Original Article

Anthropometric and body composition parameters of Kaduna and Rivers State women aged 18–30 years

Progress Dakuro Victor, Barnabas Danborno, Samuel S Adebisi

Department of Human Anatomy, Ahmadu Bello University, Zaria, Nigeria

Abstract

Differences in anthropometry and body composition in populates arising from ecological habitat has been documented in several studies. The study attempted to evaluate the differences between the anthropometric and body composition parameters in young women of Kaduna and Rivers State, Nigeria. The study involved young women, without physical deformities within the age range of 18–30 years (mean age 22.10 ± 2.62 and 22.55 ± 3.78 for Kaduna and Rivers women respectively) that are indigenes of Kaduna and Rivers State. The study was based on a cross-sectional sampling of 788 tertiary institution students (401women from Rivers State females and 387 Kaduna females). The following anthropometric variables were measured: weight to the nearest 0.1 kg and height to the nearest 0.5 cm using a stadiometer, limb circumferences, and body circumferences using a nonstretchable tape. Body composition parameters were measured using bioimpedance analyzer. Data obtained showed that limb circumferences of Kaduna women are signifi cantly higher than Rivers women ($P < 0.000$ for arm circumference, $P < 0.01$ for calf circumference, and $P < 0.000$ for forearm circumference) except for the thigh circumference. However, weight, height, iliac and tricep skinfold of women from Rivers State was signifi cantly higher than Kaduna women ($P < 0.01$, $P < 0.01$, $P < 0.05$, and $P < 0.05$). Muscle mass, percentage body fat, basal metabolic rate, and metabolic age of Rivers women were signifi cantly higher than that of their Kaduna counterparts at a signifi cant level of $P < 0.001$, $P < 0.05$, $P < 0.01$, and $P < 0.01$, respectively. Rivers state women presented higher anthropometric variables and body composition parameters, but a lower limb circumference than their counterparts from Kaduna State. The difference in body composition could be tied to genetics and physiological variation that exists between individuals of a different population.

Key words: Anthropometry, body composition, Nigeria, women

INTRODUCTION

Anthropometry is a simple, reliable method for quantifying body size and proportions by measuring the body length,

Address for correspondence:
Miss. Progress Dakuro Victor,
Department of Human Anatomy, Ahmadu Bello University,
Zaria, Nigeria.
E-mail: dakuro25@yahoo.com

Access this article online	
Quick Response Code:	Website: www.jecajournal.com
	DOI: 10.4103/1596-2393.190820

How to cite this article:
Victor, P. D., Danborno, B., & Adebisi, S. S. (2016). Anthropometric and body composition parameters of Kaduna and Rivers State women aged 18–30 years. Journal of Experimental and Clinical Anatomy, 15(1), 49-55.

width, circumference, and skinfold thickness (Wang *et al*., 2000). Pheasant (1996) suggested that the variations of body dimensions of different groups can be observed in terms of overall body size and bodily proportions. The mean anthropometric dimensions, for example, stature and sitting height, are the most typical distinctions among ethnic groups. Another significant ethnic difference lies in the ratios of body dimensions that is bodily proportions (Liu *et al*., 2004). The bodily proportion is a scaling relation calculated with a ratio of one body dimension to a specific reference dimension. The most common reference dimension is mean stature (Roebuck *et al*., 1975). Changes in lifestyles, nutrition, and ethnic composition of populations have also been shown to cause changes in the distribution of body dimensions (Adebis, 2008).

Height has been used as an indicator of the standard of living. Living conditions during the growing year's, especially in early childhood influence height through their impact on net nutrition (Silventoinen *et al*., 2003; Steckel, 2009). Genetic factors are most important when explaining these geographic differences in height (Holden and Mace, 1999).

Skinfold thickness is an important indicator for the evaluation of individual development and nutritional status. The development of human skinfold thickness (subcutaneous fat) is affected by genetic factors, sex hormones, and neuroendocrine activity. However, there are factors that affect skinfold thickness such as regional differences, ethnic differences, nutrition, and physical exercise (Huang *et al*., 2007).

The vegetation of the Kaduna State is Northern Guinea Savannah while Rivers State vegetation is rainforest. The vegetation of a state is likely to influence the diet of its indigenes; diet will affect the body composition parameters. Therefore, the purpose of this study is to evaluate the differences between the anthropometric and body composition between women from Kaduna and Rivers State, Nigeria.

MATERIALS AND METHODS

Subjects

The study involved young women without physical deformities within the age range of 18–30 (mean age 22.10 ± 2.62 and 22.55 ± 3.78 for Kaduna and Rivers women, respectively) years that are indigenes of Kaduna and Rivers State, Nigeria. The study was based on cross-sectional sample of 788 (Rivers State $n = 401$ and Kaduna $n = 387$), from Nuhu Bamali Polytechnic, Zaria, Kaduna State University, Kaduna, University of Port Harcourt, Choba, Port Harcourt, Rivers State College of Education, Rivers state. The inclusion criteria used for this study was women whose both great grandparents are from either Kaduna or Rivers State, indigenes of biethnic origin were excluded from the study.

Anthropometry

Anthropometric measurements of height, weight, arm, waist circumferences, iliac and triceps skinfold thickness, and body mass index (BMI) were obtained following standard protocols has previously described (Lohman *et al*., 1988).

Stadiometer

The stadiometer was used to measure the height and weight of study women.

i. Height (cm): Standing height was measured taking the maximum distance from the floor to the highest point on the head when women were standing in anatomical position. Shoes were put off, feet together, and arms by the sides. Heels, buttocks, and upper back should also be in contact with the wall when the measurement is made
ii. Weight (kg): Weight was measured to the nearest 0.1 kg when the woman is standing and putting on light indoor clothes using stadiometer.

Skin Fold Caliper (mm)

The skinfold thickness was taken at the left side of the body (Moreno *et al*., 2002) to the nearest 0.1 mm using a skinfold caliper. Once a firm grip is placed on the skin fold, the caliper was applied perpendicular to the site. After the release of the trigger, the measurement was read.

i. Triceps: A vertical pinch of skin fold was taken on triceps midway between the shoulder and elbow
ii. Iliac skinfold: Immediately above the iliac crest (top of hip bone), on the most lateral aspect (side).

Measuring Tape

i. Arm circumference (cm): Tape was wrapped around the biceps, halfway between the shoulder and the elbow
ii. Chest circumference (cm): Tape was wrapped around the chest at the level of the middle of the sternum (breastbone), with the tape passing under the arms. The arms were relaxed by the side, and the measurement taken at the end of a normal expiration
iii. Forearm circumference (cm): The tape was wrapped tightly around the forearm, about halfway between the elbow and the wrist
iv. Hip circumference (cm): The tape was wrapped over the maximum circumference of the buttocks
v. Thigh circumference (cm): Tape was wrapped around the thigh at the level of the midpoint on the lateral (outer side) surface of the thigh, midway between trochanterion (top of the thigh bone, femur) and tibiale laterale (top of the tibia bone)

vi. Waist circumference (cm): Tape was wrapped around the waist at the midpoint between the lowest rib and the iliac crest. The woman was asked to stand erect while measurements were taken.

Body Composition Monitor

This monitor BC 533 (Tanita Corporation, Japan) was used to analyze body composition using a simple principle: It passes small alternating current flowing between two electrodes rapidly through hydrated fat-free body tissues and extracellular water compared with fat or bone tissue because of greater electrolyte content of the fat-free component. The following were obtained: Body fat (%), total body water (%), muscle mass, bone mass, visceral fat rating, metabolic age, and physique rating.

Ethical clearance was obtained from Ahmadu Bello University Teaching Hospital with an assigned number of ABUTH/HREC/G08/2013.

Statistics

Data were expressed as a mean ± standard deviation. Student's *t*-test was used to test for the mean difference between the anthropometric and body composition parameters of women from Kaduna and Rivers States. SPSS version 16 was used to analyze the data.

RESULTS

Women from Rivers State are significantly taller and heavier than women from Kaduna as shown in Figures 1 and 2, respectively.

The skinfold thickness of women studied was compared and shown in Figure 3. Rivers state women presented a significantly higher iliac skinfold ($P < 0.05$) and triceps skinfold ($P < 0.01$) than their counterparts from Kaduna State.

Comparison of the arm, forearm, and calf circumferences between Kaduna and Rivers State women revealed that Kaduna State women presented with a significantly ($P < 0.01$) higher arm, forearm, and calf circumferences $P < 0.001$, $P < 0.01$, and $P < 0.001$, respectively [Figure 4]. Rivers women presented higher hip and waist circumference, but a lower chest circumference when compared to their Kaduna counterparts. However, there was no significant difference [Figure 5]. No difference was observed in waist-hip ratio and BMI for women from both states [Figures 6 and 7]. The BMI of Kaduna women was 0.2 kg greater than that of the Rivers women, but there was no statistically significant difference.

Body composition parameters of Kaduna and Rivers State women showed that, Rivers State women had significantly higher mean muscle mass ($P < 0.001$), body percentage fat ($P < 0.05$), metabolic age ($P < 0.05$), calories ($P < 0.001$), and basal metabolic rate [Figures 8-12, respectively]. However, no difference was observed between physique rating, total body water, visceral fat rating, and bone mass of women from Kaduna and Rivers State [Figures 13-16].

DISCUSSION

Results from this study indicate that women from Kaduna were shorter than their Rivers counterparts. This variation in height could be tied to both environmental and genetic difference between the two populations (Silventoinen *et al*., 2003). Women from Rivers State are believed to have access to seafood rich in protein than those from Kaduna State.

In this study, it was observed that Rivers women were heavier than Kaduna women. The difference in weight between two populations portrays their distinctiveness and genetic potentials (Sampei *et al*., 2008). The family socioeconomic status is an important predictor of children's overweight (Kleiser *et al.*, 2009; Andegiorgish *et al*., 2012; and Ządzińska *et al*., 2012). Skinfold thickness of Rivers women was observed to be higher than those from Kaduna State, in this study. This implies that the average thickness of the entire subcutaneous tissue and the total body

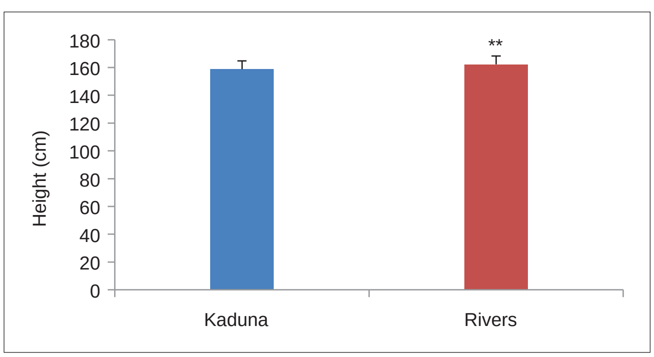

Figure 1: Mean height of Kaduna and Rivers State women. Kaduna (n = 387), Rivers (n = 401); independent sample t-test: t = 8.4; ** = $P < 0.01$

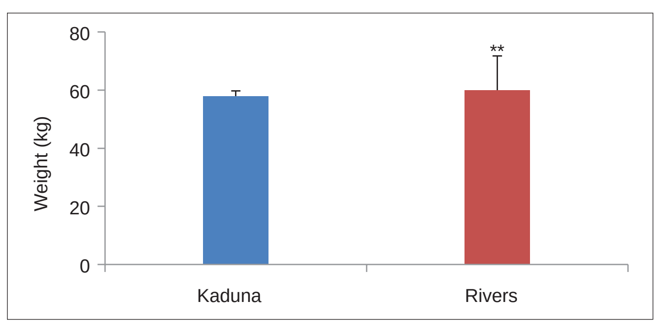

Figure 2: Mean weight Kaduna and Rivers State women. Kaduna (n = 387), Rivers (n = 401); independent sample t-test: t = 2.71, ** = $P < 0.01$

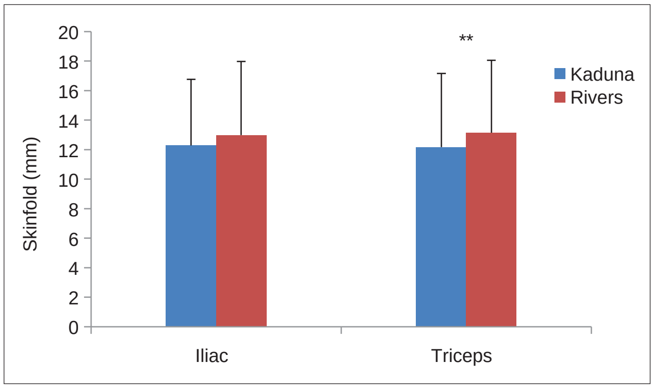

Figure 3: Comparison of Skinfold thickness (iliac and triceps) in Kaduna and Rivers state Women. Kaduna (*n* = 387), Rivers (*n* = 401); independent sample *t*-test: (*t* = 2.11,* = *P* < 0.05) and (*t* = 2.85, ** = *P* < 0.01) for iliac and triceps skinfold, respectively

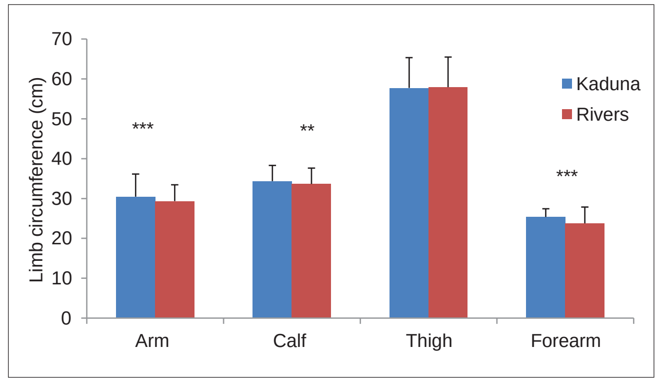

Figure 4: Limb circumferences of women from Kaduna and Rivers State. Kaduna (*n* = 387), Rivers (*n* = 401); independent sample *t*-test: (*t* = 3.76, ** = *P* < 0.01), (*t* = 2.48, *** = *P* < 0.001), (*t* = 0.37, *P* = 0.71), and (*t* = 6.85, *P* = 0.001) for arm, calf, thigh, and forearm circumference, respectively

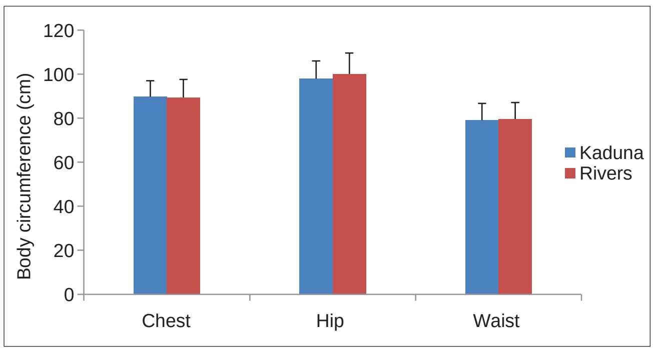

Figure 5: Body circumferences of women from Kaduna and Rivers State. Kaduna (*n* = 387), Rivers (*n* = 401); independent sample *t*-test: (*t* = 0.44, *P* = 0.66), (*t* = 0.84, *P* = 0.4), and (*t* = 0.77, *P* = 0.44) for chest, hip, and waist circumference

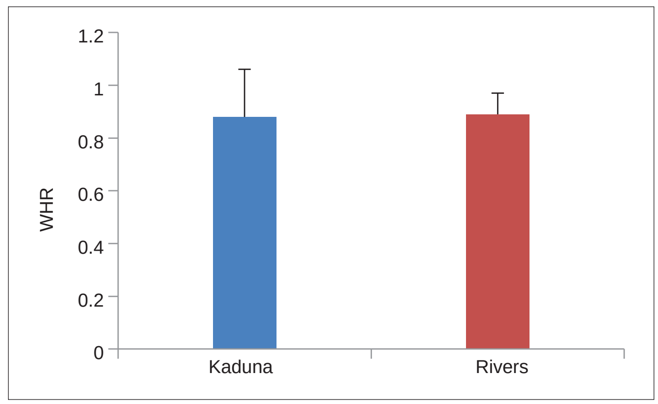

Figure 6: Comparison of waist-hip ratio. Kaduna (*n* = 387), Rivers (*n* = 401); independent sample *t*-test. There was no difference in the mean WHR of Kaduna women and Rivers women. *t* = 1.02, *P* = 0.31

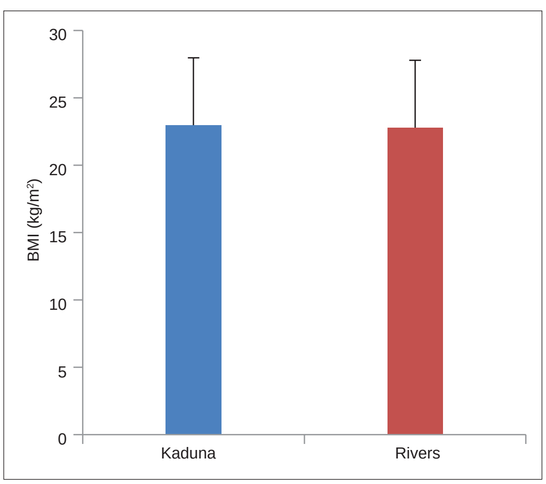

Figure 7: Comparison of body mass index in Kaduna and Rivers State women. Kaduna (*n* = 387), Rivers (*n* = 401)

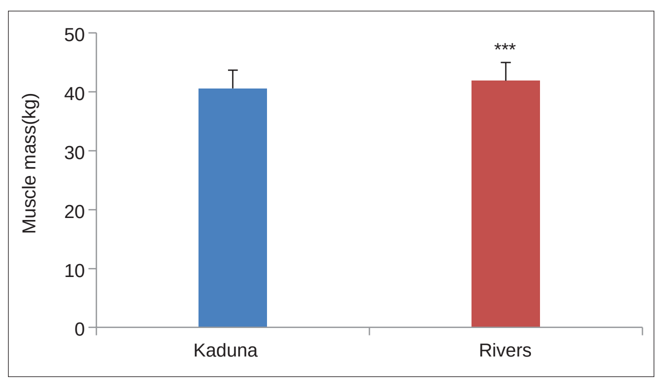

Figure 8: Comparison of muscle mass of women from Kaduna and Rivers State. Kaduna (*n* = 387), Rivers (*n* = 401); mean ± standard deviation; independent sample *t*-test: *t* = 4.73, *** = *P* < 0.001

fat of Rivers women is higher than that of their Kaduna counterparts (Piers *et al*., 2003). Variation in the distribution of subcutaneous fat occurs with sex, ethnicity, and age (Robson *et al*., 1971; Durnin and Womersley, 1974; Knechtle *et al*., 2011).

The arm, forearm, and calf circumferences of the Kaduna women were higher than that of Rivers women while the chest, waist, hip, and thigh circumference of the Rivers women were higher than that of the Kaduna women. This difference could be tied to the difference in fat distribution (Rolland-Cachera, 1997; Goran *et al*., 1998). In addition, nutrition and ethnic composition of

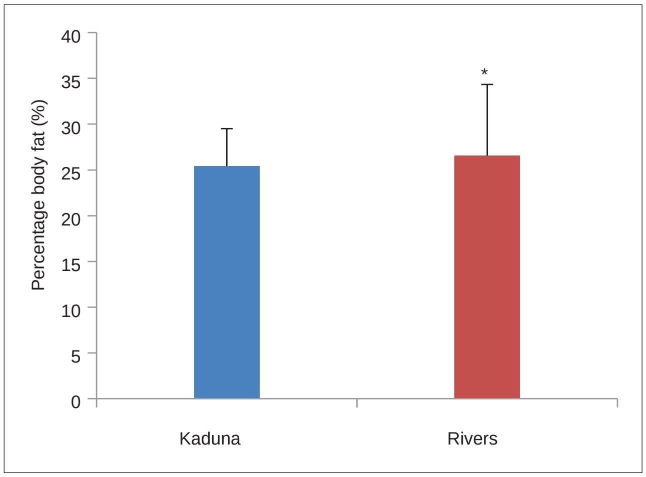

Figure 9: Percentage body fat in women from Kaduna and Rivers State. Kaduna (n = 387), Rivers (n = 401); mean ± standard deviation; independent sample t-test: t = 2.19, * = $P < 0.05$

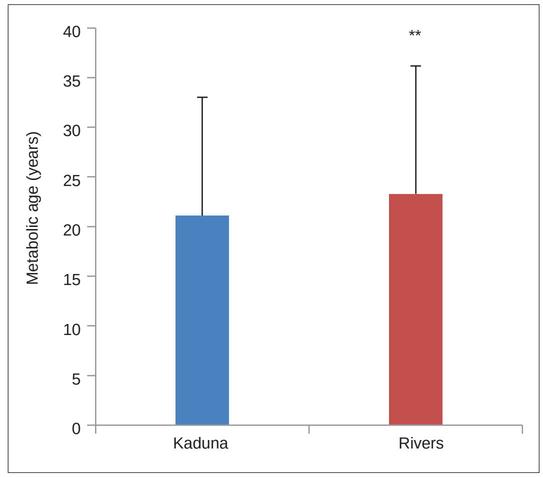

Figure 10: Metabolic age of women from Kaduna and Rivers State. Kaduna (n = 387), Rivers (n = 401); mean ± standard deviation; independent sample t-test: t = 2.18** = $P < 0.01$

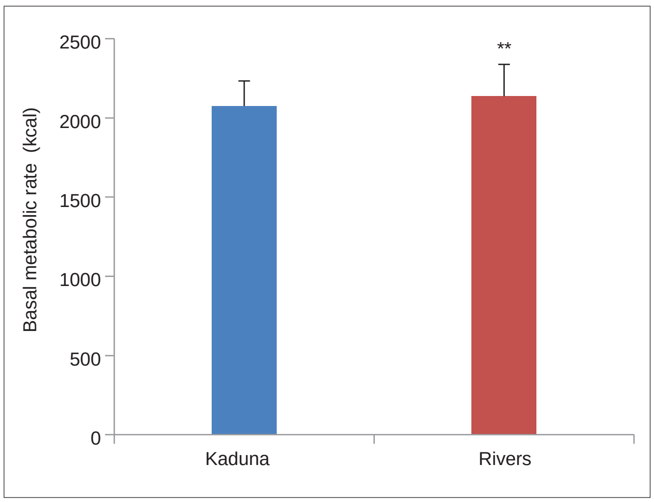

Figure 11: Basal metabolic rate of women from Kaduna and Rivers state. Kaduna (n = 387), Rivers (n = 401); mean ± standard deviation; independent sample t-test: t = 4.75, ** = $P < 0.01$

populations have also been shown to cause changes in the distribution of body dimensions (Adebis, 2008).

In this study, the hip and waist circumferences of women from Rivers State were observed to be greater than those from Kaduna State. The waist circumference of women, in this study, is lower than that reported by Akarolo-Anthony *et al.* (2013). Fat deposit in women differs across ethnic groups (Lear *et al.*, 2007), hormones influence distribution (Bjorntorp, 1997).

In this study, the mean BMI was 22.98 and 22.78 kg/m^2 for Kaduna and Rivers State women, respectively. The mean BMI value of the study population corresponds to normal BMI on the BMI reference data (Ferro-Luzzi *et al.*, 1992). Results revealed that over 64.3% of Kaduna and 63.1% of Rivers women had a normal weight.

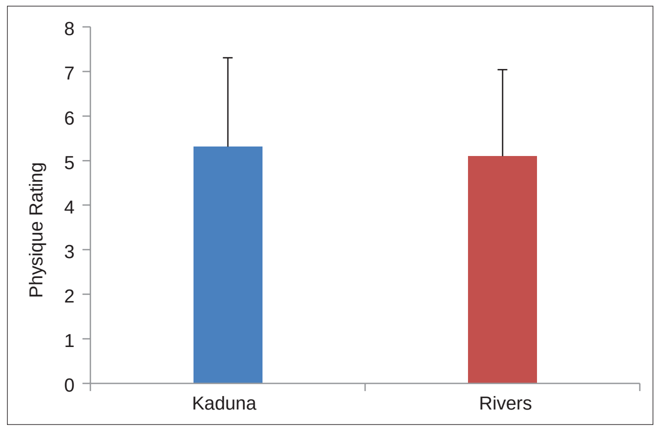

Figure 12: Physique rating of women from Kaduna and Rivers State. Kaduna (n = 387), Rivers (n = 401); independent sample t-test

Muscle mass of women from Rivers State was higher than that of Kaduna women, implying that Rivers women are likely to be healthier than Kaduna women since increased muscle mass is a protective factor for depression and anxiety (Wallymahmed *et al.*, 1997; Wagner; Gubata *et al.*, 2013). Barlett *et al.* (1991) suggested that difference in muscle mass to be associated with race, physical activity, and genetics.

Higher body fat percentage at low BMI in a Rivers women compared with Kaduna women was observed, in this study. This difference could be as a result of differences in body build (Swinburn *et al.*, 1996; Luke *et al.*, 1997; and Deurenberg-Yap *et al.*, 2000), and difference in the level of physical activity (WHO, 2004). The percentage body fat of Rivers women is significantly higher than of Kaduna women, implying that the total body water of Rivers women will be lower than that of the Kaduna women (Wang *et al.*, 1999).

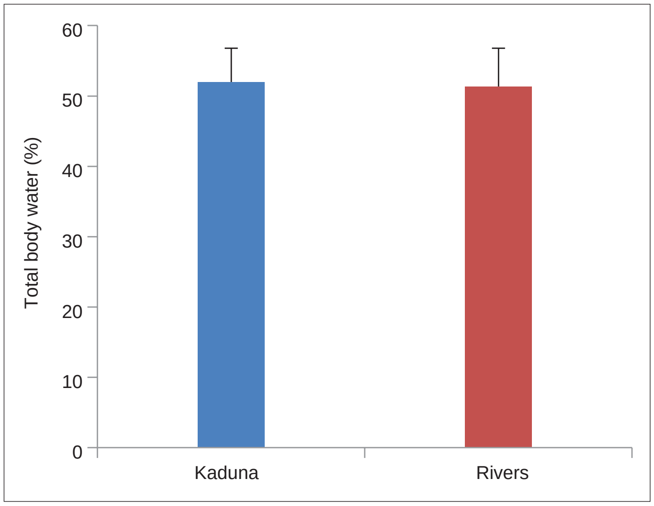

Figure 13: Total body water of women from Kaduna and Rivers State. Kaduna (n = 387), Rivers (n = 401); mean ± standard deviation; independent sample t-test: t = 1.77, P = 0.08

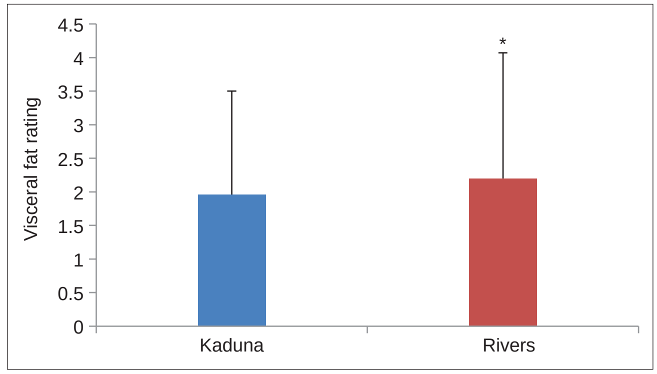

Figure 14: Visceral fat rating of women from Kaduna and Rivers State. Kaduna (n = 387), Rivers (n = 401); independent sample t-test: t = 1.94, P = 0.05

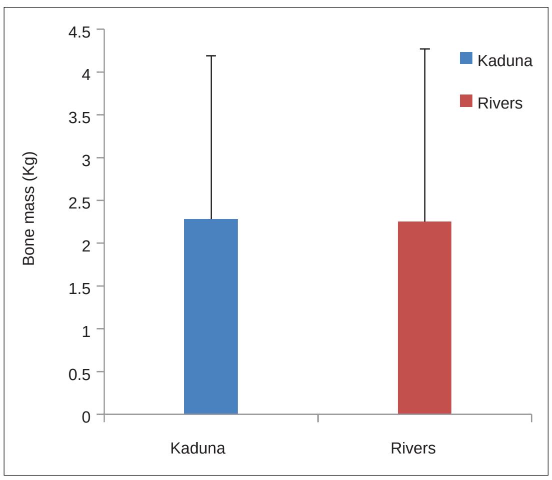

Figure 15: Bone mass of women from Kaduna and Rivers state. Kaduna (n = 387), Rivers (n = 401); mean ± standard deviation; independent sample t-test: t = 0.24, P = 0.81

In this study, the physique rating of Kaduna and Rivers women was 5.31 and 5.10 respectively, implying that these women have average body fat and muscle mass, in both populations. Hence, genetics and environmental factors such as nutrition and altitude did not influence physique rating as previous reported (Malik *et al*., 1987).

The bone mass value obtained from women in Rivers State in this study was slightly lower than those obtained from women from Kaduna State. The observed difference in bone mass ratio depicts the type of diet available in these states. According to Macdonald *et al*. (2004), dietary choices and nutrition are associated with major modulators of (bone mineral density [BMD]). Ortiz *et al*. (1992) reported that population with greater skeletal muscle have higher BMD than population with lesser skeletal muscle mass while Wagner and Heyward (2000) reported that an increase in circulation of estrogen may contribute to greater secretion of growth hormone which in turn led to an increase in bone mass. This implies that Kaduna women probably have a greater skeletal muscle mass and more circulating estrogen than their Rivers counterparts.

The mean metabolic age of Kaduna and Rivers women was 21.11 and 23.3 years, respectively. While the mean chronological age of Kaduna and Rivers women was 22.1 and 22.6 years. This implies that these women will be fit, have better health, and are likely to have more muscle mass, less fat, and can consume more calories.

Acknowledgments

I wish to acknowledge the women from the various institutions that participated in study; Mr. Agbon A.N., Miss Nancy Mubarak, and Gift Omachibe for their technical support.

Financial Support and Sponsorship

Nil.

Conflicts of Interest

There are no conflicts of interest.

REFERENCES

1. Adebis S.S. (2008). Medical impacts of anthropometric records. Ann Afr Med 7:42-7.
2. Akarolo-Anthony S.N., Odubore O.F., Yilme S., Aragbada O., Odonye G., Hu F, *et al.* (2013). Pattern of dietary carbohydrate intake among urbanized adult Nigerians. Int J Food Sci Nutr 64:292-9.
3. Andegiorgish A.K., Wang J., Zhang X., Liu X., Zhu H. (2012). Prevalence of overweight, obesity, and associated risk factors among school children and adolescents in Tianjin, China. Eur J Pediatr 171:697-703.
4. Barlett H.L., Puhl S.M., Hodgson J.L., Buskirk E.R. (1991). Fat-free mass in relation to stature: Ratios of fat-free mass to height in children, adults, and elderly subjects. Am J Clin Nutr 53:1112-6.
5. Bjorntorp P. (1997). Hormonal control and regional fat distribution. Eur Soc Hum Reprod Embryol 21:1.
6. Deurenberg-Yap M., Schmidt G., van Staveren W.A., Deurenberg P. (2000). The paradox of low body mass index and high body fat percentage among Chinese, Malays and Indians in Singapore. Int J Obes 24:1011-7.
7. Durnin J.V., Womersley J. (1974). Body fat assessed from total body density and its estimation from skinfold thickness: Measurements on 481 men and women aged from 16 to 72 years. Br J Nutr 32:77-97.
8. Ferro-Luzzi A.S., Franklin M., James W.P. (1992). A simplified approach to assessing adult chronic energy deficiency. Eur J Clin Nutr 46:173-86.
9. Goran M.I., Gower B.A., Treuth M., Nagy T.R. (1998). Prediction of intra-abdominal and subcutaneous abdominal adipose tissue in healthy pre-pubertal children. Int J Obes 22:549-58.
10. Gubata M.E., Urban N., Cowan D.M., Niebuhr D.W. (2013). A prospective study of physical fitness, obesity, and the subsequent risk of mental disorders among healthy young adults in army training. J Psychosom Res 75:43-8.
11. Holden C., Mace R. (1999). Sexual dimorphism in stature and women's work: A phylogenetic cross-cultural analysis. Am J Phys Anthropol 110:27-45.
12. Huang W., Yang W., Lin D. (2007). Obesity evaluation in 7-18 years old Dalian students from 1995 to 2005: Calculating the body fat content with skinfold thickness. J Clin Rehabil Tissue Eng Res 2:7271-4.
13. Lear S.A., Humphries K.H., Kohli S., Chockalingam A., Frohlich J.J., Birmingham C.L. (2007). Visceral adipose tissue accumulation differs according to ethnic background: Results of the Multicultural Community Health Assessment Trial (M-CHAT). Am J Clin Nutr 86:353-9.
14. Liu Y., Gold E.B., Lasley B.L., Johnson W.O. (2004). Factors affecting menstrual cycle characteristics. Am J Epidemiol 160:131-40.
15. Lohman TC., Roche AF., Martorell R, editors. (1988). Anthropometric Standardization Reference Manual. Human Kinetics, Champaign, IL.
16. Luke A., Durazo-Arvizzu R., Rotimi C., Prewitt E., Forrester T., Wilks R, *et al.* (1997). Relation between BMI and body fat in black population samples from Nigeria, Jamaica and the United States. Am J Epidemiol 145:620-8.
17. Kleiser C., Schaffrath R.A., Mensink G.B., Prinz-Langenohl R., Kurth B.M. (2009). Potential determinants of obesity among children and adolescents in Germany: Results from the cross-sectional KiGGS Study. Bio Med Cent Public Health 2:9-46.
18. Knechtle B., Knechtle P., Rosemann T. (2011). Upper body skinfold thickness is related to race performance in male ironman triathletes. Int J Sports Med 32:20-7.
19. Macdonald H.M., New S.A., Golden M.H., Campbell M.K., Reid D.M. (2004). Nutritional associations with bone loss during the menopausal transition: Evidence of a beneficial effect of calcium, alcohol, and fruit and vegetable nutrients and of a detrimental effect of fatty acids. Am J Clin Nutr 79:155-65.
20. Malik SL, Prakash M, Mookherjee P. (1986). Impact of nutrition on body size, body shape and muscular strength: An evolution of a food aid program. Man and Life 12:61-68.
21. Moreno LA., Pineda I., Rodriguez G., Fleta J., Sarria A., Bueno M. (2002). Waist circumference for the screening of the metabolic syndrome in children. Acta Paediatr 91:1307-12.
22. Ortiz O., Russel M., Daley T., Baumgarter R., Waki M., Lichtman S, *et al.* (1992). Differences in skeletal muscle and bone mineral mass between black and white females and their relevance to estimates of body composition. Am J Clin Nutr 55:8-13.
23. Pheasant S. (1996). Bodyspace: Anthropometry, Ergonomics, and the Design of Work. 2nd ed. Taylor and Francis, Bristol, PA.
24. Piers L.S., Rowley K.G., Soares M.J., Dea K.O. (2003). Relation of adiposity and body fat distribution to body mass index in Australians of Aboriginal and European ancestry. Eur J Clin Nutr 57:956-63.
25. Robson J.R., Bazin M., Soderstrom R. (1971). Ethnic differences in skin-fold thickness. Am J Clin Nutr 24:864-8.
26. Roebuck J.A., Kroemer K.H., Thomson W.G. (1975). Engineering Anthropometry Methods. Wiley, New York.
27. Rolland-Cachera MF, Brambilla P, Manzoni P, Akrout M, Sironi S, Del. Maschio A, *et al.* (1997). Body composition assessed on the basis of arm circumference and triceps skinfold thickness: A new index validated in children by magnetic resonance imaging. Am J Clin Nutr 65:170-1713.
28. Sampei M.A., Novo N.F., Juliano Y., Sigulem D.M. (2008). Anthropometry and body composition in ethnic Japanese and Caucasian adolescent boys. Pediatr Int J 50:679-86.
29. Silventoinen K., Sammalisto S., Perola M., Boomsma D.I., Cornes B.K., Davis C, *et al.* (2003). Heritability of adult body height: A comparative study of twin cohorts in eight countries. Twin Research and Human Genetic: 6:399-408.
30. Steckel R.H. (2009). Heights and human welfare: Recent developments and new directions, explorations in economic history. Vol. 46. Elsevier, Columbus, USA, p. 1-23.
31. Swinburn B.A., Craig P.L., Daniel R., Dent D.P., Strauss B.J. (1996). Body composition differences between Polynesians and Caucasians assessed by bioelectrical impedance. Int J Obes Relat Metab Disorder 20:889-94.
32. Wagner R.D., Heyward V.H. (2000). Measures of body composition in blacks and white review. Am J Clin Nutr 71:1392-402.
33. Wallymahmed M.E., Foy P., Shaw D., Hutcheon R., Edwards R.H., MacFarlane I.A. (1997). Quality of life, body composition and muscle strength in adult growth hormone deficiency: The influence of growth hormone replacement therapy for up to 3 years. Clin Endocrinol (Oxf) 47:439-46.
34. Wang J., Thornton S., Kolesnik S., Pierson R.N. Jr (2000). Anthropometry in body composition. N Y Acad Sci 904:317.
35. Wang Z.M., Deurenberg P., Wei W., Pietrobelli A., Baumgartner R.N., Heymsfield S.B. (1999). Hydration of fat-free body mass: Review and critique of a classic body-composition constant. Am J Clin Nutr 69:833-41.
36. WHO. (2004). Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. Lancet 363:157-63.
37. Ządzińska E., Rosset I., Kozieł S., Nawarycz T., Borowska-Strugińska B., Lorkiewicz W, *et al.* (2012). Frequency of under-and overweight among children and adolescents during the economic transition in Poland. Homo 63:216-32.