International Journal of Health Sciences and Research
[Indexed, Peer-Reviewed Journal]
Volume 15; Issue: 3; March 2025
Website: www.ijhsr.org
Original Research Article *ISSN: 2249-9571*

Relationship between Some Health Problems, Demography and Occurrence of Obesity among Adults in Imo state, Nigeria

Ogborogu, Veronica C[1], Oparaocha, E.T[1], Ogborogu, E.U[2], Chukwuocha, U.M[1]

[1]Department of Public Health, Federal University of Technology, Owerri, Imo state, Nigeria.
[2]Federal University Teaching Hospital, Owerri, Imo state, Nigeria

Corresponding Author: Ogborogu, Veronica C

DOI: https://doi.org/10.52403/ijhsr.20250321

ABSTRACT

Aim: The aim of study was to determine the relationship between some health problems, demography and occurrence of obesity among adults in Imo state, Nigeria.
Methods: This study is a community-based, cross-sectional study design that targeted some communities across the three geo-political zones of Imo State South East, Nigeria. Multistage proportionate stratified random cluster sampling method was used to select the study settings. A structured validated questionnaire constructed as both open and closed ended questionnaire was used to obtain data from the participants. Anthropometric measurements and laboratory tests of the participants were carried out immediately after questionnaire administration. Multiple linear regression was used to determine associations.
Results: Out of the 500 participants, 148 (29.6%) were obese. Sex and domicile significantly predicted obesity (P=0.01; P=0.00) respectively. Fasting blood sugar (t = 2.131, P=0.05), total cholesterol (t = -2.09, P=0.05) and triglycerides (t = -2.11, P=0.05) of obesity, although the overall regression was insignificant (R^2 = 0.492, F=1.94, P=0.115).
Conclusions: This study highlights a significant association between obesity and certain health parameters, such as fasting blood sugar, total cholesterol and triglycerides, all of which are predictors of obesity and its related complications.

Keywords: Obesity, health problems, body mass index

INTRODUCTION

Most researchers posit that obesity is an "acquired" disease that heavily depends on lifestyle factors (i.e., personal choices), such as low rates of physical activity and chronic overeating, despite its genetic and epigenetic influences. Researchers have also noted that various forms of obesity, including abdominal obesity, are related to increased risk of several chronic conditions and diseases, which include asthma, cancer, diabetes, hypercholesterolemia, and cardiovascular diseases [1,2].

Obesity has individual, socio-economic, and environmental causes [3,4,5] as well as neurological component [6] and correlates with other health problems like pulmonary embolism, infertility, birth defect, dementia, chronic obstructive pulmonary disease and erectile dysfunction [7], unemployment, social disadvantages, and reduced socio-economic productivity [8]. Obesity can cause neonatal skeletal muscle injury and

respiratory distress syndrome from an obese mother [9]. It can also cause psychosocial problems [10]. Adulthood obesity is a major risk factor for the world's leading causes of poor health, disability and early death [11]. The metabolic and structural changes otherwise known as metabolic syndrome in obese individuals are mostly seen in abdominal obesity and are consistently related to increased risk of coronary heart disease in men and women [12]. The health consequences of obesity include increased fat mass and increased number of fat cells. Increased fat mass could lead to osteoarthritis, obstructive sleep apnea, social stigmatization while increased number of fat cells could lead to diabetes, cancer, cardiovascular disease, non-alcoholic fatty liver [13]. In some cases, non-communicable Disease (NCD) risk rises with an increased BMI [11].

According to WHO, obesity accounts for 44% of the diabetes cases, 23% of the ischemic heart disease and around 7-14% of certain cancers [14]. Yearly, obesity correlates with 30% to 53% of new diabetes cases in the United States of which 41.9% adults have obesity [15], and it is currently ranked as the fifth most common leading cause of death globally [16]. Obesity is a leading cause of preventable death and consumes substantial social resources in many high-income and some low- and middle-income economies [17]. The impact of obesity on communicable disease, in particular viral infection [18], has recently been highlighted by the discovery that individuals with obesity are at increased risk of hospitalization and severe illness from COVID-19 [19,20,21]. This study set out to determine the relationship between obesity and demography as well as some health problems such as hypertension, dyslipidemia and type 2 diabetes (T2D) among adults in Imo State, Nigeria.

MATERIALS & METHODS

Study Design

This study is a community-based, cross-sectional study design targeting some communities across the three geo-political zones of Imo State South East, Nigeria.

Study Population

The study included adult males and females living in the selected study area, aged 18 years and above, who gave consent and met the inclusion criteria.

3.4 Sample Size

Five hundred (500) adults participated in the study. The sample size was determined using the Cochrane formula below;

$N = Z^2 Pq / d^2$

Where, N is the minimum sample size, Z is the normal standard deviation usually set at 1.96 which corresponds to 95% confidence interval, P is the proportion or the target population estimated to have a particular characteristic. In a study done in Umuahia Abia state, the prevalence of obesity was 33.7% [22]. Thus 33.7% (0.337) was used in the study to give minimum sample size estimate. q: 1–P (1.-0.337) =0.663, d: Degree of accuracy desired usually set at 0.05.

Hence $N = (1.96)^2 \times (0.337) \times (0.663) / (0.05)^2$

N = 344.

However, a sample size (NS) of 500 was used for the study to take care of non-response in the study. The selected sample size NS was calculated considering an anticipated response rate of 80% (0.8). This was calculated by dividing the original calculated sample size (N) by the anticipated response rate as follows: NS = N / 0.8. Where N = minimum sample size, NS = selected sample size. 0.8 = anticipated response rate.

Substituting in the above formula

NS = 344

0.8 = 430.

Therefore, the minimum sample size was summed up to 500.

Sampling Method

Selection of study settings

Multistage proportionate stratified random cluster sampling method was used to select

the study settings in the state. In the first stage, Imo state was clustered into the already existing three senatorial zones (Owerri, Orlu and Okigwe zones). In the second stage, each zone was further clustered into the already existing local government areas (LGA). In the third stage, proportionate sampling method was used to sample the local government areas (LGA) from each zone as they are not of equal number. 30% of the LGAs was used for the study. There are 27 LGAs in Imo state. 30/100×27=9, therefore 9 LGAs will be selected. For Orlu zone: 12/27 × 9/1 = 4, for Owerri zone: 9/27 × 9/1 = 3, for Okigwe zone: 6/9 × 9/1 =2. Stratified sampling was used to select the LGAs based on security, proximity & road accessibility. Four, three and two LGAs were selected from Orlu, Owerri and Okigwe zones respectively and the communities were randomly chosen from them.

Selection of study participants

The community and some church leaders were met and informed about the study and permission obtained from them. Awareness was created in the communities through announcements by their leaders. On the selected days for the collection of data, participants that gave consent and who met the selection criteria were registered on the selected days of the study by the researchers and research assistants. Stratified systematic sampling method was used to select the study participants. The consented adults were first of all stratified into obese and non-obese participants. A systematic random sampling method was used to select the both groups. The participants were chosen at an interval randomly until the required sample size is met. The selected participants were tested with the questionnaire, anthropometric measurements taken and laboratory test carried out on them.

Inclusion criteria

1. Adults aged 18 years and above.
2. Adults who gave consent for the study.
3. Apparently healthy adult.

Exclusion criteria

1. Adults who are taking any medication
2. Adults who have ascites and other forms of edema
3. Adults who have physical deformities affecting the spine and/or the limbs
4. Pregnant and lactating mothers were excluded from the study.

Instrument for Data Collection

A structured validated questionnaire constructed as both open and closed ended questionnaire was used to obtain data from the participants. Verbal consent was obtained from the participants after discussing about the procedures with the study participants. Standard weighing scale for weight was used for this study whose unit is in kilograms (kg). Participants height was measured using stature meter. Blood pressure (Bp) was measured using sphygmomanometer whose unit is in mmHg. Glucometer was used for measuring blood glucose level in mg/dl. Determination of fasting lipid profile (Total cholesterol, Triglyceride, High density lipo-protein) were done using Aggape reagents (Agappe Diagnostics Ltd. 'Agappe Hills', Dist. Ernakulam, Kerala, India). Manufacturer's guidelines were followed for all the procedures.

LDL-cholesterol was calculated using Friedewald Formula [23]. According to the Friedewald Formula:

LDL cholesterol = Total cholesterol – Triglycerides - HDL cholesterol

Validity of Instrument

The instrument was validated through face validity method. The contents of the study questionnaire was carefully prepared by the researcher with relevance to the topic of the study after consulting a specialist in the field and was examined by the research supervisor for corrections after which the final draft copies was approved by the research supervisor.

Reliability of Instrument

Parallel reliability test was used to test the reliability of the instrument. Two sets of the copies of the questionnaire of equivalent contents were administrated to 10 people that are not part of the study but with similar characteristics at different communities at the same time. The two sets of results were ranked and spearman correlation was used to calculate the correlation co-efficient. The spearman's rank correlation takes value between -1 and +1 (i.e. 0.1 to 1.0).

Data Collection

Data were collected through interviewer-administered technique. The data was collected after informed verbal explanation and consent was obtained from the participants. The interview was done with the participants preferred language (either English or Igbo). The literate respondents were allowed to fill the questionnaire by themselves while the illiterate ones were aided by the researchers. Each questionnaire took about 10 minutes to administer. During investigation, after each completed questionnaire, the researcher re-examined them to ensure validity and consistency before collection of specimens.

Anthropometric measurements of the participants were carried out immediately after questionnaire administration. Hana mechanical scale model BR was used for weight measurement. The scales were calibrated and re-calibrated by re-adjusting their pointers to zero. Participants were informed to remove their footwear, headwear, heavy outer garments and any heavy items from their pockets. Afterwards they were asked to stand still on the scale unaided. The weight was measured and recorded to the nearest 0.1 kg [24].

Height was measured in centimeters using a stature meter tape with the participants standing erect against a flat surface and without any footwear or headgear. The measuring indicator was then lowered until it rested on top of the head of the participant and the height was read off and recorded to the nearest 0.1 centimeters (cm), which was later converted to meters. BMI was calculated as weight (in kilograms) divided by height (in meters) squared and categorized as underweight < 18.5 kg/m2, normal weight 18.5-24.9 kg/m2, Overweight 25-29.9 kg/m2, Obese ≥ 30 kg/m2. Obesity was defined as BMI ≥ 30 mg/m2 based on WHO criteria.

After Anthropometric measurements, blood samples were collected from the participants for fasting lipid profile (FLP) and transported to laboratory afterwards.

Ethical Consideration and Informed consent

Ethical approval was obtained from the Ethics Committee of Public health Department, Federal University of Technology, Owerri. Informed verbal consents were obtained from the selected study participants before participating in the study

STATISTICAL ANALYSIS

Data was analyzed using IBM SPSS version 22. Descriptive statistics comprising of frequency tables was used and was expressed as the percentage of the distribution. Multiple linear regression was used to determine associations between variables.

RESULT

CHARACTERISTICS OF PARTICIPANTS

Among the 500 participants recruited for the study, 190 (38%) were males while 310(62%) were females. Majority of the participants were married (81%), within 48-57years (25.4%) and had at least secondary education (40.4%). Three hundred and fifty-seven (71.4%) of the participants reside in rural areas while 143 (28.6%) reside in urban areas. Out of the 500 participants, 148 (29.6%) were obese (Table 1).

TABLE 1: CHARACTERISTICS OF PARTICIPANTS.

VARIABLE	SUB-VARIABLE	NUMBER OF PARTICIPANTS	PERCENTAGE (%)
SEX	Male	190	38
	Female	310	62
	Total	500	100
AGE	18-27years	43	8.6
	28-37years	121	24.2
	38-47years	99	19.8
	48-57years	127	25.4
	58-67years	72	14.4
	68-77years	27	5.4
	78-87years	11	2.2
	Total	500	100
MARITAL STATUS	Single	60	12
	Married	405	81
	Widow	23	4.6
	Separated	07	1.4
	Divorced	5	1
	Total	500	100
DOMICILE	Rural	357	71.4
	Urban	143	28.6
	Total	500	100
OBESITY STATUS	Obese	148	29.6
	Non-obese	352	70.4
	Total	500	100

MULTIPLE LINEAR REGRESSION ANALYSIS FOR ASSOCIATION BETWEEN OBESITY AND DEMOGAPHY.

The multiple linear regression analysis was used to test if demography (Age, sex and domicile) significantly predicted obesity. The overall regression was significant (R^2 = 0.768, F=18.7, P=0.00). It was found that independently, sex and domicile significantly predicted obesity (P=0.01; P=0.00) respectively (Table 2).

TABLE 2: MULTIPLE LINEAR REGRESSION ANALYSIS FOR ASSOCIATION BETWEEN OBESITY AND DEMOGAPHY.

VARIABLE	COEFFICIENT(B)	STD ERROR	t	P-Value
Age	0.055	0.71	0.08	0.94
Sex	9.458	3.05	3.10	0.01*
Domicile	14.639	6.17	6.17	0.01*
F	18.7			0.01*
R^2	0.768			

MULTIPLE LINEAR REGRESSION ANALYSIS FOR ASSOCIATION BETWEEN OBESITY AND FASTING BLOOD SUGAR, FASTING LIPID PROFILE AND BLOOD PRESSURE.

The multiple linear regression analysis was used to test if fasting blood sugar, fasting lipid profile and blood pressure significantly predicted obesity. The overall regression was insignificant (R^2 = 0.492, F=1.94, P=0.115), but fasting blood sugar was a significant predictor (t = 2.131, P=0.05) indicating that it has a positive effect on obesity. Similarly, total cholesterol (t = -2.09, P=0.05) and triglycerides (t = -2.11, P=0.05) were also independently significant predictors indicating that they independently have positive effect on obesity. But, HDL (t = -1.89, P=0.08) and LDL (t = -0.16, P=0.88) did not significantly predict obesity. Also, blood pressure did not significantly predict obesity; systolic (t = -1.20, P=0.25), diastolic (t = -0.25, P=0.81) (Table 3).

TABLE 3: MULTIPLE LINEAR REGRESSION ANALYSIS FOR ASSOCIATION BETWEEN OBESITY AND FASTING BLOOD SUGAR, FASTING LIPID PROFILE AND BLOOD PRESSURE.

VARIABLE	COEFFICIENT (B)	STD ERROR	t	P-Value
Fasting blood sugar	0.011	0.005	2.131	0.05*
Total Cholesterol	-0.283	0.14	-2.09	0.05*
Triglycerides	-0.056	0.03	-2.11	0.05*
HDL	-0.169	0.09	-1.89	0.08
LDL	-0.005	0.03	-0.16	0.88
Systolic	-0.090	0.08	-1.20	0.25
Diastolic	-0.016	0.06	-0.25	0.81
F	1.94			0.155
R^2	0.492			

Note: n =: * = Significant at P≤0.05, n = 500, HDL= High density lipoprotein. LDL= Low density lipoprotein.

DISCUSSION

Obesity is a complex chronic disorder that affects physiological and metabolic functions. This study set out to determine any relationship between some health problems, demography and occurrence of obesity among adults in Imo state, Nigeria. The multiple linear regression analysis to test if demography significantly predicted obesity showed that the overall regression was significant (R^2 = 0.768, F=18.7, P=0.01). It was found that independently, sex and domicile significantly predicted obesity (P=0.01) (P=0.01) respectively. The association of sex and domicile with BMI were significant positive association (B=9.458, B=14.639), that is there is increase in BMI in females more than males, and there is increase BMI in urban residents than in rural residents. In line with this finding, Adeloye et al., [25] reported that the prevalence of obesity in women was higher compared to men and it was also higher among urban dwellers. Women have a higher risk of obesity due to factors like hormones and genetic differences [26,27]. Increased urbanisation is associated with lifestyle changes such as decreased physical activity. This is often accompanied by increased intake of high caloric fast foods and sugar-sweetened beverages. This combination has contributed to the rising burden of obesity in towns and cities in developing countries [28].

Multiple linear regression analysis was used to test if fasting blood sugar, fasting lipid profile and blood pressure are significantly associated with obesity. The overall regression was insignificant (R^2=0.492, F=1.94, P=0.115), however fasting blood sugar, total cholesterol and triglycerides were significant independent predictors (P=0.05, P=0.05,P=0.05 respectively) indicating that they have significant effect on obesity. In agreement to the findings of this study, Midha *et al*. [29] using multiple linear regression analysis observed a significant association between body mass index (BMI) and fasting blood sugar. Similarly, Saeid *et al.* [30] found significant positive correlation between BMI and fasting blood sugar. According to Eske [31], young adults with type 1 diabetes have a higher likelihood of developing obesity than people who do not have diabetes. At least 85% of people with type 2 diabetes are either obese or overweight. The reason is if the cells do not effectively remove glucose from the blood, the body stores the glucose in the tissue as fat, which can cause weight gain [31]. Besides, elevated fasting blood sugar levels, a precursor to diabetes, are often associated with obesity, corroborating with findings from other studies [32, 33,34,35]. HDL, LDL and blood pressure did not significantly predict obesity. The result of this study showed that total cholesterol and triglycerides have significant negative association with BMI (B= -0.283, B= -0.056) respectively, which means that increase in BMI is associated with decrease triglycerides and total

cholesterol. Similarly, Telles *et al.* [36] also observed negative association between levels of triglycerides in obese individuals. However, contrary to this, most previous studies have shown that levels of triglycerides and cholesterol are positively associated with the BMI in obese persons [37,38]. The reason for this contrast in reports could be because of the healthy lifestyle practiced by the participants of this study and complex interactions between these variables and obesity that require further investigation. According to Centers for Disease Control and Prevention (CDC) [39] and American Heart Association (AHA) [40], while HDL, LDL and blood pressure are important markers of cardiovascular health, their utility in predicting obesity among adults are limited due to the multifaceted nature of obesity etiology, presence of confounding variables and dietary differences

Limitation Of Study

Firstly, the cross-sectional design of this study will not allow causal inference to be made, however it was able to show possible associations. Secondly, a larger sample size may have given an outcome with lesser errors, nevertheless, the stratified random sampling employed ensured a good representation of the population.

CONCLUSION

This study highlights a significant association between obesity and certain health parameters, such as fasting blood sugar, total cholesterol and triglycerides, all of which are predictors of obesity and its related complications.

Recommendation

Public health campaigns should focus on increasing awareness about the risks of obesity and the importance of maintaining a healthy weight. Educational programs should target various demographics, emphasizing the dangers of obesity-related health conditions such as diabetes, hypertension, and cardiovascular diseases. Schools, workplaces, and community centers can serve as focal points for these educational efforts, ensuring widespread dissemination of information.

Regular health screenings for obesity and related health conditions should be integrated into routine healthcare services. Early detection of obesity can lead to timely interventions, preventing the onset of related complications. Healthcare providers should be trained to counsel patients on weight management and lifestyle modifications.

Additionally, integrating obesity management into primary healthcare services can ensure that individuals receive continuous support and monitoring

Declaration by Authors

Ethical Approval: Approved

Acknowledgement: None

Source of Funding: None

Conflict of Interest: The authors declare no conflict of interest.

REFERENCES

1. Young N, Atan IK, Rojas RG, Dietz HP. Obesity: how much does it matter for female pelvic organ prolapse? International Urogynecology Journal. 2017 Sep 15;29(8):1129–34. https://doi.org/10.1007/s00192-017-3455-8
2. Hu L, Huang X, You C, Li J, Hong K, Li P, et al. Prevalence of overweight, obesity, abdominal obesity and obesity-related risk factors in southern China. Li Y, editor. PLOS ONE. 2017 Sep 14;12(9):e0183934. https://doi.org/10.1371/journal.pone.0183934
3. Abubakar MB, Fatola AO, Sanusi KO, Ibrahim KG. The Burden of Obesity in Nigeria. Nigerian Journal of Basic and Applied Medical Sciences. 2021 Dec 31;1(1). https://doi.org/10.53994/njbams.202111.6
4. Kassotis CD, Vandenberg LN, Demeneix BA, Porta M, Slama R, Trasande L. Endocrine-disrupting chemicals: economic, regulatory, and policy implications. The Lancet Diabetes & Endocrinology. 2020 Aug;8(8):719–30. https://doi.org/10.1016/s2213-8587(20)30128-5

5. Yazdi FT, Clee SM, Meyre D. Obesity genetics in mouse and human: back and forth, and back again. PeerJ [Internet]. 2015 Mar 24;3: e856. https://doi.org/10.7717/peerj.856
6. Venkatrao M, Nagarathna R, Majumdar V, Patil SS, Rathi S, Nagendra H. Prevalence of Obesity in India and Its Neurological Implications: A Multifactor Analysis of a Nationwide Cross-Sectional Study. Annals of Neurosciences. 2020 Jul;27(3-4):153–61. https://doi.org/10.1177/0972753120987465
7. Thom G, Lean M. Is There an Optimal Diet for Weight Management and Metabolic Health? Gastroenterology. 2017 May;152(7):1739–51. https://doi.org/10.1053/j.gastro.2017.01.056
8. Blüher M. Obesity: Global Epidemiology and Pathogenesis. Nature Reviews Endocrinology [Internet]. 2019 Feb 27;15(5):288–98. https://doi.org/10.1038/s41574-019-0176-8
9. Endalifer ML, Diress G. Epidemiology, Predisposing Factors, Biomarkers, and Prevention Mechanism of Obesity: A Systematic Review. Journal of Obesity. 2020 May 31; 2020:1–8. https://doi.org/10.1155/2020/6134362
10. Sarwer DB, Polonsky HM. The Psychosocial Burden of Obesity. Endocrinology and Metabolism Clinics of North America [Internet]. 2018 Jul 19;45(3):677–88. https://doi.org/10.1016/j.ecl.2016.04.016
11. WHO. Obesity [Internet]. World Health Organization. 2024. https://www.who.int/health-topics/obesity#tab=tab_1
12. Powell KE, King AC, Buchner DM, Campbell WW, DiPietro L, Erickson KI, et al. The Scientific Foundation for the Physical Activity Guidelines for Americans, 2nd Edition. Journal of Physical Activity and Health. 2018 Dec 17;16(1):1–11. https://doi.org/10.1123/jpah.2018-0618
13. Gu C, Bernstein N, Mittal N, Soumya Kurnool, Schwartz H, Rohit Loomba, et al. Potential Therapeutic Targets in Obesity, Sleep Apnea, Diabetes, and Fatty Liver Disease. Journal of clinical medicine. 2024 Apr 12;13(8):2231–1. https://doi.org/10.3390/jcm13082231
14. Khan I, Ul-Haq Z, Taj AS, Iqbal AZ, Basharat S, Shah BH. Prevalence and Association of Obesity with Self-Reported Comorbidity: A Cross-Sectional Study of 1321 Adult Participants in Lasbela, Balochistan. BioMed Research International. 2017; 2017:1–9. https://doi.org/10.1155/2017/1076923
15. Tsao CW, Aday AW, Almarzooq ZI, Alonso A, Beaton AZ, Bittencourt MS, et al. heart disease and Stroke Statistics—2022 Update: A Report From the American Heart Association. Circulation [Internet]. 2022 Jan 26;145(8). https://doi.org/10.1161/cir.0000000000001052
16. Ibrahim S, Akram Z, Noreen A, Baig MT, Sheikh S, Huma A, et al. Overweight and Obesity Prevalence and Predictors in People Living in Karachi. Journal of Pharmaceutical Research International [Internet]. 2021 Jun 15;194–202. https://doi.org/10.9734/jpri/2021/v33i31B31708
17. An R, Ji M, Zhang S. Global warming and obesity: a systematic review. Obesity Reviews. 2017 Oct 4;19(2):150–63. https://doi.org/10.1111/obr.12624
18. Bhattacharya I, Ghayor C, Pérez Dominguez A, Weber FE. From Influenza Virus to Novel Corona Virus (SARS-CoV-2)–The Contribution of Obesity. Frontiers in Endocrinology. 2020 Oct 6;11. https://doi.org/10.3389/fendo.2020.556962
19. Cummings MJ, Baldwin MR, Abrams D, Jacobson SD, Meyer BJ, Balough EM, et al. Epidemiology, clinical course, and outcomes of critically ill adults with COVID-19 in New York City: a prospective cohort study. The Lancet. 2020 Jun;395(10239):1763–70. https://doi.org/10.1016/s0140-6736(20)31189-2
20. Petrilli CM, Jones SA, Yang J, Rajagopalan H, O'Donnell L, Chernyak Y, et al. Factors associated with hospital admission and critical illness among 5279 people with coronavirus disease 2019 in New York City: prospective cohort study. BMJ [Internet]. 2020 May 22;369. https://doi.org/10.1136/bmj.m1966
21. Zhao X, Gang X, He G, Li Z, Lv Y, Han Q, et al. Obesity Increases the Severity and Mortality of Influenza and COVID-19: A Systematic Review and Meta-Analysis. Frontiers in Endocrinology. 2020 Dec 21;11. https://doi.org/10.3389/fendo.2020.595109

22. Ogah OS, Madukwe OO, Onyeonoro UU, Chukwuonye II, Ukegbu AU, Akhimien MO, et al. Cardiovascular risk factors and non-communicable diseases in Abia state, Nigeria: report of a community-based survey. International Journal of Medicine and Biomedical Research. 2013;2(1):57–68. https://doi.org/10.14194/ijmbr.2110
23. Friedewald WT, Levy RI, Fredrickson DS. Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. Clin Chem. 1972 Jun;18(6): 499-502.
24. Best C, Shepherd E. Accurate measurement of weight and height 1: weighing patients | Nursing Times [Internet]. Nursing Times. 2020 [cited 2024 Sep 15]. https://www.nursingtimes.net/assessment-skills/accurate-measurement-of-weight-and-height-1-weighing-patients-30-03-2020/ (accessed 2024 Sep 15)
25. Adeloye D, Abaa DQ, Owolabi EO, Ale BM, Mpazanje RG, Dewan MT, et al. Prevalence of hypercholesterolemia in Nigeria: a systematic review and meta-analysis. Public Health [Internet]. 2020 Jan; 178:167–78. https://doi.org/10.1016/j.puhe.2019.09.002
26. Leeners B, Geary N, Tobler PN, Asarian L. Ovarian hormones and obesity. Human Reproduction Update [Internet]. 2017 May 1;23(3):300–21. https://doi.org/10.1093/humupd/dmw045
27. Naidoo D, editor. Why do women have a greater risk of obesity compared to men? | The Specialist Forum. The Specialist Forum [Internet]. 2023 [cited 2025 Feb 6];23(8). https://doi.org/10.10520/nm.specf.v23.n8;ctype:string:Journal
28. Amugsi D. Research shows shocking rise in obesity levels in urban Africa over past 25 years [Internet]. The Conversation. 2018. https://theconversation.com/research-shows-shocking-rise-in-obesity-levels-in-urban-africa-over-past-25-years-90485
29. Midha T. Correlation between hypertension and hyperglycemia among young adults in India. World Journal of Clinical Cases. 2015;3(2):171. https://doi.org/10.12998/wjcc.v3.i2.171
30. Saeid R.D, Negar S.S, Muhammadefs, Aly-Ahmed A, Saniyab, Sreemathi K, Abdulazizaz, Nyanhtain L, Khin T.Z, S. Saravana K, Hlaing T.D, Khin T, Rebecca S.W , Su W , Noraasyikin R , Shushan L, Muftahabdusalam E , Ahmad Y , Mohd N.M.D, Nazmul M , Karim A , Ahmad T.K, Jamal H (2020). Correlation between Body Mass Index (BMI) and Fasting Blood Glucose (FBG) Level among Malaysian Adults Age 40-60. P J M H S Vol. 14, NO. 3, JUL – SEP 2020
31. Eske J. Does insulin make you gain weight? Causes and management [Internet]. www.medicalnewstoday.com. 2023. https://www.medicalnewstoday.com/articles/325328
32. Wondmkun YT. Obesity, Insulin resistance, and Type 2 diabetes: Associations and Therapeutic Implications. Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy. 2020 Oct; Volume 13(13): 3611–6.
33. Klein S, Gastaldelli A, Yki-Järvinen H, Scherer PE. Why Does Obesity Cause diabetes? Cell Metabolism [Internet]. 2022 Jan 4;34(1):11–20. https://doi.org/10.1016/j.cmet.2021.12.012
34. Ruze R, Liu T, Zou X, Song J, Chen Y, Xu R, et al. Obesity and type 2 diabetes mellitus: connections in epidemiology, pathogenesis, and treatments. Frontiers in Endocrinology [Internet]. 2023 Apr 21;14(1161521). https://doi.org/10.3389/fendo.2023.1161521
35. Chandrasekaran P, Weiskirchen R. The role of obesity in type 2 diabetes mellitus—an overview. International Journal of Molecular Sciences [Internet]. 2024;25(3):1882–2. https://doi.org/10.3390/ijms25031882
36. Telles S, Pal S, Sharma SK, Singh A, Kala N, Balkrishna A. The association between the lipid profile and fasting blood glucose with weight related outcomes in healthy obese adults. BMC Research Notes. 2018 Jun 14;11(1). https://doi.org/10.1186/s13104-018-3485-4
37. Dharmapriya W.L.G.U.B.N., Bandara W.V.R.T.D.G. Relationship of Serum Cholesterol and Triglycerides Levels with the Body Mass Index in a Group of Healthy Undergraduates. Journal of Health Sciences and Innovative Research. 2022 Jul 31;3(01). https://doi.org/10.31357/jhsir.v3i01.5967
38. Kim Y-N, Kim S, Cho Y-O. Body mass index was positively correlated with blood triglyceride and total cholesterol levels. ˜The œFASEB journal. 2012 Apr 1;26(S1).

https://doi.org/10.1096/fasebj.26.1_supplement.lb356
39. Centers for Disease Control and Prevention. Adult Obesity Causes & Consequences [Internet]. Centers for Disease control and prevention. 2021. https://www.cdc.gov/obesity/adult/causes.html
40. Powell-Wiley TM, Poirier P, Burke LE, Després J-P, Gordon-Larsen P, Lavie CJ, et al. Obesity and Cardiovascular disease: a Scientific Statement from the American Heart Association. Circulation [Internet]. 2021 Apr 22;143(21):984–1010. https://doi.org/10.1161/cir.0000000000000973

How to cite this article: Ogborogu, Veronica C, Oparaocha, E.T, Ogborogu, E.U, Chukwuocha, U.M. Relationship between some health problems, demography and occurrence of obesity among adults in Imo state, Nigeria. *Int J Health Sci Res.* 2025; 15(3):139-148. DOI: *https://doi.org/10.52403/ijhsr.20250321*

******