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Correlation of Anthropometric Indices and Age with Fasting Plasma Glucose among Inhabitants of Ogun State, South-West Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Authors THR, OO and OF designed the study and wrote the protocol. Author THR analysed the results, managed the literature searches and wrote the first draft of the manuscript. Author AOO carried out the laboratory analysis. All authors read and approved the final manuscript.

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ABSTRACT

Background: Type 2 diabetes has assumed epidemic proportion. Several reports have linked both general and central obesity with diabetes mellitus but there are ethnic differences between adiposity, visceral adipose tissue and type 2 diabetes. This study aims to determine the correlation of anthropometric indices and age with fasting plasma glucose (FPG) in south-west Nigeria.

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Methods: This is a cross-sectional survey involving 521 adult participants comprising of 134 (25.7%) males and 387 (74.3%) females. Body mass index (BMI), waist circumference (WC), waist-to-hip ratio (WHR), and waist-to-height ratio (WHtR) were determined by standard protocols. Fasting plasma glucose (FPG) was determined by glucose oxidase method. Student's t-test was employed to compare the means of FPG of the obese and non-obese participants.
Results: The mean FPG of obese men was significantly higher than those of non-obese men (94.62±25.86 mg/dL vs 81.14±13.29 mg/dL, P=.029 with WC; 86.56±20.09 mg/dL vs 80.04±11.42 mg/dL, P=.024 with WHR; 89.23±20.34 mg/dL vs 79.92±12.92 mg/dL, p=.006 with WHtR; 91.4±23.4 mg/dL vs 80.5±12.4 mg/dL, P= .013 with BMI). Among the women, FPG was significantly greater in those with general obesity compared to the non-obese in the fifth decade (81.93±11.59 mg/dL vs 75.3±88.18 mg/dL, P=.025). Similarly women with central obesity had greater FPG compared with the non-obese between the fifth to sixth decades: WC,94.34±40.89 mg/dL vs 77.28±8.04 mg/dL, P=.009; WHR,81.73±12.13 mg/dL vs 75.76±6.84 mg/dL, P=.016; WHtR,95.00±40.16 mg/dL vs 74.41±6.51 mg/dL, P=.001)
Conclusions: Plasma glucose correlated with obesity. Participants with obesity had higher mean fasting plasma glucose compared with those who were not obese. The difference was apparent among women between the fifth to sixth decades only. Among the men, the difference was observed with only WHR between the seventh to eight decades. Preventive strategies may need to be directed at certain age groups.

Keywords: Obesity; glucose; age; correlations.

1. INTRODUCTION

Type 2 diabetes has assumed epidemic proportion. About 415 million people have diabetes worldwide, and this figure is expected to reach 642 million by 2040 [1]. Africa has the highest percentage of undiagnosed people with diabetes mellitus, while Nigeria has the highest number of adults with diabetes mellitus in the continent [1].

The prevalence of obesity is increasing worldwide such that overweight and obesity is a threat to the health of populations in many countries [2]. Body mass index (BMI) [defined as weight in kilogrammes divided by height in metres] is a measure of general adiposity, while waist circumference (WC), waist- to- hip ratio (WHR) and waist- to -height ratio (WHtR) are measures of abdominal obesity. Obesity is associated with insulin resistance and defects in insulin secretion [3]. Several reports have linked obesity with diabetes mellitus, [4-9] and both abdominal and general obesity have been implicated in the development of diabetes mellitus. Body mass index, waist circumference, waist- to- hip ratio and waist- to -height ratio were associated with higher risk of diabetes mellitus in prospective and cross-sectional studies [4,5,8,10].

Aging is associated with insulin resistance. Insulin resistance increases with age, due to greater adiposity and reduction in physical activity; additionally, aging is associated with pancreatic β-cell secretory defect [11]. These changes ultimately lead to hyperglycaemia.

The reports linking diabetes and obesity mentioned above emanated from outside Nigeria, but it has been recognized that ethnic differences exist between adiposity, visceral adipose tissue and type 2 diabetes [12-14]. While some of these differences are genetically determined, environmental factors are also contributory [3]. These observations have led some authorities to propose different anthropometric cut-off points for different regions of the world [15]. Previous reports from Nigeria were limited to the association between blood glucose and BMI [16,17]. The studies were also limited to younger people. In a study of association between waist circumference and risk of hypertension and type 2 DM, plasma glucose was not available for the Nigerian participants [5]. Is the association between obesity, particularly central or abdominal obesity, and plasma glucose described in other ethnic groups valid for Nigerians? If this is so, is it applicable to all age groups? There is currently no answer to these questions. Yet, answer to these questions will help plan preventive strategies. It becomes necessary therefore to explore the association between plasma glucose and obesity, particularly central obesity in Nigeria. This study determines the relationship between indices of obesity (general and central) and age, with fasting plasma glucose (FPG) in south-west Nigeria.

2. METHODOLOGY

2.1 Study Design

This is a cross-sectional descriptive study.

2.2 Study Location and Study Participants

The study was conducted at Sagamu and Remo North local government areas of Ogun State, Nigeria. The locations were chosen by convenience sampling. Ogun State is a state in western Nigeria, occupies 16,406,226 km^2 area of land, and is populated by 3.7 million people according to the census figure of 2006 [18]. Yoruba is the main ethnic group in Ogun State.

The participants included market men and women, artisans, farmers, drivers, and few civil servants who were chosen by convenient sampling. Initial sensitization visits were paid to the communities, and the people that met the inclusion criteria were told to meet at a designated point for the screening, including the King's palace, the market, town halls, and parks. Apparently healthy participants who were 20 years old and above, Yoruba by tribe, and who gave their consent were included in the study. People, who were less than 20 years old, not Yoruba by tribe, breastfeeding mothers and pregnant women, and those who did not give their consent, were excluded from the study. With the aid of a structured interview questionnaire, demographic parameters such as age, gender, marital status, were obtained from the participants. The height, weight, waist and hip circumferences were measured, and venous blood was drawn for fasting plasma glucose determination.

2.3 Anthropometric Measurements and Laboratory Analysis

Anthropometric measurements were taken as recommended by the World Health Organization [19]. The height was measured to the nearest 0.1metre with a calibrated meter rule placed horizontally against the wall. The weight was measured with a weighing scale without shoes and with the patient wearing light clothing, to the nearest 0.1kg. The body mass index (BMI) was taken as the value of weight divided by the square of the height. The BMI was classified as follows: <25.0 kg/m2, normal weight; ≥25.0 kg/m^2, overweight/obese. With the aid of a non-stretchable tape rule, the waist circumference (in centimetres) was taken midway between the inferior margin of the last rib and the iliac crest in a horizontal plane. Hip circumference was measured to the nearest centimetres at the level of the greater trochanters with the subjects wearing underwear or light clothing. The waist-to-hip ratio (WHR) was calculated from the values of the waist and hip circumferences. Waist to height ratio (WHtR) was calculated from the values of waist circumference and height in centimetres.

Central obesity was defined as (1) WC >80 cm in females or WC >94 cm in males) [20], (2) WHR >0.85 in females or >0.90 in males, [19], (3) WHtR of 0.5 or more in both men and women [12].

Fasting venous blood sample was drawn for plasma glucose, after an overnight fast using aseptic techniques into fluoride–oxalate bottles for storage at -20°C until laboratory analysis. Plasma glucose was determined using the glucose oxidase method [21].

2.4 Statistical and Data Analysis

Data were analysed using the statistical package for social sciences (SPSS) version 20.0 (Chicago, Illinois, USA). The variables were expressed as means (standard variation). Pearson correlation between FPG and the obesity indices (BMI, WC, WHR and WHtR) was determined. Student's t-test was employed to compare the means of FPG of the overweight/ obese and non-obese participants. A p-value of <0.05 was taken to be significant.

2.5 Ethical Approval

The ethic and research committee of the Olabisi Onabanjo University Teaching Hospital, Sagamu, Ogun State approved the study (REF: OOUTH/ DA.326/508). The consents of the king and community leaders were also sought, as well as the consent of each study participant also obtained.

3. RESULTS

There were 521 adult participants comprising of 134 (25.7%) males and 387 (74.3%) females. Compared with men, women were significantly older, and had higher mean WC, WHtR, and BMI. There was no significant difference in the mean FPG in male and female participants. The clinical characteristic of the participants is shown in Table 1.

Table 1. Anthropometric and laboratory characteristics of the study participants

Characteristics of the study participants	Female	Male	P
Age (years)	50.1(15.3)	44.2(16.9)	<.001
Height (m)	1.6(0.6)	1.7(0.6)	<.001
Weight (kg)	61.9(15.1)	63.0(11.8)	.398
WC (cm)	84.6(15.2)	79.2 (12.4)	<.001
HC (cm)	95.6(11.2)	87.1 (10.8)	<.001
WHR	0.88(0.09)	0.91(0.06)	.002
WHtR	0.54(0.09)	0.48(0.07)	<.001
BMI(kg/m^2)	25.1 (5.8)	22.8(3.7)	<.001
FPG(mg/dL)*	84.13(22.29)	83.25(16.54)	.675

*FPG, fasting plasma glucose; WC, waist circumference; HC, hip circumference; WHtR, waist to height ratio; WHR, waist to hip ratio; BMI, body mass index. *To convert mg/dL to mmol/L the value is divided by 18*

3.1 Correlation between FPG and Obesity

Among the participants, there was a positive correlation between FPG and obesity indices. The correlation coefficient was greater in males (Table 2).

Tables 3-6 show that overall, the mean FPG of obese men was significantly higher than those of non-obese men. Overall, the mean FPG of obese women was not significantly higher than those who were not obese. However, among the women FPG was significantly greater in those with general obesity compared to the non-obese in the fifth decade. Similarly women with central obesity had greater FPG compared with the non-obese between the fifth and sixth decades.

4. DISCUSSION

This study evaluated the relationship between plasma glucose and obesity. The study aims to determine the correlation between the indices of obesity and plasma glucose, as well as to compare the mean FPG in the obese and non-obese. The influence of age on this relationship was also explored. Previous reports from Nigeria were limited to only BMI and younger participants [16,17]. Compared to these reports, the strength of this current study lies in the fact that the relationship between three indices of central adiposity and body mass index were evaluated among participants with a wide age range.

4.1 Relationship between Fasting Plasma Glucose and Anthropometric Indices

We found a positive correlation between fasting plasma glucose and anthropometric indices among the participants, but the correlation was significant only in men. In a previous study on the relationship between BMI and FPG among some Nigerian undergraduates there was a positive but weak correlation between BMI and FPG in males

Table 2. Correlation between obesity indices and fasting plasma glucose after controlling for age in the participants

Obesity indices	FPG	WC	WHR	WHtR
		Females		
FPG	—			
WC	0.075	—		
WHR	0.073	0.778	—	
WHtR	0.060	0.980	0.772	—
BMI	0.047	0.792	0.332	0.793
		Males		
FPG	—			
WC	0.333*	—		
WHR	0.180¶	0.596	—	
WHtR	0.282⁺	0.969	0.659	—
BMI	0.241¥	0.808	0.545	0.800

FPG, fasting plasma glucose; WC, waist circumference; WHtR, waist to height ratio; WHR, waist to hip ratio. BMI, body mass index

**P<.001; ⁺P=.001; ¶P=.04; ¥P=.005. P>.05 for all the correlations between FPG and obesity indices in the females*

Table 3. Fasting plasma glucose in the obese and non-obese participants (Body mass index)

Age group (years)	No	BMI status	FPG (mg/dL)* Mean (sd)	p- value
		Males		
20-29	34	Non-obese	77.18(8.03)	.204
	4	Overweight/obese	96.50(23.85)	
30-39	19	Non-obese	78.79(9.99)	.550
	6	Overweight/obese	81.67(10.63)	
40-49	10	Non-obese	77.90(7.58)	.310
	6	Overweight/obese	85.83(16.58)	
50-59	5	Non-obese	98.80(34.25)	.848
	11	Overweight/obese	95.91(24.33)	
60-69	24	Non-obese	82.71(11.2)	.447
	4	Overweight/obese	102.75(45.81)	
≥ 70	8	Non-obese	83.50(11.63)	.953
	3	Overweight/obese	84.00(13.86)	
Total	100	Normal	80.47(12.44)	.013
	34	Overweight/obese	91.44(23.36)	
		Females		
20-29	46	Non-obese	81.70(18.09)	.303
	9	Overweight/obese	89.22(27.83)	
30-39	25	Non-obese	79.16(13.26)	.740
	24	Overweight/obese	78.17(6.59)	
40-49	21	Non-obese	75.38(8.18)	.025
	41	Overweight/obese	81.93(11.59)	
50-59	27	Non-obese	78.37(8.78)	.013
	38	Overweight/obese	97.61(44.70)	
60-69	62	Non-obese	85.34(17.86)	.846
	35	Overweight/obese	86.26(28.58)	
≥ 70	40	Non-obese	85.55(20.57)	.857
	19	Overweight/obese	86.58(19.99)	
Total	221	Non-obese	82.12(16.64)	.056
	166	Overweight/obese	86.81(27.93)	

Overall, the FPG in men who were overweight/obese was significantly greater than in non-obese men. Among the women FPG was significantly greater in the obese compared to the non-obese in the fifth decade and sixth decade

*FPG, fasting plasma glucose; BMI, body mass index. *To convert mg/dL to mmol/L the value is divided by 18*

and a strong correlation in females [17]. In another study, there was no significant correlation between random blood glucose (RBG) and BMI in both males and females [16]. In fact, the above study revealed a negative correlation between RBG and BMI in the male participants. Compared to the study by Bakari et al. [17] our participants were older but had similar body mass index, and comparable blood glucose. Fasting plasma glucose is expected to be lower than RBG (which was taken without regard to the last meal) more so, when glucose-meter was used to determine the RBG. Even though direct comparison of FPG and RBG may be difficult, if FPG were done by Bakari et al. [17] the value could have been lower than ours. This suggests that older age led to higher plasma glucose in our study. This is not surprising since increasing age is associated with insulin resistance. Additionally, their participants (in the northern Nigeria) could be more active than ours (in south-west Nigeria), and consume less refined diet. Increased physical activity may negate the correlation between obesity and plasma glucose since exercise makes the cells more sensitive to insulin [22]. The strong correlation between BMI and FPG among the female in the study by Ifie et al. [16] may be because it was conducted among undergraduates who were exposed to obesogenic environment (unhealthy diet and lack of physical activity). Differences in the ethnic background and location of the studies (northern Nigeria versus Southern Nigeria versus Western Nigeria) may also account for the different findings. Taken together age, level of physical activity, and ethnic background probably influenced the relationship between obesity and plasma glucose. Studies among Americans and Jamaicans revealed a weak positive correlation between WC and FPG in both men and women [5], while an Iranian study revealed a positive and significant correlation between FPG and WC, although this is dependent on age especially among the women [23]. FPG was not done among Nigerians who participated in the above study [5]. The above findings support the fact that apart from obesity, there are other risk factors for the development of diabetes mellitus.

Gender differences in the association between diabetes and obesity have been observed. While men have android obesity, women have gynaecoid obesity. Android obesity is associated with insulin resistance whereas gynaecoid obesity represented by peripheral fat is associated with improved insulin sensitivity [24]. In the abdomen, men have more visceral fat than women, while women have more subcutaneous fat than men. Unlike subcutaneous fat, visceral fat is metabolically active. Along with other cytokines, it secrets tumour necrosis factor-α, and interleukin (IL)-6 [24]. These inflammatory cytokines induce insulin resistant state. Therefore, for the same BMI, men are more insulin resistant than women, and may have greater plasma glucose [25]. This may also explain the fact that although women had greater mean WC, BMI, WHR, and WHtR than men in our study, there was no corresponding significant difference in the mean plasma glucose. This was also observed by other authors [16,25].

Table 4. Fasting plasma glucose in the obese and non-obese participants (Waist circumference)

Age group (years)	No	WC status	FPG (mg/dL)* Mean (sd)	p- value
		Males		
20-29	37	Normal	78.97(11.89)	.459
	1	Obese	88.00	
30-39	22	Normal	78.50(9.39)	.190
	3	Obese	86.67(13.65)	
40-49	16	Normal	80.88(11.9)	N/A
	0	Obese	-	
50-59	5	Normal	98.80(34.25)	.848
	11	Obese	95.91(24.33)	
60-69	24	Normal	81.83(11.03)	.306
	4	Obese	108.00(42.50)	
≥ 70	11	Normal	83.64(11.54)	N/A
	0	Obese	-	
Total	113	Normal	81.14(13.29)	.029
	21	Obese	94.62(26.85)	
		Females		
20-29	43	Normal	83.12(19.59)	.895
	12	Obese	82.25(21.76)	
30-39	14	Normal	82.86(15.96)	.205
	35	Obese	77.00(6.80)	
40-49	15	Normal	76.73(7.49)	.230
	47	Obese	80.66(11.75)	
50-59	18	Normal	77.28(8.04)	.009
	47	Obese	94.34(40.89)	
60-69	45	Normal	85.27(20.28)	.869
	52	Obese	86.02(23.89)	
≥ 70	30	Normal	86.10(23.43)	.934
	29	Obese	85.66(16.69)	
Total	165	Normal	83.01(18.65)	.391
	222	Obese	84.97(24.67)	

*Overall, the FPG in obese men was significantly greater than in non-obese men. Among the women FPG was significantly greater in the obese compared to the non-obese in the sixth decade. FPG, fasting plasma glucose; WC, waist circumference. *To convert mg/dL to mmol/L the value is divided by 18*

Table 5. Fasting plasma glucose in the obese and non-obese participants (Waist to hip ratio)

Age group (years)	No	WHR status	FPG (mg/dL)* Mean (sd)	p- value
		Males		
20-29	36	Normal	80.00(11.65)	.081
	2	Obese	65.00(0.00)	
30-39	14	Normal	76.00(8.07)	.058
	11	Obese	83.91(10.80)	
40-49	5	Normal	78.40(12.01)	.593
	11	Obese	82.00(12.27)	
50-59	3	Normal	110(43.30)	.359
	13	Obese	93.77(22.82)	
60-69	20	Normal	80.90(10.89)	.046
	8	Obese	97.25(31.14)	
≥ 70	2	Normal	102.00 (0.0)	.004
	9	Obese	79.56 (7.95)	
Total	68	Normal	80.04(11.42)	.024
	66	Obese	86.56(20.09)	
		Females		
20-29	40	Normal	80.15(16.79)	.170
	15	Obese	90.33(25.65)	
30-39	13	Normal	82.15(17.01)	.346
	36	Obese	77.42(6.64)	
40-49	21	Normal	75.76(6.84)	.016
	41	Obese	81.73(12.13)	
50-59	11	Normal	76.45(5.87)	.182
	54	Obese	92.30(38.64)	
60-69	34	Normal	83.00 (7.97)	.387
	63	Obese	87.11(26.87)	
≥ 70	14	Normal	95.64(30.82)	.154
	45	Obese	82.84(14.79)	
Total	125	Normal	82.06(16.39)	.207
	262	Obese	85.12(24.57	

Overall, the FPG in obese men was significantly greater than in non-obese men but the difference was observed mainly between the seventh to eight decades. Among the women FPG was significantly greater in the obese compared to the non-obese in the fifth decade

*FPG, fasting plasma glucose; WHR, waist to hip ratio. *To convert mg/dL to mmol/L the value is divided by 18*

However, in contrast to the above, some authors found higher mean value for obesity index and FPG [23], but they used WC as opposed BMI, and the study populations were from different ethnic background. Indeed, Logue et al. [25] suggested further research in other ethnic groups to confirm their findings.

Gender difference in fat metabolism may also explain the association between obesity and plasma glucose. Catecholamine mediated leg free fatty acid release is lower in women than in men, whereas free fatty acid release from the upper body depots is comparable [26]. Similarly, men release more free fatty acid from the upper body subcutaneous fat depots than women [26]. The glycerol is converted to glucose while the free fatty acid negatively affects insulin sensitivity and stimulates gluconeogenesis. The net result is hyperglycaemia.

4.2 Fasting Plasma Glucose in the Obese and Non-obese Participants

In our study, we found that the FPG in men who were overweight/obese was significantly greater than in non-obese men. This was true irrespective of the measure of obesity: total or central. However, when the men were analysed according to their age group, the significance in the difference was lost except in the seventh and eight decade for WHR. This loss of significance may be due to type II error. Among the women, as a whole, the FPG in the obese was not significantly greater than in those who were not obese.

Table 6. Fasting plasma glucose in the obese and non-obese participants (Waist–to-height ratio)

Age group (years)	No	WHtR status	FPG (mg/dL)* Mean (sd)	p- value
		Males		
20-29	36	Normal	77.56(8.3)	.374
	2	Obese	109.00(29.69)	
30-39	16	Normal	78.25(9.71)	.424
	9	Obese	81.67(10.71)	
40-49	10	Normal	77.9(7.57)	.207
	6	Obese	85.83(16.58)	
50-59	5	Normal	98.80(34.25)	.848
	11	Obese	95.91(24.33)	
60-69	17	Normal	80.82(11.64)	.116
	11	Obese	92.91(27.24)	
≥ 70	4	Normal	88.00(8.44)	.475
	7	Obese	81.14(16.17)	
Total	86	Normal	79.92(12.96)	.006
	48	Obese	89.23(20.34)	
		Females		
20-29	42	Normal	83.36(19.73)	.776
	13	Obese	81.54(21.11)	
30-39	13	Normal	79.92(16.95)	.731
	36	Obese	78.22(7.08)	
40-49	15	Normal	76.73(7.49)	.230
	47	Obese	80.66(11.75)	
50-59	17	Normal	74.41(6.51)	.001
	48	Obese	95.00(40.16)	
60-69	38	Normal	84.87(22.13)	.777
	59	Obese	86.19(22.39)	
≥ 70	22	Normal	87.86(26.59)	.566
	37	Obese	84.70(15.57)	
Total	134	Normal	82.89(19.05)	.424
	253	Obese	84.79(23.84)	

Overall, the FPG in obese men was significantly greater than in non-obese men. Among the women FPG was significantly greater in the obese compared to the non-obese in the sixth decade

*FPG, fasting plasma glucose; WHR, waist to hip ratio. *To convert mg/dL to mmol/L the value is divided by 18*

Previous works also revealed that people with obesity either had higher plasma glucose or higher risk of type 2 diabetes compared with the non-obese [23,27]. Obesity, in particular central obesity is a risk factor for type 2 diabetes [8]. Central obesity induces insulin resistance, and both have been shown to account for the excess risk of diabetes among certain ethnic groups compared to the Caucasians, particularly in women [28].

Furthermore, some authors found that among Chinese population, measures of central obesity predicted prevalence of glucose intolerance better than BMI [29]. A Korean study found that WC predicted the development of DM and impaired fasting glucose regardless of age, sex, and BMI [9].

4.3 Fasting Plasma Glucose and Age

As mentioned above, among the women, as a whole, the FPG in the obese was not significantly greater than in those who were not obese. However, between the fifth and sixth decades, the FPG of those with general obesity was greater than those without general obesity. Similarly, the FPG of the obese women in the fifth decade using WHR as measure of obesity, and for those in the sixth decade using WC and WHtR as measure of obesity were significantly greater than in the non-obese. Thus, apart from the influence of gender, the relationship between FPG and obesity may also be age dependent. This is in agreement with finding by previous authors [23]. The above study also revealed that the correlation between FPG and

WC was age dependent particularly among women.

Increasing age is associated with rising plasma glucose, [5] and incidence of diabetes mellitus [9]. Insulin resistance increases with age, due to greater adiposity and reduction in level of activity [11]. Additionally, aging is associated with pancreatic β-cell secretory defect, and elderly persons may have co-morbid illnesses which may warrant use of agents that may worsen both pancreatic function and insulin sensitivity [11]. These changes ultimately lead to hyperglycaemia. Nevertheless, the influence of age on plasma glucose may be complex. In a study on the effect of gender on the association between obesity cardiovascular risk factors, Wakabayashi et al. found that multiple cardiometabolic risk factors in obese versus non-obese subjects were significantly higher in women than in men in younger (35-40 years) but not in older (60-70 years) individuals. Similar to the above findings, we also found in the current study that the difference in the plasma glucose between the obese and non-obese women was significant in the fifth to sixth decades. Karakelides et al. [30] showed that the relationship between age and insulin resistance depended on changes in body composition associated with age rather than the chronological age. However, this needs to be confirmed in our own population.

Apart from gender difference in body composition discussed earlier, the influence of sex hormones, adipokines, and gender difference in energy balance also modulate plasma glucose [31]. Oestrogen enhances beneficial adipose tissue distribution and insulin sensitivity. It also has antioxidant and anti-inflammatory properties, and decreases hepatic glucose output. The anti-inflammatory and anti-oxidant function decreases insulin resistance, and preserves β-cell of the pancreas respectively. The effect of oestrogen on hepatic glucose production may explain the higher fasting plasma glucose in men compared to women despite the higher BMI in the latter [22]. Summarily, oestrogen protects against the development of T2DM. In contrast to the effect of oestrogen, testosterone increases insulin resistance. Women have higher levels of adiponectin and leptin compared to men, and these adipokines have desirable effect on insulin sensitivity [31].

Given the relationship between obesity and plasma glucose, concerted efforts should be made to achieve weight and waist-line reduction through lifestyle modification. This in turn is expected to curb the rising prevalence of type 2 diabetes mellitus.

5. LIMITATIONS AND FUTURE DIRECTIONS

The effects of alcohol, smoking, and level of physical activity on the plasma glucose were not accounted for. These factors are known to influence plasma glucose negatively. The cross-sectional design makes it difficult to accurately determine the influence of age on the relationship between obesity and plasma glucose. The sampling method adopted in this study recruited more women than men, and this probably led to the findings among men. Our study showed clearly that age influences the relationship between obesity and plasma glucose, but is limited to the population studied until it is replicated in other parts of the country, because of ethnic differences. There is need for a large prospective study to accurately determine the contribution of obesity to the development of diabetes mellitus in Nigeria.

6. CONCLUSIONS

There was positive correlation between anthropometric indices of obesity and fasting plasma glucose. Participants with obesity had higher mean fasting plasma glucose compared with those who were not obese. The difference was apparent among women between the fifth to sixth decades only. Among the men, the difference was observed with only WHR between the seventh to eight decades. Preventive strategies may need to be directed at certain age groups.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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