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Anthropometric Correlates of Menstrual Disorders in Women Attending a Fertility Clinic in Southeast Nigeria

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Abstract

We aimed to investigate the association between anthropometric parameters—body mass index (BMI), waist-to-hip ratio (WHR), and waist-to-height ratio (WHtR)—and menstrual disorders (oligomenorrhea, menorrhagia, and amenorrhea) among women attending the Fertility Clinic at Nnamdi Azikiwe University Teaching Hospital (NAUTH), Nnewi, Nigeria. We employed random sampling to select 200 women aged 17 to 43 years who had no underlying medical conditions known to affect menstrual cycles. Data collection involved a structured questionnaire that gathered demographic information, menstrual history, and anthropometric measurements, including height, weight, waist circumference, and hip circumference. Results of the analysis showed a strong positive correlation between oligomenorrhea and BMI ($r = 0.445$, $p = 0.001$), WHR ($r = 0.207$, $p = 0.003$), and WHtR ($r = 0.440$, $p = 0.001$). However, no significant correlations were found between menorrhagia and BMI ($r = -0.035$, $p = 0.618$), WHR ($r = -0.010$, $p = 0.890$), or WHtR ($r = -0.008$, $p = 0.912$). Age was weakly correlated with oligomenorrhea ($p = 0.084$) and menorrhagia ($p = 0.104$), but these associations were not statistically significant. Notably, there were no reported cases of amenorrhea among participants. The findings indicated that higher BMI is likely a risk factor for oligomenorrhea, whereas age does not significantly impact the likelihood of experiencing either oligomenorrhea or menorrhagia. Additionally, amenorrhea was not observed in this population.

Keywords: *BMI, Menstrual disorders, Menstrual irregularities, Obesity, Young women*

Introduction

Menstrual disorders encompass a variety of changes or irregularities in a woman's menstrual cycle, including variations in cycle frequency, duration, and the amount of menstrual bleeding. It is estimated that about 20–40% of women in their reproductive year experience menstrual irregularities (Ansong et al., 2019; Igbokwe & John-Akinola, 2021; Ju et al., 2014). These disorders include conditions such as amenorrhea (absence of menstruation), oligomenorrhea (infrequent menstruation), menorrhagia (excessive bleeding), and metrorrhagia (irregular bleeding), along with associated symptoms like menstrual pain. A typical menstrual cycle ranges between 21 and 35 days (NHS, 2023), though individual variability means some cycles may fall outside this range (Grieger & Norman,

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2020). The menstrual cycle is a highly regulated biological process essential for reproduction, controlled by hormones from the hypothalamus and pituitary gland. Any hormonal imbalance can disrupt this cycle, leading to significant disturbances (Amboss, 2023; Popat et al., 2008). Such disruptions may indicate underlying issues in the endocrine or reproductive systems, organic disorders, or conditions like polycystic ovarian syndrome (Rasquin Leon et al., 2023). Furthermore, research has linked other menstrual disorders to anthropometric measures (Abdolahian et al., 2020; Dhar et al., 2023; Thathapudi et al., 2014).

Anthropometric parameters include physical characteristics such as height, weight, body mass index (BMI), and waist circumference, which are useful indicators of overall health and disease risk (Casadei & Kiel, 2022). Waist circumference and waist-to-hip ratios, for instance, serve as measures of abdominal obesity and visceral fat distribution (Gadekar et al., 2020). BMI, a widely used metric for body fat, is calculated by dividing an individual's weight in kilograms by the square of their height in meters (kg/m²) (Casadei & Kiel, 2022). BMI classifications range from underweight (<18.5), normal weight (18.5–24.9), overweight (25.0–29.9), to various levels of obesity: class 1 (30.0–34.9), class 2 (35.0–39.9), and class 3 (≥40.0), as defined by the World Health Organization (WHO, 2010) and the Centers for Disease Control and Prevention (CDCP, 2022). In Nigeria, the prevalence of overweight individuals falls between 20.3% and 35.1%, while obesity rates range from 8.1% to 22.2% (Chukwuonye et al., 2013).

Recent studies have explored how body measurements correlate with menstrual irregularities. Anthropometric indices, particularly BMI, are strongly associated with energy balance, and deviations in this balance – whether due to undernutrition or overnutrition – can affect menstrual function (Bradley et al., 2023; Entringer et al., 2012; Fluitman et al., 2017; Romieu et al., 2017). High waist circumference, particularly when accompanied by elevated BMI, has been linked to an increased likelihood of disorders like oligomenorrhea and anovulation (Itriyeva, 2022; Lentscher & Decherney, 2021). Excess abdominal fat may disrupt the hormonal equilibrium critical for menstrual cycle regulation. The interplay between menstrual disorders and anthropometric factors is multifaceted, influenced by physiological and psychological mechanisms (Castillo-Martínez et al., 2003; Attia et al., 2023).

Despite the global attention to obesity and menstrual health, research from underrepresented regions such as southeastern Nigeria remains limited. Therefore, this study was designed to examine the relationship between key anthropometric parameters—body mass index (BMI), waist-hip ratio (WHR), and waist-height ratio (WHtR)—and menstrual disorders, including oligomenorrhea, menorrhagia, and amenorrhea, among women attending a fertility clinic in Southeast Nigeria.

Methods

Ethics approval

The study strictly adhered to the institutional ethics guidelines. The study ethics approval was obtained from the Faculty of Basic Medical Sciences Ethics Committee of College of Health Sciences, Nnamdi Azikiwe University, Nnewi campus, Nigeria. The approval reference number is NAU/CHS/NC/FMBS/496 dated 11th April 2023.

Study design

This study adopted a cross-sectional analytical design to examine the association between anthropometric parameters and menstrual disorders among women attending the Fertility Clinic of the Obstetrics and Gynecology Unit, Nnamdi Azikiwe University Teaching Hospital (NAUTH), Nnewi, Nigeria. Anthropometric indices such as body mass index (BMI), waist-hip ratio (WHR) and waist-height ratio (WHtR), and menstrual characteristics were assessed concurrently to determine potential correlations within the study population. We employed this design with the aim to enhance the generalizability of our findings to the typical patient population seeking fertility care.

Inclusion and exclusion criteria

Participants in this study were selected based on specific criteria. Inclusion criteria required participants to be women aged 15 to 49 years, within their reproductive years, attending the Fertility Clinic at NAUTH, and free from known medical conditions that could affect menstrual function. This age range was selected to encompass the entire spectrum of reproductive-aged women likely to present at a fertility clinic, from post-adolescence to the perimenopausal transition.

Exclusion criteria ruled out women who were pregnant, breastfeeding, or perimenopausal; those with a history of hormonal contraception, hormonal therapy, gynecological surgery, or reproductive disorders; individuals with chronic health conditions that could influence menstruation; and women unable to provide informed consent.

Participant screening

Participants were provided with detailed informed consent forms, which were thoroughly explained to them. Data collection commenced only after obtaining voluntary consent. Eligibility was determined based on defined inclusion and exclusion criteria.

Sampling

Eligible participants were selected randomly, and the sample size was determined using a standardized formula:

$$n = \frac{\hat{p}(1-\hat{p})z^2}{ME^2}$$

Using a margin of errors of 5% (ME=0.05), Confidence interval of 90% (z=1.645) and a 0.5 level of significance (=0.5), the sample size is evaluated thus:

$$n = \frac{(1.645)^2 \times 0.5(1-0.5)}{(0.05)^2} = \frac{2700 \times 0.25}{0.0025}$$

$$n = 270$$

The study included a total of 200 patients selected from over 2,000 individuals who visited the Fertility Clinic at Nnamdi Azikiwe University Teaching Hospital, Nnewi, Nigeria, during the study period. Participants ranged in age from 17 to 43 years.

Data collection tools and timeline

Demographic information and menstrual history were gathered using a structured questionnaire, which helped identify menstrual irregularities such as infrequent cycles, excessive or prolonged bleeding, and amenorrhea. Anthropometric data were collected using standardized instruments, including a weight scale, steel tape, and flexible measuring tape, over the course of three months (April 20, 2023, to July 19, 2023).

Measurement protocols for anthropometric parameters

Height (cm): Height was measured using a steel tape securely fixed to a wall. Subjects stood barefoot in an upright position, with their back of the head, shoulder blades, buttocks, and heels in contact with the wall. Measurements were taken from the highest point of the scalp and recorded to the nearest 0.1 cm (ISAK, 2011).

Weight (kg): Weight was determined using a digital scale, ensuring subjects stood barefoot with minimal clothing and balanced weight distribution. The scale was placed on a flat, hard surface to prevent errors. Any heavy clothing, such as jackets, was removed before measurement. Values were recorded to the nearest 0.1 kg (ISAK, 2011).

Waist circumference (cm): A flexible tape was used to measure waist circumference. Measurements were taken while participants stood upright, at the narrowest section between the last palpable rib and the iliac crest, typically at the navel. The tape was snug but not tight, and readings were taken at the end of a normal exhalation (ISAK, 2011; WHO, 2011).

Hip circumference (cm): Hip circumference was measured at the widest part of the hips using a flexible, stretch-resistant tape. Care was taken to ensure the tape lay flat and did not compress the skin. Measurements were accurate to the nearest 0.1 cm (ISAK, 2011; WHO, 2011).

Body mass index (BMI) (kg/m²): BMI was calculated using the formula below, based on the participant's height and weight:

$$\text{BMI (kg/m}^2) = \frac{\text{Weight (kg)}}{\text{Height}^2\ (\text{m}^2)}$$

The resulting BMI values were interpreted according to the World Health Organization's standard classification (WHO, 2010).

Methodology for collecting menstrual history of participants

Menstrual cycle length: Participants were asked to provide the duration in days between the onset of one menstrual cycle and the next.

Menstrual flow: Participants were interviewed about the typical duration and intensity of their menstrual flow, including whether they experienced heavy or prolonged bleeding. While participants could not specify the exact volume of blood loss, they provided details about the average duration of their flow and estimated intensity by reporting the number of sanitary pads used daily.

Menstrual regularity: Participants were asked about irregularities in their menstrual cycles, such as skipped periods or noticeable fluctuations in cycle length.

Menstrual symptoms: Information was gathered on additional symptoms associated with menstruation, such as dysmenorrhea (cervical pain).

Statistical analysis

The data collected were analyzed using IBM SPSS Statistics version 25. Statistical significance was set at $p \leq 0.05$. Pearson's correlation coefficient (r) was used to determine the relationships between anthropometric measurements and menstrual abnormalities. The strength of Pearson correlation coefficients (r) was interpreted using conventional qualitative descriptors based on established thresholds (Evans, 1996). Coefficients were categorized as follows: $r \geq 0.80$ (very strong positive), 0.60 – 0.79 (strong positive), 0.40 – 0.59 (moderate positive), 0.20 – 0.39 (weak positive), and 0.00 – 0.19 (very weak positive).

Results

Out of 200 participants, 40 reported experiencing menorrhagia, 36 reported oligomenorrhea, and none reported amenorrhea (Table 1). Consequently, statistical analysis for correlations between amenorrhea and anthropometric parameters (body mass index, waist-to-hip ratio, and waist-to-height ratio) was not feasible (Table 2). The mean age of participants ranged from 23 to 24 years (Table 1). The anthropometric characteristics of the participants are summarized in Table 2. The mean weight and height were 77.02 kg and 168.23 cm, respectively, resulting in a mean Body Mass Index (BMI) of 27.28 kg/m², which falls within the overweight range. The mean waist and hip circumferences were 86.13 cm and 106.76 cm, respectively, yielding a mean waist-hip ratio (WHR) of 0.81, which is within generally accepted health limits. In contrast, the mean waist-height ratio (WHtR) was 0.51, slightly exceeding the recommended cutoff of 0.5.

Table 1. Descriptive Statistics of Menstrual Variables among subjects

	Mean	SD	N
Menorrhagia	40.0	0.41	200
Oligomenorrhea	36.0	0.39	200

SD: Standard Deviation; N: Sample size

Table 2. Descriptive Statistics of Anthropometric Variables among subjects

	N	Minimum	Maximum	Mean	SEM	SD
Age (years)	200	17	43	23.89	0.36	5.09
Weight (kg)	200	46.30	137.00	77.02	1.39	19.60
Height (cm)	200	150	190	168.23	0.47	6.69
Waist circumference (cm)	200	60	135	86.13	1.03	14.51
Hip circumference (cm)	200	78	145	106.76	0.94	13.34
Body Mass Index (BMI)	200	15.85	50.94	27.28	0.50	7.05
Waist-Hip Ratio (WHR)	200	0.68	1.01	0.81	0.01	0.07
Waist-Height Ratio (WHtR)	200	0.36	0.82	0.51	0.01	0.09

N: Sample size; SEM: Standard Error of Mean; SD: Standard Deviation

Relationship between oligomenorrhea and anthropometric parameters

Pearson's correlation analysis revealed the following: a moderate positive correlation between oligomenorrhea and BMI (r=0.445, n=200, p=0.001); a weak positive correlation between oligomenorrhea and waist-to-hip ratio (r=0.207, n=200, p=0.003); a moderate positive correlation between oligomenorrhea and waist-to-height ratio (r=0.440, n=200, p=0.001); a very weak positive correlation between oligomenorrhea and age, which was not statistically significant (r=0.112, n=200, p=0.084) (Table 3).

Relationship between menorrhagia and anthropometric parameters

Analysis showed the following correlations: a very weak negative correlation between menorrhagia and BMI, which was not statistically significant (r= −0.035, n=200, p=0.618); a very weak negative correlation between menorrhagia and waist-to-hip ratio, also not statistically significant (r= −0.010, n=200, p=0.890); a very weak negative correlation between menorrhagia and waist-to-height ratio, which was similarly non-significant (r= −0.008, n=200, p=0.912); a very weak positive correlation between menorrhagia and age, which was not statistically significant (r=0.115, n=200, p=0.104) (Table 3).

Table 3. Relationship between Amenorrhea, Oligomenorrhea and Menorrhagia, and Body Mass Index (BMI), Waist-hip ratio (WHR), and Waist-Height ratio (WHtR)

		AGE	BMI	WHR	WHtR
Oligomenorrhea	Pearson Correlation	0.122	0.445**	0.207**	0.440**
	Sig. (2-tailed)	0.084	<0.001	0.003	<0.001
	N	200	200	200	200
Menorrhagia	Pearson Correlation	0.115	-0.035	0.010	-0.008
	Sig. (2-tailed)	0.104	0.618	0.890	0.912
	N	200	200	200	200

*. Correlation is significant at the 0.05 level (2-tailed); **. Correlation is significant at the 0.01 level (2-tailed); Correlation strength is indicated using qualitative descriptors (e.g., Strong, Moderate); see the Methods section for the corresponding numerical thresholds and citation.

Discussions

The data revealed significant insights into the relationship between menstrual irregularities and anthropometric parameters among participants. However, the absence of amenorrhea in the cohort limited the scope of correlation analysis to menorrhagia and oligomenorrhea.

Correlations between menorrhagia and anthropometric indices were very weak and statistically non-significant. These findings suggested that menorrhagia was not influenced by BMI, WHR and WhtR in this population. A useful conceptual framework posited that menstrual disorders are often dichotomized into those driven by chronic anovulation and endocrinopathy (such as oligomenorrhea) and those driven by structural pathology (such as menorrhagia) (Harlow et al., 2000). The failure of BMI, WHR, and WHtR to correlate with menorrhagia indicated that the disorder in this population was likely not primarily hypothalamic-pituitary-ovarian (HPO) axis dysfunction exacerbated by obesity, but rather localized uterine pathology. In support of this, several Nigerian studies had consistently confirmed that the presence and size of fibroids were the strongest predictors of heavy menstrual bleeding (Uimari et al., 2022; Vannuccini et al., 2023). This result aligned with Amgain et al. (2022), who observed that increased waist-to-height ratio did not predispose study subjects to menorrhagia.

In contrast, oligomenorrhea demonstrated moderate positive correlations with BMI and waist-to-height ratio, as well as a weaker yet significant correlation with waist-to-hip ratio. These findings supported prior research linking higher BMI and central adiposity to irregular menstrual cycles, likely due to their influence on insulin resistance, androgen levels, and hypothalamic-pituitary-ovarian axis function (Pasquali et al., 2007). This was further corroborated by studies on Nigerian women with polycystic ovary syndrome—a condition strongly associated with chronic anovulation and often characterized by oligomenorrhea—which had revealed significant relationships with increased BMI and WHR (Emokpae et al., 2024; Ukibe et al., 2021).

Notably, the non-significant correlation between oligomenorrhea and age suggested that in this relatively young population, age was not a major determinant of this menstrual irregularity. This observation was consistent with reports that irregular cycles in younger age groups often reflect ongoing reproductive system maturation rather than aging-related factors (Hickey & Balen, 2003). However, the broad age range of our cohort, while increasing the generalizability of our findings, may also have introduced physiological heterogeneity. For instance, the etiologies of oligomenorrhea could differ between a 17-year-old with HPO axis immaturity and a 40-year-old with declining ovarian reserve. The non-significant correlation between age and oligomenorrhea in our study may have reflected this confluence of underlying causes. Future studies with larger sample sizes could be stratified by age groups to elucidate more specific risk factors within different reproductive stages.

This study was conducted in a region where research infrastructure and technological resources remain limited, largely due to constraints in research funding and access to advanced laboratory diagnostics. However, these limitations did not hinder scientific inquiry; rather, they encouraged context-specific methodologies that maximized available resources to generate relevant data. Our findings, derived from direct anthropometric measurements and careful clinical history, demonstrated the capacity of such locally driven investigations to provide valuable insight into population-specific health patterns. Studies emerging from such underrepresented environments were crucial for challenging broad generalizations and contributing to a more balanced and equitable global understanding of reproductive health.

Overall, these findings support the growing body of evidence that adiposity and altered body composition are key modulators of menstrual health, reinforcing the need for early lifestyle interventions and targeted reproductive counseling among women of reproductive age.

Conclusion

This study demonstrated a significant association between oligomenorrhea and higher body mass index, waist-to-hip ratio, and waist-to-height ratio among women attending a fertility clinic in Southeast Nigeria. In contrast, no meaningful relationship was found between these anthropometric indices and menorrhagia. These findings highlight obesity and central adiposity as modifiable risk factors for oligomenorrhea, reinforcing the importance of weight management in clinical strategies for menstrual health and fertility. Furthermore, this research underscores the value of locally driven investigations in underrepresented regions to enrich global understanding and promote equitable reproductive healthcare.

Recommendations and future lines of research

Based on the findings of this study, the following recommendations are proposed:

For clinical practice, routine anthropometric screening, including BMI, waist-to-hip ratio, and waist-to-height ratio should be integrated into gynecological and fertility consultations. Identifying women with elevated adiposity metrics provides a critical opportunity for early intervention. Healthcare providers should offer targeted counseling on weight management as a fundamental component of treating oligomenorrhea and improving reproductive outcomes.

At the public health level, there is a need for community-based education campaigns that emphasize the link between healthy body weight and menstrual health. These initiatives should promote balanced nutrition and regular physical activity, specifically tailored to the cultural and socioeconomic context of Southeast Nigeria, to mitigate the risk of obesity-related menstrual dysfunction.

Future research should prioritize longitudinal studies to establish causal relationships between adiposity and menstrual disorders in this population. To provide a more comprehensive understanding, such studies would benefit from employing gold-standard body composition assessment tools like Bioelectrical Impedance Analysis (BIA) or Dual-Energy X-ray Absorptiometry (DXA). Furthermore, other promising lines of research could explore the utility of these markers in routine clinical screening.

Investigations into menorrhagia should focus on elucidating the role of structural pathologies, such as uterine fibroids, given the lack of correlation with anthropometric factors. Furthermore, building local capacity and securing funding for advanced diagnostic tools are essential to advance reproductive health research in underrepresented regions.

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Author roles

DNO: Conceptualization, Supervision, Writing – original draft, Methodology, Formal analysis, Writing – review and editing. IFO: Investigation, Formal analysis, Writing – review and editing. AKC: Resources, Investigation, Project administration, Writing – review and editing. ATN: Resources, Formal analysis, Writing – review and editing. CBA: Data curation, Resources, Writing – review and editing. AEA: Methodology, Data curation, Writing – review and editing. CGO: Investigation, Project administration, Writing – review and editing. DEE: Formal analysis, Methodology, Writing – review and editing. OMA: Writing – review and editing.

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