***Original Research Article***

**Assessment of Health Using Anthropometric Indices of Igbo Ethnic Group of Nigeria**

**Abstract**

**Background:** Anthropometric indices are important clinically relevant parameters used as indicators to assess health status such as abdominal adiposity, obesity, fat distribution and cardiovascular risks to avoid health risks.

**Aim:** This study aimed at assessing the health status of the Igbo ethnic group of Nigeria using BMI and WHR.

**Method:** A descriptive cross-sectional study design was adopted in this study and a total number of 300 subjects (150 males and 150 females) between the ages of 18-37 years were randomly selected. BMI was deduced from the division of body weight by the square root of standing height and WHR by direct division of waist and hip circumferences.

**Result:** The association of BMI with gender shows that 14.7% are underweight, 64.7% are normal, 18.7% are overweight and 2% are obese were found in males while in females, 12% are underweight, 53.3% are normal, 28.7% are overweight and 6% are obese and this shows no significant. The WHR shows that 84% of males and 83.3% of females were within the normal range.

**Conclusion:** The association of BMI and WHR among the genders shows no significant

**Keywords:** Body mass index; Waist-to-hip ratio; Igbo

**1.0 Introduction**
Anthropometric indices are essential for assessing health, providing valuable insights into body composition, nutritional status, and potential risks for chronic diseases [1]. Body mass index (BMI), waist circumference and waist-hip ratio are widely used to evaluate physical health and identify individuals at risk for obesity, diabetes, and cardiovascular diseases [2]. The BMI is broadly used to calculate an estimated body height and weight of an individual based on tissue mass (muscle, fat, or bone). It is an easy and inexpensive way to assess if someone is underweight, overweight, or obese. It is calculated by dividing a person's weight in kilograms by the square of their height in meters [3].

However, BMI helps assess the body fat of an individual as Waist circumference (WC) and Waist-to-Hip Ratio (WHR) also help assess health risks and obesity by measuring the amount of fat around the abdomen [4]. WC is the measurement of the distance around the waist while WHR is calculated by dividing the circumference of the waist by the circumference of the hips [5]. According to the WHO, a healthy WHR is 0.85 or less for women. 0.9 or less for men and having a WHR of over 1.0 may increase the risk of developing conditions that relate to being overweight, including heart disease and type 2 diabetes [6].

The Igbo ethnic group in Nigeria is a rapidly urbanizing area with a young and dynamic population. The lifestyle and dietary habits of the people in this region are influenced by the interplay of traditional and modern practices, making them an important group for health assessment.

**2. MATERIALS AND METHODS**

The study endorses a cross-sectional descriptive study design to create a value for values for body mass index (BIM) and waist-to-hip ratio (WHR) of the adult population of the Igbo ethnic group of Nigeria within the elected age interval of 18-37 years. The Federal University of Technology Owerri, Imo State, Nigeria was used as the study area and the study elapsed from February to May 2024. The study population comprised three hundred subjects (150 males and 150 females). A multi-stage random sampling technique was used to evaluate the outcome of the subjects.

**2.1 Data Collection**

A descriptive questionnaire was issued to gather the subjects’ socio-demographic data. A non-stretchable measuring tape was used to measure the waist circumference (WC) by adopting the following anatomical landmark; from the umbilicus to just above the iliac crest, measurement around the largest part of the hips; the widest part of your buttocks marks the hip circumference (HPC). The standing height and weight were measured using a Goodcare ZT-160 stadiometer and a digital weight balance. The waist-to-hip ratio (WHR) was acquired by dividing the waist and hip circumference. Body mass index was obtained by dividing the weight by height in meters square (kg/m2).

**2.2 Statistical Analysis**

The obtained data was subject to statistical analysis using the statistical package for social science (SPSS version 25) data was presented as Descriptive statistics. Independent t-test was used to compare the mean among genders. Pearson correlation, to determine the association between BMI and WHR Probability value less than 0.05 was considered statistically significant (P<0.05).

**3. RESULTS**

The study involved three hundred subjects 150 (males) and 150 (females) with an age interval of 18-37 years from the Igbo ethnic group of Nigeria with a mean value of body weight of 170.01±13.06, standing height of 65.66±9.85, body mass index of 22.64±3.61, a waist circumference of 76.67±8.18, the hip circumference of 94.79±7.83, and waist-to-hip ratio of 0.812±0.07 (Table 1). Table 2 shows the sexual differences among the Igbo ethnic group of Nigeria. Table 3 indicated that underweight was 14.7%, normal was 64.7%, overweight was 18.7% and obese was 2.0% in males, while in females, underweight was 12.0%, normal was 53.3%, overweight was 28.7% and obese was 6.0%. The association of BMI with gender was viewed as no significant in the gender (Table 3). The waist-to-hip ratio showed that in males, 84% was verified to be within the normal range (< 0.9) and 16% of the total male population was above the obese (accumulation of abdominal fat) while in the female population, 83% were within the normal range (<0.85), only 16.7% indicated the accumulation of abdominal fat. It shows no significant difference with the gender (Table 4). Table 5. Illustrate that between the age of 18-22 years, more of the subjects were observed to have normal BMI, followed by overweight, underweight and obese were observed with a low frequency, the age of 22-25 years had normal weight as predominance, followed by overweight, underweight and obese were few among the interval. Table 6 examined the WHR, it showed that the aged 18-21 years were more likely to have obesity 25 (17.2%), followed by the aged 22-25 years 14(14.1%) and aged 26-29 and 34-37 years were observed at a minimum.

**Table 1. Descriptive Statistics**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameters  | N | Minimum | Maximum | Mean | Std. Deviation |
| Standing Height (cm) | 300 | 16.50 | 200.00 | 170.0157 | 13.06927 |
| Weight (kg) | 300 | 45.00 | 94.00 | 65.6600 | 9.85146 |
| Body mass index (k/m2) | 300 | 15.00 | 36.00 | 22.6400 | 3.61765 |
| Waist Circumference (cm)  | 300 | 23.00 | 102.00 | 76.6780 | 8.18308 |
| Hip Circumference (cm) | 300 | 80.00 | 122.00 | 94.7920 | 7.83172 |
| Waist to hip ratio (cm) | 300 | 0.63 | 0.98 | 0.8116 | 0.06659 |

**Table 2**. **Sexual Differences of Igbo Ethnic Group of Nigeria**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameters  | Male  | Female  | T-test  | P-value | Inference |
| Standing Height (cm) | 1716.77±7.83 | 163.25±13.76 | 10.449 | 0.000 | S |
| Weight (kg) | 69.00±8.49 | 62.32±10.01 | 6.233 | 0.000 | S |
| Body mass index (k/m2) | 22.200±3.47 | 23.08±3.71 | -2.119 | 0.035 | NS |
| Waist Circumference (k/m2)  | 76.09±6.62 | 77.26±9.47 | -1.232 | 0.219 | NS |
| Hip Circumference (cm) | 93.09±6.88 | 96.48±8.36 | -3.839 | 0.000 | S |
| Waist to hip ratio (cm) | 0.818±0.076 | 0.805±0.547 | 1.862 | 0.064 | NS |

*S= Significant, NS= Not Significant*

**Table 3. Association of BMI with Gender**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  | X2 | p-value | Inference  |
| Male  | Underweight NormalOverweight Obese  | 22 (14.7%) 97 64.7%)28 (18.7%)3 (2.0%) | 8.202 | 0.042 | NS |
| Female  | UnderweightNormalOverweight Obese  | 18 (12.0%)80 (53.3%)43 (28.7%)9 (6.0%) |  |  |  |

*NS= Not Significant*

**Table 4. Association of WHR with Gender**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  | X2 | p-value | Inference  |
| Male | Normal Obese  | 126 (84.0%)24 (16.0%) | 0.024 | 0.876 | NS |
| Female  | Normal Obese  | 125 (83.3%)25 (16.7%) |  |  |  |

*NS= Not Significant*

**Table 5. Association of BMI with Age**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Age  | Underweight  | Normal  | Overweight  | Obese  | X2 | p-value  | Inference  |
| 18-21 |  23 (15.9%) |  88 (60.7%) |  29 (20.0%) |  5 (3.4%) |  |  |  |
| 22-25 |  11 (11.1%) |  58 (58.6%) |  23 (23.2%) |  7(7.1%) |  |  |  |
| 26-29 |  2 (6.1%) |  18 (54.5%) |  13(39.4%) |  0 (0.0%) | 13.273 | 0.350 | NS |
| 30-33 |  2 (18.2%) |  5 (45.5%) |  4 (36.4%) |  0 (0.0%) |  |  |  |
| 34-37 |  2 (16.7%) |  8 (66.7%) |  2 (16.7%) |  0 (0.0%) |  |  |  |

**Table 6. Association of WRH with Age**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Age  | Normal  | Obese  | X2 | p-value  | Inference  |
| 18-21 | 120 (82.8%) |  25 (17.2%) |  |  |  |
| 22-25 | 85 (85.9%) | 14 (14.1%) |  |  |  |
| 26-29 | 27 (81.8%) | 6 (18.2%) | 13.273 | 0.350 | NS |
| 30-33 | 10 (90.9%) | 1 (9.1%) |  |  |  |
| 34-37 | 9 (75%) | 3 (25%) |  |  |  |

**4. Discussion**

The current study assessed the health of morphometry of the anthropometric indices of the Igbo ethnic group in Nigeria, with the mean values of standing height, weight, body mass index, waist circumference, hip circumference, and waist-to-hip ratio of 170.01±13.06, 65.66±9.85, 22.64±3.61, 76.67±8.18, 94.79±7.83, 0.811± 0.066 respectively among the population. A study by Rufa’i et al., [7], Singh et al., [8], Ahmed and Sayed [9] and Jaeschke et al., [10], conducted on the Nigerian population, Indian population, Egyptian population and German population respectively, reported similar outcomes to the present study.

This study also expresses the BMI categories in the male and female populations studied. The results show that 64.7% of male populations have normal weight, 18.7% are overweight, 14.7% are underweight, and 2% are obese. In contrast to the female population, 53.3% have normal weight, 28.7% are overweight, 12% are underweight, and 6% are obese. The findings of this study are consistent with the findings of Jaiyeoba-Ojigho, [11], Ahmad et al., [6], and Asiwe et al., [12] where normal weight is more predominate over the overweight, underweight, and obese. The findings of Fernald et al., [13] contradict the findings of the current study, where overweight and obesity were more noticeable among the Mexican population. Carmo et al., [14] also observed that overweight and obese were excessively more in Portugal. The study further shows a sexual dimorphism of BMI, which concurs with Al-Nuaim et al., [15] whose research shows a significant variation between males and females. According to the findings, most respondents will probably have fewer joint and muscular problems, better blood pressure and bodily fluid regulation, increased blood circulation, improved sleep, and a lower risk of cardiovascular diseases.

When determining whether a person has abdominal fat or obesity, the waist-to-hip ratio is crucial, and the location of adipose tissue storage frequently impacts an individual's health [16, 17, 18]. However, the normal WC for males range from 90cm to 95cm while females range from 80cm to 85cm. In addition, the male and female WHR ranging from 0.85-0.9.0 and 0.75-0.80 respectively are categorizes as healthy groups while those above this range are considered at risk of diseases associated with obesity. Our study evaluates the association of WHR between the genders and explores that 84% of males and 83.3% of females were categorized under the normal range. While 16% to 16.3% of genders showed that there is an accumulation of abdominal fat, and this agreed with Jaiyeba-Ojigho [11], Ravishankar et al.,[19] and Lutoslawska et al., [20]

There was no significant age difference between BMI and WHR, which examines the various age groups linked to these metrics. In addition, it stated that the prevalence of obesity rises with age. This finding implies that while body fat tends to increase with age, size, and even diet, although it is similar to WHR, abdominal adipose is not age-dependent. The prevalence of obesity and overweight among adults in Middle Eastern countries from 2000 to 2020: A systematic review and meta-analysis done by Okati-Aliabad et al. [21] agrees with the present research which shows that obesity rises with age.

**5. CONCLUSION**

The study shows that the association of BMI and WHR among the genders and ages shows no significance. This means that there are variations in fat storage patterns, with men tending to store more visceral fat while women store more subcutaneous fat. However, external factors like lifestyle, genetics, or hormonal changes could contribute to the variability.

**ETHICAL APPROVAL**

Ethical approval was obtained from the Research Ethics Committee of the University of Port Harcourt, Port Harcourt, Nigeria (UPHCEREMAD/REC/MM/91/046). All subjects were adequately informed about the study procedure, and they gave their consent in writing.

**REFERENCES**

1. Madden AM, Smith S. Body composition and morphological assessment of nutritional status in adults: a review of anthropometric variables. Journal of human nutrition and dietetics. 2016 Feb;29(1):7-25.
2. Hu G, Tuomilehto J, Silventoinen K, Sarti C, Männistö S, Jousilahti P. Body mass index, waist circumference, and waist-hip ratio on the risk of total and type-specific stroke. Archives of internal medicine. 2007 Jul 9;167(13):1420-7.
3. Sizoo D, de Heide LJ, Emous M, van Zutphen T, Navis G, van Beek AP. Measuring muscle mass and strength in obesity: a review of various methods. Obesity surgery. 2021 Jan;31:384-93.
4. Arif M, Gaur DK, Gemini N, Iqbal ZA, Alghadir AH. Correlation of percentage body fat, waist circumference and waist-to-hip ratio with abdominal muscle strength. InHealthcare 2022 Dec 7 (Vol. 10, No. 12, p. 2467). MDPI.
5. Nnamani WC, Omotoso DR. Anthropometric evaluation and significance of waist circumference, hip circumference and waist-hip ratio among 16-25 years old females in Ede, Osun State, Nigeria. Journal of Experimental and Clinical Anatomy. 2024 Dec 31;21(2):323-8.
6. Ahmad N, Adam SI, Nawi AM, Hassan MR, Ghazi HF. Abdominal obesity indicators: waist circumference or waist-to-hip ratio in Malaysian adults population. International journal of preventive medicine. 2016 Jan 1;7(1):82.
7. Rufa'i AA, Sajoh KI, Oyeyemi AL, Gwani AS. Waist Circumference, Waist Hip Ratio and Body Mass Index in Female Undergraduates of a Tertiary Institution in Nigeria: a Cross-sectional Study. Internet Journal of Allied Health Sciences and Practice. 2019;17(1):12.
8. Singh S, Kaur N, Sharma RS. Waist-hip ratio and waist circumference as simple measures of cardiovascular risk assessment and weight management among medical students. J Evid Based Med Healthc. 2018;5(3):237-42.
9. Ahmed AY, Sayed AM. The development of reference values for waist circumference, waist-hip and waist height ratios in Egyptian adolescents.
10. Jaeschke L, Steinbrecher A, Pischon T. Measurement of waist and hip circumference with a body surface scanner: feasibility, validity, reliability, and correlations with markers of the metabolic syndrome. PloS one. 2015 Mar 6;10(3):e0119430.
11. Jaiyeoba-Ojigho EJ. Prevalence of Obesity among adolescents in Asaba, South Southern Nigeria. International Journal of Forensic Medical Investigation. 2019 Dec 6;5(1):1-7.
12. Asiwe N, Irozulike FC, Wariboko LI, Adheke OM. Health Assessment of the Ikwerres and Okrikas Ethnic Group of Rivers State, Nigeria: Using Body Mass Index and Waist-to-Hip Ratio. Journal of Complementary and Alternative Medical Research. 2023 Jul 31;23(2):27-35.
13. Fernald LC, Gutierrez JP, Neufeld LM, Olaiz G, Bertozzi SM, Mietus-Snyder M, Gertler PJ. High prevalence of obesity among the poor in Mexico. Jama. 2004 Jun 2;291(21):2544-5.
14. Cornier MA, Després JP, Davis N, Grossniklaus DA, Klein S, Lamarche B, Lopez-Jimenez F, Rao G, St-Onge MP, Towfighi A, Poirier P. Assessing adiposity: a scientific statement from the American Heart Association. Circulation. 2011 Nov 1;124(18):1996-2019.
15. Al-Nuaim AR, Al-Rabeaan K, Al-Mazrou Y, Al-Attas O, Al-Daghari N, Khoja J. High prevalence of overweight and obesity in Saudi Arabia. International journal of obesity. 1996 Jun 1;20(6):547-52.
16. Frank AP, de Souza Santos R, Palmer BF, Clegg DJ. Determinants of body fat distribution in humans may provide insight about obesity-related health risks. Journal of lipid research. 2019 Oct 1;60(10):1710-9.
17. Börgeson E, Tavajoh S, Lange S, Jessen N. The challenges of assessing adiposity in a clinical setting. Nature Reviews Endocrinology. 2024 Oct;20(10):615-26.
18. Börgeson E, Tavajoh S, Lange S, Jessen N. The challenges of assessing adiposity in a clinical setting. Nature Reviews Endocrinology. 2024 Oct;20(10):615-26.
19. Ravishankar A, Sethu G, Jain AR. Waist-to-hip measurement ratio among dental students in urban areas. National Journal of Physiology, Pharmacy and Pharmacology. 2018 Apr 30;8(5):640-.
20. Lutoslawska G, Malara M, Tomaszewski P, Mazurek K, Czajkowska A, Kęska A, Tkaczyk J. Relationship between the percentage of body fat and surrogate indices of fatness in male and female Polish active and sedentary students. Journal of Physiological Anthropology. 2014 Dec;33:1-6.
21. Okati-Aliabad H, Ansari-Moghaddam A, Kargar S, Jabbari N. Prevalence of obesity and overweight among adults in the Middle East countries from 2000 to 2020: a systematic review and meta‐analysis. Journal of Obesity. 2022;2022(1):8074837.