHO. Factsheet No. 311 - Obesity and Overweight. Geneva: World Health Organization; 2006.http://www.who.int/mediacentre/factsheets/fs311/en/index.html (Accessed on 24June 2017).
29. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. Brit Med J 2000; 320: 1240-3.
30. Friedman JM. Obesity in the new millennium. Nature 2000; 404: 632-4.
31. Chan DC, Watts GF, Barrett PHR, Burke V. Waist circumference, waist-to-hip ratio and body mass index as predictors of adipose tissue compartments in men. Q J Med 2003; 96: 441-7.
32. Baska T, Straka S, Mad'ar R. Smoking and some life-style changes in medical students-Slovakia, 1995-1999. Cent Eur J Public Health 2001; 9: 147-9.
33. Morar N, Seedat YK, Naidoo DP, Desai DK. Ambulatory blood pressure and risk factors for coronary heart disease in black and Indian medical students. J Cardiovasc Risk 1998; 5: 313-8.
34. Lean MEJ, Han TS, Seidell JC. Impairment of health and quality of life in people with large waist circumference. Lancet 1998; 351: 853-6.
35. Patel S, Unwin N, Bhopal R, White M, Harland J, Ayis SA, Watson W, Alberti KG. A comparison of proxy measures of abdominal obesity in Chinese, European and South Asian adults. Diabet Med 1999; 16: 853-60.
36. Dudeja V, Misra A, Pandey RM, Devina G, Kumar G, Vikram NK. BMI does not accurately predict overweight in Asian Indians in northern India. Br J Nutr 2001; 86: 105-12.
37. Fredriks AM, van Buuren S, Fekkes M, Verloove-Vanhorick SP, Wit JM. Are age references for waist circumference, hip circumference and waist-hip ratio in Dutch children useful in clinical practice? Eur J Pediatr 2005; 164: 216-22.
38. Wells JC. Sexual dimorphism of body composition. Best Practice & Research Clinical Endocrinology & Metabolism. Best Pract Res Clin Endocrinol Metab 2007; 21: 415-30.
39. Derby CA, Zilber S, Brambilla D, Morales KH, McKinlay, JB. Body mass index, waist circumference and waist to hip ratio and change in sex steroid hormones: the Massachusetts Male Ageing Study. Clin Endocrinol 2006; 65:125-31.
40. McLorg P. Anthropometric patterns in middle-aged and older rural Yucatec Maya women. Ann Hum Biol 2005; 32: 487-97.
41. Cartwright MJ, Tchkonia T, Kirkland JL. Aging in adipocytes: potential impact of inherent, depotspecific mechanisms. Exp Gerontol 2007; 42: 463-71.
42. WHO. Waist Circumference and Waist–Hip Ratio: Report of a WHO Expert Consultation Geneva 8–11 December 2008. Geneva: World Health Organization, 2011.
43. Ford ES, Mokdad AH, Giles WH. Trends in waist circumference among U.S. adults. Obes Res 2003; 11:1223-31.
44. Shimokata H, Tobin JD, Muller DC, Elahi D, Coon PJ, Andres R. Studies in the distribution of body fat: I. Effects of age, sex, and obesity. J Gerontol 1989; 44: 66-73.
45. Lahti-Koski M, Harald K, Mannisto S, Laatikainen T, Jousilahti P. Fifteen-year changes in body mass index and waist circumference in Finnish adults. Eur J Cardiovasc Prev Rehabil 2007; 14:398-404.
46. Sahoo K, Sahoo B, Choudhury AK, Sofi NY, Kumar R, Bhadoria AS. Childhood obesity: causes and consequences. J Family Med Prim Care 2015; 4: 187–92.

47. Londoño-Lemos ME Pharmacological advances to the treatment of obesity. J Child Obes 2018; 3(1): 3.
48. Kumar RB, Aronne LJ, Pharmacologic Treatment of Obesity, in Endotext, L.J. De Groot, et al., Editors. 2017: South Dartmouth (MA).

Conflict of Interest: None
Source of Funding: Nil