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Variations in Glycosylated Haemoglobin (Hba1c) Levels of Obese Women Resident in Rivers State, Nigeria

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Abstract

Globally, the incidence of obesity is known to be linked to a number of other riskfactors such as diabetes, cardiovascular disease, amongst others, however, there are population specific variance and severity. Therefore, this study t investigated the possible variations in glycosylated haemoglobin (HbA1c) levels of obese women resident in Rivers State, Nigeria. Precisely, 334 obese and non-obese women within the ages of 18 and 65 years with no obvious health challenge and resident in Upland and Riverine areas of Rivers State were actually surveyed by the present study. A multistage sampling technique was adopted, and subjects were surveyed across the upland and riverine locations of the State. These subjects were evenly drawn from the multi-ethnic residents of the state. Anthropometric (body mass index- BMI) data and blood sample (via antecubital vein following standard procedures) were obtained from the consenting subjects. After laboratory analyses, the quantitative data got were subjected to statistical analyses using the statistical package for social sciences (SPSS) version 21.0. One-way analysis of variance (ANOVA) and independent t-test with a $p< 0.05$ considered statistically significant were determined. The result also revealed that all obese subjects as well as their UPL and RVR subgroups had significantly ($P<0.05$) elevated HbA1c compared to their respective non-obese groups and these increases were both graded and marked ($P<0.05$) with increasing BMI. It is also important to note that the non- obese and obese class III of the RVR subjects had markedly ($P<0.05$) higher levels when compared to those of their UPL counterparts.The finding of this study on the changes in HbA1c levels of obese women resident in UPL and RVR residents revealed significant ($P<0.05$) rising percentages of HbA-1c with increasing BMI. It can thus be concluded that the incidence of obesity and associated comorbidities are substantially linked to sex, ethnic/culture and socioeconomic status.

Keywords: Incidence of obesity, diabetes mellitus, glycosylated haemoglobin (HbA1c), obese women.

INTRODUCTION

In talk of a decade from now, the prevalence of obesity is expected to be elevated beyond forty percent (40%) (Kovesdy *et. al.*, 2017; Pommer, 2018). The risks of diabetes, cardiovascular disease, and chronic conditions are all implicated by this trend of obesity.

One of the major risk factors for type 2 diabetes mellitusis a high body mass index (Kovesdy *et al*., 2017). More so, some major effects of the disease are that, in adults, it raises the likelihood of the incidences of type dyslipidaemia, hypertension, coronary heart disease, certain cancers, etc. The associated adverse effects of the increasing severity of the disease do not spare the reproductivesystem and its performance (WHO, 2021).

Apart from the health impact, obesity has also been connected to both social and economic setbacks considering its tow on the educational prospects of the individual, lower earning capacity, and increased spending on healthcare, thus, likely raising financial stress and economic wastes on the society. Again, the incidence of obesity is considerably related to sex, racial ethnic identity, and socioeconomic status.

Now, considering the deep connection and frequent co-existence of obesity and diabetes, it is important to understand the population specific variance

and severity of diabetes in a highly obesity prone population—women. The present study thus set out to evaluatedemorgraphic profile and the variations in glycosylated haemoglobin (HbA1c) levels of obese women resident in Rivers State, Nigeria. Of course, HbA1c is a known better reliable marker (Kovatchev *et al*., 2000) for evaluating diabetes and it progression aswell as itsrecession.

MATERIALS AND METHODS

Research Design

This study was a cross-sectional survey of obese women in Rivers State, Nigeria. It focused on obese women resident in upland and riverine areas of the State, using multistage sampling techniques. Ethical approval was sought and obtained from the institutional Ethics Committee of the University of Port Harcourt and properly signed consent forms were obtained from each subject before being recruited into the study.

Study Area

The study was conducted in Rivers State, Nigeria,between the upland and riverine residentsof the State. Rivers State, also known simply as Rivers, is the sixth largest and one of the 36 states of Nigeria. It is home to many indigenous ethnic groups: Abua, Ikwerre, Ekpeye, Ijaws, Eleme/Ogoni, Etche, Ogba, Engeni, Egbema, and others. The inland part of the state consists of tropical rainforest; towards the coast the typical Niger Delta environment features many mangrove swamps (Jones, 2000).

The target population of this study was female residents in Upland and Riverine Regions of Rivers State and these included adults (18 and 65 years). Adopting the method of Azuogu *et al*., (2018), a multistage sampling technique was adopted, and a proportionate number of the study proforma were allocated to each stratified group based on their total number. During the periodic scheduled meetings the subjects, the attendance lists were used as a sampling frame. And the systematic random method was used to select participants with sampling interval of three until total number of questionnaires allocated to that group was exhausted.

Sample Size Determination

A minimum sample size of 272 was obtained using the Leslie Fischer's formula (Azuogu *et al*., 2018):

$$n = \frac{Z^2pq}{d^2}$$

with confidence interval set at 95%, normal deviate--**Z**
Z = 1.96, (Z—score for 95% confidence interval)
d(d is considered 0.05 to produce good precision and smaller error of estimate) = 0.05.
q=1-P (expected level of precision)

P=Expected prevalence or proportion of population if unknown 0.5; but in this case, the report of Chukwuonye *et al*., (2022) reported a prevalence rate of obesity in women Nigeria at 23% (i.e. 0.23). Consequently, a total of 334 subjects were actually surveyed by the current study.

Inclusion Criteria

It were obese women who are resident in Upland and Riverine areas of Rivers State, who are within their 18 and 65 years of age. And non-obese women with similar criteria as above to serve as control.

Exclusion Criteria

Were subjects as stated in the inclusion criteria but were critically ill; those who were non-residents of the study area; women below 18 years or above 65 years. And then, women who met the inclusion criteria but did not give consent to be recruited into the study.

Methods of Data Collection

The collection of data was via a well thought out proforma and laboratory analysis of the obtained biological/blood samples from the study subjects using standard methods. A lengthened meter rule and standiometer were used to determine the BMI. The classification of BMI as adopted by the present study was stipulated by the World Health Organization (WHO, 2021). Glycosylated haemoglobin was determined using Kovatchev *et al*., (2000)'s method.

Method of Data Analyses

Quantitative data obtained from the present study were subjected to statistical analysis using the statistical package for social sciences (SPSS) version 21.0. Statistical significance was determined using the following tools: one-way analysis of variance (ANOVA) and independent t-test. A $p< 0.05$ was considered statistically significant.

RESULTS

The occupation of most of the upland (UPL) residents were mainly farming (62.34 percent) and civil service (16.67 percent), whereas their RVR associates were majorly civil service (42.44 percent) and trading (31.39 percent).

Considering the marital status of the study subjects, comparatively, more of the UPL residents were married (50 percent), divorced (16.05 percent) and widowed (14.20 percent) as against those of the riverine (RVR) subjects (33.72 percent; 2.21 percent and 6.39 percent respectively). In fact, most of the later are singles (47.67 percent).

The educational level of the respondents indicated most of the RVR residents had tertiary education (49.2 percent) and least no formal education (8.72 percent) as matched to the their UPL counterparts

(who had 19.13 percent and 24.69 percent respectively). Both RVR and UPL residents were predominantly of the Christian faith (95.35 percent and 89.51 percent respectively.

Table 1: Socio-Demographic Profile of upland and riverine female residents of Rivers State

S/NO.	VARIABLES	ALL SUBJECTS [Frequency (percent)] [n=334]	Upland [Frequency (percent)] [n=162]	Riverine [Frequency (percent)] [n=172]
1.	**Occupation**			
	Fishing	28(8.38)	7(4.32)	21(12.21)
	Farming	119(35.63)	101(62.34)	18(10.46)
	Traders	76(22.75)	22(13.58)	54(31.39)
	Artisans	13(3.89)	7(4.32)	6(3.49)
	Civil Servants	100(29.94	27(16.67)	73(42.44)
2.	**Marital Status**			
	Single	114(34.13)	32(19.75)	82(47.67)
	Married	139(41.62)	81(50)	58(33.72)
	Divorced	47(14.07)	26(16.05)	21(2.21)
	Widowed	34(10.18)	23(14.20)	11(6.39)
3.	**Educational Level**			
	Primary education	58(17.37)	32(19.75)	26(15.12)
	Secondary educational level	102(30.54)	59(36.42)	43(25)
	Tertiary education	116(34.73)	31(19.13)	85(49.42)
	No formal education	55(16.47)	40(24.69)	15(8.72)
4.	**Religion**			
	Christianity	309(92.51)	145(89.51)	164(95.35)
	Islam	18(5.39)	5(3.09)	3(1.74)
	others	16(4.79)	5(3.09)	11(6.39)

Table 1 displays the data on socio-demographic profile of the study subjects.

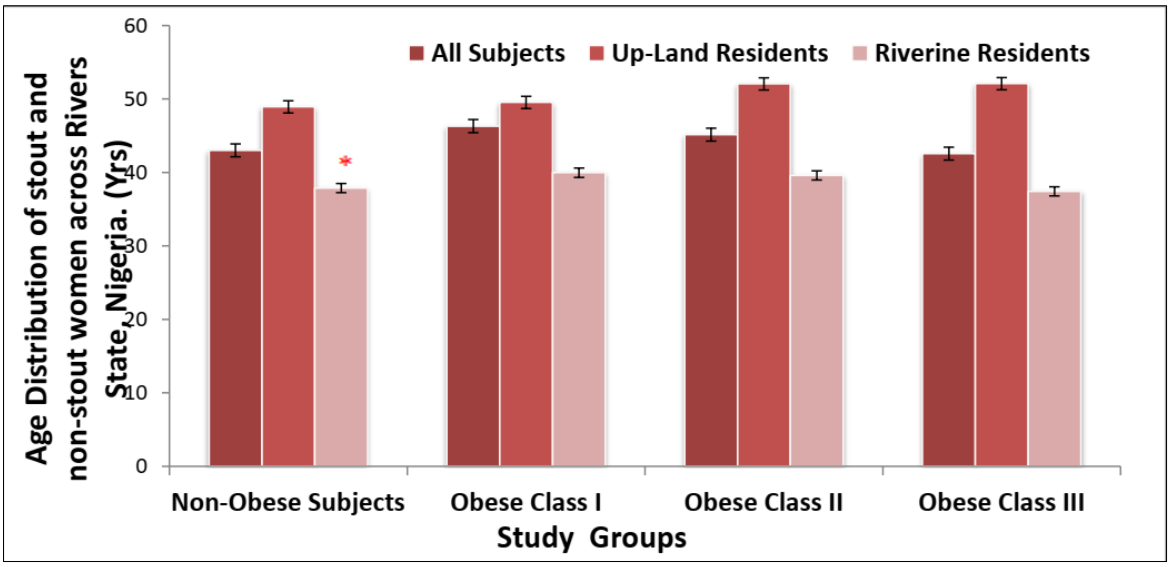

Figure 1: Age Distribution of subjects

Values are expressed as Mean ± Standard Deviation (SD); n [Non-obese All=125; UPLR=58; RVR =67; Obese Class I: All=77; UPLR=51; RVR =26; Obese Class II: All=72; UPLR=32; RVR =40; Obese Class III: All=60; UPLR=21; RVR =39]. [a] Marked at P < 0.05 when matched to Non-obese; [b] Marked at P < 0.05 when matched to Obese Class I; [c] Marked at P < 0.05 when matched to Obese Class II; * Marked at P < 0.05 when values of RVR residents are matched to those of UPLR residents.

The data on Figure1 shows the age distribution of obese and non-obese women across RvS, Nigeria. The average age of all respondents ranged between

42.56 and 46.30 years. While the ages of all respondents varied marginally (p greater than 0.05) across the respective groups, only that of the Non-obese RVR residents were markedly ($p < 0.05$) lower when matched to their up—land counterparts. Generally, the age of the UPLR respondents were tending towards the middle age whereas those of the RVR residents were just below forty years.

The overall mean age of all the study subgroups revealed markedly ($p < 0.05$) younger age for the RVR subjects (38.49 ± 9.19) when matched to that of the UPLR subjects (50.15 ± 7.83).

Table 2: Changes in Glycosylated Haemoglobin Levels of all obese and non-obese resident in the Upland (UPL) and riverine (RVR) areas of Rivers State

Groups	Glycosylated Haemoglobin (HbA-$_{1c}$) Levels (percent)		
	All Subjects	UPL Residents	RVR Residents
Non-Obese Subjects	4.54 ± 0.33	4.45 ± 0.23	4.62 ± 0.38*
Obese Class I	5.14 ± 0.79 [a]	4.89 ± 0.65 [a]	5.64 ± 0.81 [a]
Obese Class II	5.57 ± 0.98 [a, b]	5.41 ± 0.99 [a, b]	5.69 ± 0.97 [a]
Obese Class III	6.42 ± 0.69 [a, b, c]	5.94 ± 0.85 [a, b, c]	6.68 ± 0.40 [a, b, c, *]

Values are expressed as Mean ± Standard Deviation (SD); n [Non-obese All=125; UPL=58; RVR =67; Obese Class I: All=77; UPL=51; RVR =26; Obese Class II: All=72; UPL=32; RVR =40; Obese Class III: All=60; UPL=21; RVR =39]. [a] Marked at P<0.05 when compared to Non-obese; [b] Marked at P<0.05 when compared to Obese Class I; [c] Marked at P<0.05 when compared to Obese Class II; * Marked at P<0.05 when values of RVR residents are compared to those of UPL residents.

The results on Table 2 are the changes in glycosylated haemoglobin (HbA-$_{1c}$) levels of obese women resident in UPL in RVR regions of Rivers State, Nigeria.

All obese subjects as well as their UPL and RVR segmentations indicated markedly (P<0.05) elevated HbA-$_{1c}$ compared to their respective non-obese groups and these increases were both graded and marked (P<0.05) with increasing BMI.

It is also important to note that the non-obese and obese class III of the RVR subjects had markedly (P<0.05) higher levels when compared to those of their UPL counterparts.

DISCUSSION

Considering the distribution of occupation of the subjects, the UPL residents engage in more physically demanding job tasks than those of their RVR residents. This position is supported by previous reports which submits that white-collar workers were at a greater risk of high sedentary behaviour matched with pink-collar and blue-collar workers (Parry and Straker, 2013; Sung *et al*., 2021). Occupation has been implicated as a remarkable determiner of the prevalence of obesity ((Djalalinia *et al*., 2015; Kim and Lee, 2021). In fact, Kim and Lee, (2021) reported that the prevalence of obesity was higher amongst subjects who were at managerial CADxre and lower in craft and related trade workers in their study. This is succinctly so with the RVR residents than their UPL associates; as mainly civil servants and traders, they are obviously predisposed to sedentary lifestyle. This may have largely contributory to the higher incidences of obesity markers amongst the RVR residents than the UPL residents who were more into physically demanding tasks.

The educational level of the respondents indicated that most of the RVR residents attained tertiary education and least of no formal education as matched to their UPL counterparts. Alink *et al*., (2013), submitted that higher education may put one in a position to achieve a higher social status, even though the extent is determined by the individual (Alink *et al*., 2013). Even more so, given how food has been used to symbolize the "good life" and distinguish social strata. Accordingly, depending on the food environment and culture, some meals may be consumed more frequently by comparatively higher income groups and thus be seen as positional; as a result, increased social standing may encourage the use of processed foods.

Further, by the conclusion of Mekonnen *et al*., (2023), which said gropping income disparity is needed to backup healthier household food preferences above social status. This suggests that the RVR population may be more prone to relying on processed foods than their UPL counterparts. Thus implying more predispositions to higher social status that has been linked to more reliance on processed foods (Alink *et al*., 2013); which is a remarkable risk dynamic for obesity.

The finding of this study on the changes in glycosylated haemoglobin (HbA-$_{1c}$) levels of obese women resident in UPL and RVR residents revealed markedly rising percentages of HbA-$_{1c}$ with increasing BMI. And these increases in HbA-$_{1c}$ levels were even more with the RVR subjects compared to those of the UPL residents.

Diabetes-related insulin resistance is known to be brought on by obesity. Adipose tissue in obese people releases increased levels of non-esterified fatty

acids, glycerol, hormonal substances, and cytokines associated with inflammation that may contribute to the emergence of insulin resistance. In addition, genetic predisposition, adipose tissue hypoxia, oxidative stress, lipodystrophy, and endoplasmic reticulum stress all contribute to insulin resistance. From the above outcome of the present study, it can be inferred that the subject subjects maybe prone to diabetes mellitus as it is known that higher HbA-1c levels indicate protracted hyperglycaemic conditions and are able to dramatically aggravate the risk of HTN even in subjects without diabetes (Song *et al*., 2020). Further, this finding also shows that the subjects may be predisposed to diabetes associated morbidities).

CONCLUSION

This study has thus revealed that the obese women in the riverine region of the State have higher prevalence of comorbidity of obesity and diabetes compared to their upland counterparts in same State/geographical location. It can thus be inferred that the incidence of obesity and associated comorbidities are substantially linked to sex, ethnic/culture and socioeconomic status. The foregoing rationale may be very reliable for the surveyed population because they represent the core line of distinction of the two subgroups in their demographic profile.

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