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COMPARATIVE EFFECTS OF URBANIZATION ON ANTHROPOMETRIC MEASURES OF CENTRAL AND GENERALIZED BODY ADIPOSITY AMONG HAUSA ETHNIC GROUP IN KANO STATE

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Abstract

Adiposity is associated with adverse cardio-metabolic outcomes and various measures of adiposity do not pose equal metabolic risk. The adverse effect of urbanization on body adiposity is well documented. Studies on the comparative effects of urbanization on the centripetal and generalized measures of adiposity and sex difference in such effects are scarce. This study was conducted to determine and compare the effects of urbanization on the centripetal (truncal) and generalized measures of adiposity and sexual dimorphism in such effect among Hausa ethnic group of Kano State. The study was a cross sectional study including 465 (266 males and 199

females) Hausas of Kano, with a mean age of 34.4 years and 32.0 years for males and females respectively. Systematic random sampling technique was employed for subject recruitment. Height, weight, waist circumference (WC), hip circumference (HC), neck circumference (NC), body mass index (BMI), waist-to-hip ratio (WHR), WHtR (waist-to-height ratio), body adiposity index (BAI) were obtained using standard protocol. Subjects were selected from urban and rural settlements of Kano State. Student t test was used to compare parameters of urban and rural participants and of males and females. SPSS version 20 (IBM Corporation, NY) soft ware was used for statistical analyses and $P < 0.05$ was set as level of significance. BMI, NC, HC, WC, WHR and WHtR were significantly higher in urban participants. Body adiposity index (BAI) was significantly higher only in female urban participants. In both males and females, NC, HC and BAI were least affected by urbanization. The effects of urbanization on WHR, WC and WHtR were higher than for BMI.

Key words: urbanization, centripetal adiposity, generalized adiposity, Hausa, Kano State

INTRODUCTION

The adverse effects of urbanization on body adiposity (Ekezie *et al.,* 2011; Mbanya *et al.,* 2014) and its attendant metabolic consequences (Adediran *et al.,* 2012; Sabir *et al.,* 2013) is documented. This effect is widely attributed to high rates of physical inactivity and consumption of high fat and low fiber diets that characterizes the urban dwellers (Taro *et al.,* 2001; Nyenwe *et al.,* 2003; Amuna and Zotor, 2008). This rural-urban difference in adiposity profile has been implicated in population variations in the prevalence rates of adverse metabolic indices (Abubakari *et al.,* 2008; Ramachandran *et al.,* 2008; Mbanya *et al.,* 2014).The different anatomic sites and regions of adipose tissue aggregation do not carry equal cardio-metabolic risks (Mathieu *et al.,* 2009; Browning *et al.,* 2010) due to the difference in the structural and functional characteristic of the adipocytes constituting the adipose tissue of different sites (Ibrahim, 2010; McQuaid *et al.,* 2010; Labbe *et al.,* 2011).

There are conflicting reports from different populations on the adiposity measure that is most germane in terms of metabolic risk prediction (Schulze *et al.,* 2012; Antoninus *et al.,* 2014; Goh *et al.,* 2014). Among the anthropometric adiposity indices, centripetal indices have received great attention in recent years (Schulze *et al.,* 2012; Talaei *et al.,* 2013; Antoninus *et al.,* 2014; Goh *et al.,* 2014) and have been shown to be more relevant to metabolic risk compared to overall measures of adiposity (Talaei *et al.,* 2013; Antoninus *et al.,* 2014). Sequel to the current controversy on the discriminatory powers of different adipose tissue measures and the observation that ethnic and population differences exist in total and compartmental adiposity measures and also in the determinants and factors that affect adiposity, it is now widely recommended that the subject of adiposity be discussed in terms of ethnicity (Lear *et al.,* 2007; Lear *et al.,* 2010; Katzmarzyk *et al.,* 2011). Further to this, there are variations reported in the body of literature on the impact of urbanization on individual measures of body adiposity in different populations (Adediran *et al.,* 2012; Sabir *et al.,* 2013; Obirikorang

et al., 2015), suggesting that the extent of exposure to urban life style, inherent genetic differences in the mechanisms for metabolizing food nutrients in different populations may be important determinants of the interrelationships between urbanization and body adiposity. This study was therefore conducted to determine and compare the impacts of urban dwelling on the central (WC, HC, WHR, WHtR, NC, BAI) indices of adiposity and generalized index (BMI) of body adiposity in Kano. Also, to investigate if there is sex difference in the interrelationship of urbanization and body adiposity.

The findings of this study is expected to give a clue on the extent to which urbanization affects body adiposity measures and to identify the adiposity measures that are most affected by urbanization in Hausa ethnic group of Kano State. This may serve as the basis for increased creation of awareness on the adverse effect of urbanization on adiposity by health authorities. Additionally, emphasis may be placed on specific preventive, therapeutic and physical activity strategies targeted at those adiposity measures observed to be most affected by urbanization.

MATERIALS AND METHODS

Systematic random sampling technique was employed in selecting 465 Hausas from Kano based on a history of at least two parental generation being Hausas from Kano State. Participants were recruited from outpatient units of Murtala Muhammad specialist Hospital, Khadija Memorial Hospital and the old campus of Bayero University, Kano as urban participants and from SU clinic Gabasawa, General Hospital Dawakin – Tofa as rural participants based on history. The study included only subjects in the age range of 18 years to 68 years. Subjects with pregnancy, abdominal or pelvic space occupying lesions, congenital and/or acquired spinal deformity were however excluded. Ethical approval was obtained from Kano state hospitals management board and written informed consent obtained from the subjects. Height was measured to the nearest 0.1cm as the vertical distance between the standing surface and the vertex of the head while the subject was standing erect in the frank forth plane and without shoes using a stadiometer. The weight was measured in kilograms using a digital weighing scale while the subject is in light clothes. The body mass index was calculated by dividing the weight in kilograms by the square of the height in meters and the result expressed in kg/m^2. Waist circumference was measured in centimeter with a non- stretchable plastic tape horizontally placed over the unclothed abdomen at the narrowest point between the lowest rib and the iliac crest. The hip circumference was measured while the subject was standing erect with the feet fairly close together; pockets emptied and the tape passed around the point with the maximum circumference over the bottom. WC was divided by the HC to obtain waist-hip ratio (WHR) and was divided by the height to obtain the waist-height ratio (WHtR). Neck circumference was measured in centimeter with a non- stretchable plastic tape horizontally placed over the unclothed neck at the level of the thyroid cartilage.

Body adiposity index was obtained using the formula proposed by Bergman *et al.* (2011). This formula has been shown to be a good measure of central adiposity in some populations (Bergman *et al.*, 2011)

$$\text{Body Adiposity Index (BAI)} = \frac{\text{Hip Circumference (cm)}}{\text{Height (m)}^{1.5}} - 18$$

Student's t test was used to compare parameters of urban and rural participants and of males and females. SPSS version 20 (IBM Corporation, NY) soft ware was used for statistical analyses and $P < 0.05$ was set as level of significance.

RESULTS

A total of 465 subjects were studied, 266 males (57%) and 199 females (43%). Table 1 shows descriptive statistics for age, anthropometric indices of central and generalized adiposity of participants. The subjects had a mean age of 34.45 years and 32.06 years for males and females respectively.

Table 1: Descriptive statistics for age, anthropometric indices of central and generalized adiposity of participants

	Male (n=266)		**Female (n= 199)**	
Variables	Mean ± SD	Min-max	Mean ± SD	Min-max
Age	34.45± 13.52	18-68	32.06 ± 15.18	18-65
Height (cm)	169.15 ± 6.27	142-182.3	158.53 ± 6.83	136.9-175
Weight (kg)	63.03 ±12.28	40.5-98.3	55.86 ± 12.99	36-108.9
BMI (kg/m^2)	21.98 ±3.93	14.52-34.33	22.19 ± 4.70	12.96-39.15
WC (cm)	77.28 ±11.17	57-111	76.02 ± 13.00	51-118.5
HC (cm)	87.01 ± 7.80	72.1-109.9	88.96 ± 9.86	65.6-136
NC (cm)	34.99 ± 2.29	30-42	31.58 ± 2.46	26.5-39.5
W/H	0.89 ± 0.08	0.71-1.11	0.85 ± 0.11	0.65-1.25
W/Ht	0.46 ± 0.06	0.34-0.65	0.48 ± 0.08	0.30-0.72
BAI	21.60 ± 3.71	13.88-33.90	26.61 ± 4.62	15.38-45.58

Key: BMI: body mass index, WC: waist circumference, HC: hip circumference, NC: neck circumference, W/H: waist-to-hip ratio, W/Ht: waist-to-height ratio, BAI: body adiposity index

Table 2 shows the effect of urbanization on the anthropometric indices of adiposity in the general population.

Table 2: Effect of urbanization on anthropometric indices of adiposity in the general study population

	All study population		
	Rural	Urban	T
Variables	Mean ± SD	Mean ± SD	
Height (cm)	164.23 ± 8.25	164.95 ± 8.48	-0.93
Weight (Kg)	54.53 ± 9.94	64.93 ± 13.61	-9.32**
BMI	20.16 ± 3.01	23.83 ± 4.5	-10.24**

WC (cm)	69.7 ± 7.91	83.18 ± 11.46	-14.63**
HC (cm)	86.26 ± 7.46	89.29 ± 9.63	-3.77**
NC (cm)	32.47 ± 2.58	34.5 ± 2.85	-8.02**
W/H	0.81 ± 0.06	0.93 ± 0.07	-18.95**
W/Ht	0.42 ± 0.05	0.51 ± 0.07	-14.45**
BAI	23.14 ± 4.33	24.3 ± 5.15	-2.61*

* P < 0.05, **P < 0.001, BMI: body mass index, WC: waist circumference, HC: hip circumference, NC: neck circumference, W/H: waist-to-hip ratio, W/Ht: waist-to-height ratio, BAI: body adiposity index

It can be seen from Table 2 that both central and generalized adiposity indices were observed to be significantly higher in urban dwellers. For BMI, WC, HC, WHR, NC and WHtR (P < 0.01) while for BAI (P < 0.05)

Table 3 shows the effect of urbanization on the anthropometric indices of adiposity in the male participants.

Table 3: Effect of urbanization on anthropometric indices of adiposity in the male participants

	Males		
	Rural	Urban	T
Variables	Mean ± SD	Mean ± SD	
Height (cm)	168.59 ± 6.56	169.65 ± 5.98	-1.38
Weight (Kg)	59.1 ± 9.06	66.52 ± 13.66	-5.15**
BMI	20.79 ± 3.03	23.04 ± 4.32	-4.86**
WC (cm)	71.38 ± 7.4	82.52 ± 11.36	-9.35**
HC (cm)	85.53 ± 6.47	88.33 ± 8.62	-2.97*
NC (cm)	34.15 ± 1.71	35.73 ± 2.49	-5.93**
W/H	0.83 ± 0.05	0.93 ± 0.07	-13.31**
W/Ht	0.42 ± 0.04	0.49 ± 0.07	-9.11**
BAI	21.14 ± 3.32	22.01 ± 3.99	-1.92

* P < 0.05, **P < 0.001, BMI: body mass index, WC: waist circumference, HC: hip circumference, NC: neck circumference, W/H: waist-to-hip ratio, W/Ht: waist-to-height ratio, BAI: body adiposity index

It can be observed from Table 3 that while BMI, WC, WHR, WHtR and NC and HC were observed to be significantly higher in urban participants, BAI did not show significant (P > 0.05) rural-urban difference in the mean measure. Among the indices that were observed to be higher in urban participants, HC was least affected by urbanization (P < 0.05) as against (P < 0.01) for BMI, WC, WHR and NC.

Table 4 shows the effect of urbanization on the anthropometric indices of adiposity in female participants.

4: Effect of urbanization on anthropometric indices of adiposity in the female participants

	Female		
	Rural	Urban	T
Variables	Mean ± SD	Mean ± SD	
Height (cm)	158.61 ± 6.67	158.45 ± 7.01	0.17
Weight (Kg)	48.65 ± 7.7	62.72 ± 13.3	-9.08**
BMI	19.34 ± 2.81	24.91 ± 4.53	-10.37**
WC (cm)	67.53 ± 8.06	84.09 ± 11.6	-11.64**
HC (cm)	87.22 ± 8.52	90.63 ± 10.77	-2.47*
NC (cm)	30.3 ± 1.76	32.8 ± 2.41	-8.31**
W/H	0.78 ± 0.07	0.93 ± 0.08	-14.47**
W/Ht	0.43 ± 0.05	0.53 ± 0.07	-12.28**
BAI	25.72 ± 4.14	27.45 ± 4.91	-2.70*

* P < 0.05, **P < 0.001, BMI: body mass index, WC: waist circumference, HC: hip circumference, NC: neck circumference, W/H: waist-to-hip ratio, W/Ht: waist-to-height ratio, BAI: body adiposity index

From Table 4 it can be observed that BMI, WC, WHR, WHtR and NC were significantly higher (P < 0.01) in urban dwellers. HC and BAI were also observed to be significantly higher in urban participants but the impact of urbanization on these indices were weaker (P < 0.05) when compared with that for BMI, WC, WHR, WHtR and NC (P < 0.01).

DISCUSSION

The adverse effects of urban dwelling on the anthropometric measures of body adiposity as observed in the present study were similarly reported by previous investigators (Adediran *et al.*, 2012; Sabir *et al.*, 2013; Obirikorang *et al.*, 2015). This effect has been widely attributed to high prevalence rates of physical inactivity and consumption of high fat and low fibre diet that characterizes the urban dwellers (Amuna and Zotor, 2008), thereby making the adiposity profile of physically inactive individuals and urban dwellers to be somewhat identical (Amuna and Zotor, 2008). Others however attributed these urban-rural difference in adiposity measure to extreme changes in dietary habits and psychological stress (Taro *et al.*, 2001; Nyenwe *et al.*, 2003; Amuna and Zotor, 2008; Sabir *et al.*, 2013). In keeping with the results of the present study, a group of observers reported that urbanization is an important contributor to rising global obesity prevalence and its attendant metabolic syndrome (Abubakari *et al.*, 2008; Ramachandran *et al.*, 2008; Mbanya *et al.*, 2014) and that urbanization is a substantial contributor to the difference in adiposity and metabolic characteristics of different communities (Abubakari *et al.*, 2008; Ramachandran *et al.*, 2008; Mbanya *et al.*, 2014). In addition to the factors reported by previous observers, the rural-urban difference in adiposity measures of the participants of our study is further explained by the fact that, in Kano State, while a vast majority of the urban inhabitants are business men and civil servants which are essentially sedentary in nature, majority of rural dwellers are farmers and cattle rearers which are active life styles. This impression is strengthened by the

observation that in both sexes of this study, all the anthropometric indices of adiposity except BAI in males were significantly higher in the urban participants. There was slight sex difference observed in the effects of urbanization on the adiposity indices. While all the adiposity measures were significantly higher in female urban participants compared to their rural counterparts, there was no significant urban rural difference in BAI of male participants. This may indicate that females are more susceptible to the adverse effects of urbanization. This may not be unconnected with the fact that even in the urban setting where sedentary lifestyle is common; females have a higher tendency of adopting a sedentary life style when compared to males. In the present study, even though females of both urban and rural settlements were mostly full time house wives, while the females of rural communities by their routine of cracking fire wood to cook and drawing water from the well were more active, females in the urban communities were not engaged in such activities and therefore were less active. This may have accounted for the higher rural-urban difference in adiposity indices of females compared to males.

The observed higher adverse impact of urbanization on BMI, WC, NC, WHR and WHtR compared to HC and BAI may suggest that the different anatomic sites of adipose tissue aggregation are not equally affected by urbanization and that for the Hausa ethnic group of Kano State. BMI, WC, NC and WHR are most affected by urbanization and therefore emphasis should be placed on prophylactic and therapeutic strategies targeted at combating these indices in the urban settlements. This particular finding is of utmost significance because it is documented that the various anthropometric measures of body adiposity do not pose equal metabolic risk (Bergman *et al.*, 2011; Amato and Giordano, 2014), therefore, identifying the extent to which urbanization affect a particular measure of adiposity indirectly provides an insight on the consequence of urbanization on the metabolic parameters that are tight correlates of that adiposity measure.

In agreement with our study, Sabir *et al.* (2013) conducted a study to compare the adiposity profile of a rural and urban settlement in Nigeria and showed that the mean values of WC, BMI, WHR were higher for the urban inhabitants. Also, Adediran *et al.* (2012) conducted an observational study on rural and urban settlements of Abuja, Nigeria to compare the distribution of adiposity and metabolic syndrome parameters among the people in both communities and found that WC, WHR and BMI were significantly lower in rural settlements.

Overall comparison of the result of the present study and previous studies demonstrates a similar adverse effect of urbanization on body adiposity measures but with little variation in terms of the magnitude of impact on the different indices. These variations could be due to differences in the extent of exposure to urban life style in the subject of the different studies or individual differences in the inherent mechanism of metabolizing food nutrients.

CONCLUSION

The study revealed that both central (NC, HC, WC, WHR, WHtR and BAI) and generalized (BMI) anthropometric indices of adiposity are adversely affected by urbanization. HC and BAI were least affected by urbanization. BAI was only significantly higher in female urban participants but not in males. The adverse effect of urbanization on body adiposity was more pronounced in females.

Conflict of Interest: There is no existence of conflict of interest financially or otherwise

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