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Original Research Article

Changes in Atherogenic Lipid Profile amongst Obese Women Resident in Rivers State, Nigeria

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Abstract

Increasing incidences of obesity are widely and significantly connected to the risks of cardiovascular/coronary heart diseases, hypertension, stroke, etc. However, prevalence of obesity contrasts by genetic, gender and inter/intra population factors. The present study thus investigated the changes in atherogenic lipid profile in obese women resident in Rivers State. A minimum sample size of 272 was determined using the Leslie Fischer's formula; precisely 334 obese and non-obese women within their 18 and 65 years of age with no critical health condition 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 recruited across the upland and riverine locations of the State. These subjects were uniformly 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 numerical data 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. Virtually all atherogenic lipid profile markers evaluated in the present study [TC, TG, and LDL-C, Castelli risk index (CRI), atherogenic index of plasma (AIP) and AC atherogenic coefficient (AC)] were significantly ($p<0.05$) higher in the obese subjects compared to those of the non-obese. And the values were even higher in the riverine obese subjects than in those of their upland counterparts. In conclusion, the outcome of the present study indicates possible existence of intra-cultural or intra-population distinctions that may be responsible for the severer atherogenic lipid profile of the obese subjects, (particularly amongst the riverine subjects). The likely imminent grave health risks (like coronary artery diseases, cardiovascular diseases and atherosclerotic, etc.) amongst the subjects (mainly the riverine residents) must be checked and properly managed at the levels of the individual, caregiver and government/regulators, in order to consciously reduce the huge health burden of obesity in our populace.

Keywords: Obesity, attherogenic lipid profile, women, Rivers State of Nigeria, body mass index (BMI) status.

INTRODUCTION

The buildup of unhealthful, excessive bodily fat is referred to as obesity (WHO, 2021). With the rising global rates of the disease, it has become a serious public health issue that affects practically every nation in the globe (Lim and Boster, (2023). Obese individuals are those with a body mass index of 30 kg/m2 or greater. Obesity is usually categorized into three: Class I (BMI of 30 to < 35); Class II (BMI of 35 to < 40); Class III (BMI of 40 or above). Class III obesity is frequently described as "severe" obesity (WHO, 2021).

The prevalence of obesity has grown globally by 27.5% in adults and 47.1% in children during the past three decades (Apovian, 2016). Complex interactions between genetic, social, and cultural factors lead to obesity. More so, obesity prevalence is influenced by dietary choices, urban planning, and way of life (Apovian, 2016). Aside from health burden, obesity has also been linked to both social and economic problems as affected people have less educational prospects, lower earning capacity, and increased spending on healthcare, thus, likely raising financial stress and economic wastes on the society (Apovian, 2016). Again, the incidence of obesity is considerably related to sex, racial ethnic identity, and socioeconomic status (Lee *et al.,* 2015).

Other times, access to food continues to play a big part in obesity, leading to regional differences in prevalence and higher rates of obesity among those with lower socioeconomic status (Becker *et al.,* 2022). The availability of high- calorie, high-energy food choices that are or are seen to be more affordable, along with decreases in occupational and transportation-related physical activity, can help maintain a favorable energy balance (Lee *et al.,* 2015; Becker *et al.,* 2022).

Being a complex disease with many factors contributing to its manifestation; it is important to conduct not only population specific investigation but gender and variant biological marker statuses in obese individuals. Moreover, considering the fact that obesity is a highly comorbid health condition particularly with type 2 diabetes mellitus, hypertension and cardiovascular diseases (CVDs) amongst many other conditions (Maric-Bilkan, 2013), the present study set out to investigate the changes in atherogenic lipid profile in obese women resident in Rivers State.

MATERIALS AND METHODS

Research Design

In this study, obese women in Rivers State, Nigeria, were cross-sectionally surveyed. Using multistage sample procedures, it focused on obese women living in upland and riverine parts of the State. Before recruiting subjects for the study, ethical approval was granted by the University of Port Harcourt's institutional ethics committee, and each participant provided duly completed consent forms.

Study Area

The research involved both people of the Rivers state's riverine and upland regions. The state remains the sixth-largest of Nigeria's 36 states and is usually referred to as Rivers. The state is home to numerous indigenous ethnic groups, including the Abua, Ikwerre, Ekpeye, Ijaws, Eleme/Ogoni, Etche, Ogba, Engeni, and Egbema. Tropical rainforest may be found in the state's interior, whereas mangrove swamps typical of the Niger Delta can be found near the shore (Jones, 2000).

Female inhabitants of Rivers State's Upland and Riverine Regions who were adults (within their 18 to 65 years of age) made up the study's target population. Similar to the approach of Azuogu *et al.,* (2018), a multistage sampling methodology was used, and according to the size of each stratified group, a proportionate number of research proforma were assigned to them. The attendance lists at the regularly planned meetings were utilized as a sample frame for the subjects. Additionally, participants were chosen using a systematic random procedure with a sampling interval of three until all questionnaires assigned to that group had been distributed.

Sample size determination

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

Consequently, a total of 334 subjects were actually surveyed by the current study.

Inclusion Criteria

It was 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).

The laboratory determination of the lipids was determined using Spectrophotometeric technique (Sug, Spec, Engl; 23P, 2013) as specified by Schaefer *et al.,* (2016) and following the guide of the reagent kits manufacturer's manual.

The data of atherogenic index of plasma (AIP), Castelli's Risk Index (CRI) and atherogenic coefficient (AC) were got via the following formulas: AIP = log triglyceride/high-density lipoprotein cholesterol (HDLc), CRI = Total cholesterol/HDLc and AC = (Total cholesterol−HDLc)/HDLc, and non-HDLc (NHC) which is Total cholesterol–HDL (Sujatha and Kavitha, 2017).

Method of Data Analyses

Quantitative data got 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

Table 1: Changes in Lipid Profile of Non—obese and obese Women Resident in Upland and Riverine Areas of Rivers State, Nigeria

Groups	TC		TG		LDL—C		HDL—C	
	Upland Residents	Riverine Residents	Upland Residents	Riverine Residents	Upland Residents	Riverine Residents	Upland Residents	Riverine Residents
Non-Obese Subjects	3.21 ± 0.55	3.88 ± 0.45	1.13 ± 0.30	0.91 ± 0.15*	2.18 ± 0.43	2.64 ± 0.46	0.17	1.04 ± 0.21
Obese Class I	4.47 ± 0.79 ^{a}	5.74 ± 0.83 ^{a}	1.27 ± 0.22 ^{a}	1.58 ±0.26 ^{a}	2.91 ± 0.76 ^{a}	3.68 ± 0.65 ^{a}	1.38 ± 0.24 ^{a}	1.54 ± 0.18 ^{a,} *
Obese Class II	5.42 ± 0.93 $^{a, b}$	6.60 ± 0.58 $^{a, b,}$ *	1.58 ± 0.22 $^{a, b}$	1.79 ± 0.16 $^{a, b,}$ *	3.49 ± 0.60 $^{a, b}$	4.03 ± 0.39 $^{a, b,}$ *	1.41 ± 0.25 ^{a}	1.74 ± 0.2 $^{a, b}$
Obese Class III	6.46 ± 0.73 $^{a, b, c}$	7.01 ± 0.35 $^{a, b, c,}$ *	2.13 ± 0.28 $^{a, b, c}$	2.07 ± 0.32 $^{a, b, c}$	3.74 ± 0.40 $^{a, b}$	4.23 ± 0.23 $^{a, b,}$ *	1.82 ± 0.09 $^{a, b, c}$	1.83 ± 0.20 $^{a, b}$

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

Table 2: Changes in Atherogenic Profile of Non—obese and Obese Women resident in Upland and Riverine locations of Rivers State, Nigeria

Groups	AIP			Atherogenic coefficient (AC)			Castelli risk index (CRI)		
	All subjects	Upland Residents	Riverine Residents	All subjects	Upland Residents	Riverine Residents	All subjects	Upland Residents	Riverine Residents
Non-Obese Subjects	-0.01 ± 0.30	0.12 ± 0.34	-0.12 ± 0.21*	2.55 ± 0.64	2.24 ± 0.40	2.82 ± 0.68	3.55 ± 0.64	3.24 ± 0.40	3.82 ± 0.68
Obese Class I	-0.04 ± 0.18	-0.08 ± 0.16 ^{a}	0.01 ± 0.20 ^{a,} *	2.44 ± 0.57	2.29 ± 0.57 ^{a}	2.74 ± 0.46	3.44 ± 0.57	3.29 ± 0.57	3.74 ± 0.46
Obese Class II	0.07 ± 0.17 ^{b}	0.11 ± 0.14 ^{b}	0.04 ± 0.18 ^{a,} *	2.85 ± 0.43 $^{a, b}$	2.85 ± 0.38 $^{a, b}$	2.84 ± 0.48*	3.85 ± 0.43 $^{a, b}$	3.85 ± 0.38 $^{a, b}$	3.84 ± 0.48 *
Obese Class III	0.13 ± 0.16 $^{a, b}$	0.15 ± 0.12 ^{b}	0.12 ± 0.18 ^{a}	2.78 ± 0.64 ^{b}	2.57 ± 0.51	2.89 ± 0.67	3.78 ± 0.64 ^{b}	3.57 ± 0.51 ^{a}	3.89 ± 0.67

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

Table 1 shows the data on changes in lipid profile of obese women resident in upland in riverine areas of Rivers State, Nigeria.

The trend of the changes in TC and TG mean levels was similar for both the upland and riverine residents; as all obese classes indicated remarkable (p<0.05) elevations when compared to their respective non-obese counterparts. Further, the aforementioned increases were also seen to be graded and significant (p<0.05) with increasing BMI. Also important to note are that, one, the TC level of obese classes II and III of the riverine residents were markedly (p<0.05) raised with respect to those of the upland residents. And two, the TG level of obese class II of same riverine residents towed similar path as the foregoing.

The pattern of changes in the LDL-C and HDL-C results were similar; as there were significant (p<0.05) increases in their levels amongst the obese subjects for both upland and riverine residents. Again, the values of LDL-C and HDL-C were seen to be significantly (p<0.05) higher in obese classes II and III of the respective residents when compared to their individual obese class I groups; except the HDL-C level for obese class II of the upland residents which was not significant compared to that of its obese class I counterparts. Also important to note here are that the LDL- C levels of obese classes II and III of the riverine subjects indicated remarkably higher values compared to those of the upland residents; and this trend was same with the HDL-C value of obese class I of the riverine residents.

On Table 2 the outcome on the changes in atherogenic profile of obese women in Rivers State, Nigeria are presented.

The atherogenic index of plasma (AIP) of all the surveyed subjects indicated significant ($p<05$) increases in the obese classes II and III when compared to that of obese class I and so was obese class III to the non-obese subjects. Further, the atherogenic coefficient (AC) and Castelli risk index (CRI) levels of all subjects were seen to similarly vary amongst the subjects; only obese class II showed markedly ($p<0.05$) increased AC and CRI when compared to their respective non-obese groups. Both obese classes II and III equally had markedly raised AC and CRI levels with respect to their individual obese class I.

Considering the result on the changes in atherogenic profile of obese women resident in Upland and Riverine locations of Rivers State, Nigeria, the AIP of the upland residents had a characteristically/significantly ($p<0.05$) reduced level in obese class I when compared to every other groups. But for the riverine residents, all obese classes (I, II and III) indicated remarkably ($p<0.05$) higher AIP levels when compared to that of non-obese. While the obese classes I and II of the riverine subjects had significantly ($p< 0.05$) raised values AIP with respect to those of the upland resident, the AIP of the non-obese of the riverine subjects had remarkably lower level compared to that of the upland dwellers.

The AC level in the upland residents revealed BMI graded significant ($p<0.05$) increases in obese classes I and II with respect to the none-obese subjects. Surprisingly, the riverine residents had no significant ($p>0.05$) changes in their AC values when those of obese subjects were compared to that of the non-obese and amongst the obese subjects. Comparing the AC values of the riverine subjects to that of the upland subjects, only obese class II had marked ($p<0.05$) in the riverine residents.

DISCUSSION

Obesity is a complicated condition that increases the risk of both medical and psychological consequences. Thus, more and detailed investigation of the condition and the encouragement of healthy living practices should be promoted while taking patient resources into consideration in order to improve health and reduce weight (Imhagen *et al.*, 2023). Consequently, the present study did a population specific investigation on the atherogenic profile of obese women in a Nigerian population and presented the findings in the following paragraphs.

The finding of the present study on lipid profile of the subject's generally revealed increased incidences of dyslipidaemia with increasing BMI. This trend was more with the riverine residents with higher TC, TG, and LDL-C. But surprisingly, this sub-group of subjects also presented with higher HDL-C.

It is established that severe forms of obesity are strongly associated with deranged lipid profile (Shahid and Sarwar, 2020; Ren *et al.*, 2021). However, the significantly worsened alterations of lipid profile in the Riverine residents of this investigation are an indication that possible intra-cultural and intra-population distinctions may result in severer comorbidity in obesity. This must be checked by both researcher and regulator or healthcare systems in order to forestall. Record also has it that up to 70% of people with obesity also have concomitant dyslipidemia, which is characterized by clinically raised LDL and decreased HDL values (Lim and Boster, 2023). Thus, considering the above outcome on the lipid profile of the subjects, particularly the riverine residents, it is suggestive to state that untreated obesity may pose a remarkable negative influence on most physiological processes which may perhaps affect the quality of life, raise the risk of other adverse health conditions and place a huge burden on the public health.

Further, an interesting finding of the present study was the incidence of higher levels of HDL-C amongst the riverine subjects. Of course, higher HDL-C levels are known to be beneficial; as it is identified to mop up other forms of cholesterol from the bloodstream, thus reducing the tendency of plague formation in arterial lumens (Franczyk *et al.*, 2021). Thus, the raised level of HDL-C may to an extent cushion the negative effect of other forms of deranged lipids in the plasma of the riverine subjects. This outcome of the present study has revealed that although the riverine subjects have higher obesity morbidity tendencies, their location and possibly unique diets, like sea foods, may be helpful to their conditions. This is so because it is established that consumption of rich sea foods provide a good source of protein and vitamins, and are a primary dietary source of heart-healthy omega-3 fatty acids; as well, omega-3 fatty acids can lower the risk of heart disease and lower triglyceride levels (Brodberg and Klasing, 2003).

Again, the present study also found elevations in atherogenic profiles with increasing BMI and these were even more with the obese class II of the riverine residents.

The foregoing result of the present has shown that with the obesity related elevations in Castelli risk index (CRI), atherogenic index of plasma (AIP) and AC atherogenic coefficient (AC), the subjects may face increasing risks of coronary artery diseases (CAD), cardiovascular diseases (CVD) and atherosclerotic conditions respectively. The above finding of this study is consistent with some earlier reports that also recorded that increases in these values are markers of the presence of various degrees of cardiovascular diseases (Zhu *et al.,* 2018; Salcedo-Cifuentes *et al.,* 2020). It is therefore imperative that these subjects, especially the riverine, are aware of these and make conscious efforts to modify lifestyle and seek necessary healthcare to avert possible severe cardiovascular disorders or even sudden cardiac death.

CONCLUSION

The changes in the attherogenic lipid profile of the subjects generally revealed increased incidences of dyslipidaemia with increasing BMI. This trend was more with the riverine residents with higher TC, TG, LDL-C, CRI, AIP and AC.

As seen from the outcome of the present study, severer forms of obesity may be strongly associated with deranged atherogenic lipid profiles; however, there were further significantly worsened alterations of these markers in the riverine residents of this study. This can be an indication that possible intra-cultural and intra-population distinctions may result in severer comorbidity in obesity. Imminent grave health risks (like coronary artery diseases, cardiovascular diseases and atherosclerotic, etc.) amongst the subjects (particularly the riverine residents) must be checked and properly managed at the individual, caregiver and government/regulators levels, in order to consciously reduce the huge health burden of obesity on our populace.

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