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Short Research Report

Evaluation of the correlation between waist anthropometric indices and perceived lower back pain among Nigerian middle age adult

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Abstract - Lower back pain (LBP) is a prevalent musculoskeletal disorder and a leading cause of disability especially among middle-aged adults, as compounded by age-related anatomical changes, sedentary lifestyle, and increasing rates of central obesity. This study aimed to evaluate the relationship between waist anthropometric indices and perceived LBP among middle-aged adults in Ekpoma, Edo State, Nigeria. A descriptive cross-sectional design was adopted, and a total of 223 respondents were selected using a multistage sampling technique. Standardized procedures were used to obtain Waist Circumference (WC), Waist-to-Height Ratio (WHtR), and Hip-to-Height Ratio (HHtR), while perceived LBP was assessed using a structured questionnaire and a Visual Analog Scale. Data were analyzed using descriptive statistics, Pearson correlation, and independent t-tests. The findings revealed a high prevalence of LBP (63.6%) among the study population. The mean Waist Circumference was 91.8 ± 11.6 cm, Waist-to-Height Ratio 0.54 ± 0.06, and Hip-to-Height Ratio was 0.60 ± 0.05. A statistically significant positive correlation was found between Waist Circumference ($r = 0.476$), Waist-to-Height Ratio ($r = 0.511$), and Hip-to-Height Ratio ($r = 0.228$) with perceived LBP ($p < 0.01$). Gender differences were also observed, with females demonstrating significantly higher anthropometric measures and LBP scores. These findings underscore the anatomical and biomechanical relevance of waist anthropometry in musculoskeletal health. Waist-to-Height Ratio emerged as the most predictive index of LBP risk, suggesting its clinical value for early screening and intervention. The study recommends the integration of waist-based anthropometric assessments into primary healthcare screening programs and advocates for gender-sensitive strategies in the prevention and management of lower back pain among Nigerian adults.

***Keywords**:* Lower back pain, Anthropometry, Waist-to-height ratio, Middle aged adults, Waist circumference, Hip circumference.

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Introduction

Lower back pain (LBP) is a global musculoskeletal concern, characterized by discomfort or dysfunction localized in the lumbar region of the spine. It is a non-specific condition with multifactorial etiologies but is fundamentally rooted in the anatomical and biomechanical integrity of the vertebral column, particularly the lumbosacral vertebrae and surrounding musculoskeletal structures. Understanding the anatomical underpinnings of LBP is critical to appreciating its relationship with anthropometric variables such as waist circumference (WC), waist-to-height ratio (WHtR), and hip-to-height ratio (HHtR). The vertebral column, comprising 33 vertebrae, is structurally divided into cervical, thoracic, lumbar, sacral, and coccygeal regions. Of these, the lumbar spine (L1–L5) is the largest and bears the greatest load, as it supports the weight of the upper body while permitting a wide range of motion. The anatomical robustness of the lumbar vertebrae is reflected in their large, kidney-shaped bodies, thick intervertebral discs, and robust ligamentous attachments (Moore *et al*. 2018; Standring 2020). The intervertebral discs in the lumbar region consist of a central nucleus pulposus surrounded by an annulus fibrosus, which provides both elasticity and resistance to compressive forces. These discs, along with the vertebral endplates and facet joints, allow movement while maintaining stability. Supporting these bony elements are numerous ligaments, including the anterior and posterior longitudinal ligaments, ligamentum flavum, interspinous, and supraspinous ligaments. Additionally, muscle groups such as the erector spinae, quadratus lumborum, and psoas major contribute to the stabilization and motion of the lumbar region (Snell 2012; Marieb & Hoehn 2019).

Degeneration or mechanical overload of any of these structures can disrupt spinal biomechanics and lead to LBP. Exaggerated abnormal spinal curvature, increased disc pressure, and strained soft tissues initiate a cascade of biomechanical compensations, potentially resulting in chronic discomfort and functional limitation. Anthropometry is the scientific study of the measurements and proportions of the human body, widely used in clinical and public health assessments to evaluate nutritional status, growth, development, and disease risk. It provides indirect but reliable measures of body composition, particularly adiposity, fat distribution, and somatic growth proportions (Pheasant & Haslegrave 2005). Among the various anthropometric parameters, Waist

Circumference, Waist-to-Height Ratio, and Hip-to-Height Ratio are especially relevant in understanding the impact of abdominal mass on spinal load and posture.

These indices do not simply reflect body size but rather inform us about the distribution of mass a critical determinant in the mechanical interplay between soft tissue and the axial skeleton. They are considered reliable, reproducible, and easy-to-administer metrics that correlate well with central adiposity and mechanical strain imposed on the musculoskeletal system (Martini *et al*. 2017). Waist circumference is the horizontal distance around the abdomen, typically measured at the midpoint between the lower margin of the last palpable rib and the iliac crest. It is a primary indicator of abdominal adiposity and is strongly linked with the biomechanical burden placed on the lumbar spine. Waist Circumference represents a direct estimation of anterior body mass, which influences spinal curvature, balance, and axial loading. From a mechanical standpoint, increased Waist Circumference displaces the body's center of gravity anteriorly, prompting compensatory lumbar hyperlordosis to maintain balance. This alteration increases compressive forces on intervertebral discs and shear forces on the posterior elements of the vertebrae (Bogduk 2012). Chronic exposure to these abnormal forces contributes to structural fatigue, decreased disc hydration, ligament laxity, and muscle overuse, all of which are risk factors for LBP. The Waist-to-Height Ratio (Waist-to-Height Ratio) is measured by first measuring the waist circumference at the midpoint between the lowest rib and the top of the iliac crest (hip bone), then dividing that value by the height measured in the same units (e.g., both in centimeters or both in inches). It refines the waist circumference measurement by accounting for stature, thereby allowing for more proportional and individual-specific interpretation. As body height reflects vertebral length and spinal leverage, the inclusion of height into the waist metric normalizes spinal strain across varying body frames. Biomechanically, individuals with high Waist-to-Height Ratio values may experience disproportionate abdominal loading relative to their spinal length and muscular support. This discrepancy can exacerbate postural instability, increase energy expenditure during locomotion, and strain lumbar paraspinal musculature. As Waist-to-Height Ratio increases, so does the torque generated around the lumbosacral junction, which is especially vulnerable to degenerative changes due to its position at the transition between mobile and immobile spinal segments (Moore *et al*. 2018; McGill 2007). Hip-to-Height Ratio, although less commonly used than Waist Circumference or Waist-to-Height Ratio, provides important insights into the distribution of body mass around the pelvic region. Hip circumference is typically measured at the level of the greater trochanters or the widest part of the gluteal region. When normalized to height, Hip-to-Height Ratio gives an indication of pelvic morphology, muscle volume, and the lumbopelvic angle, all of which influence lumbar mechanics. A high Hip-to-Height Ratio may reflect excessive gluteofemoral mass, which shifts load posteriorly, alters pelvic tilt, and influences lumbar lordosis. Conversely, a low Hip-to-Height Ratio may suggest underdeveloped gluteal musculature or disproportionate abdominal loading, which can compromise pelvic alignment and exacerbate lumbar instability. In both cases, Hip-to-Height Ratio can serve as a biomechanical proxy for analyzing posture and predisposition to LBP (Pheasant & Haslegrave 2005). This principle underscores how waist anthropometry influences spinal load: the farther the abdominal mass extends from the spinal fulcrum, the greater the stress imposed on lumbosacral joints (McGill 2007; Adams & Dolan 2005).

Middle age (approximately 40 to 60 years) represents a critical period for musculoskeletal health. During this stage of life, the vertebral column undergoes natural degenerative changes including reduced disc hydration, decreased vertebral bone density, and ligamentous laxity (Snell 2012). These changes impair the spine's capacity to absorb shock, adapt to postural variation, and recover from mechanical strain. At the same time, age-related hormonal and metabolic shifts contribute to changes in body fat distribution, typically resulting in increased visceral adiposity. Sedentary behavior, reduced lean muscle mass, and diminished flexibility compound the risk. In individuals with anthropometric profiles indicating high Waist Circumference, Waist-to-Height Ratio, or Hip-to-Height Ratio, the lumbar spine faces increased susceptibility to injury and dysfunction due to the convergence of internal (degeneration) and external (mass distribution) stresses.

The rationale to this study is that despite established knowledge that central obesity influences spinal biomechanics, few studies have quantitatively examined the relationship between waist-based anthropometric indices (WC, WHtR, HHtR) and perceived lower back pain among middle-aged adults but only prevalence rates and specifically in semi-urban Nigerian communities like Ekpoma, with a population heavily engaged in subsistence farming, trading, and manual labor—occupations that place repetitive mechanical stress on the lumbar spine.

Statement of the Problem of this study is that middle-aged adults in Ekpoma experience age-related spinal degeneration concurrent with rising rates of central adiposity due to lifestyle habits, daily and behavioral activities. However, local primary healthcare facilities do not routinely assess waist anthropometry as a predictor of LBP risk, and no previous study has established the relationship between WC, WHtR, or HHtR and perceived LBP in this population. Without such evidence, preventive strategies remain generic and miss the biomechanical link between abdominal fat distribution and lumbar spinal stress.

Ekpoma was selected for the reasons that most Nigerian LBP studies have been conducted in urban centers or rural agrarian villages. Ekpoma represents a semi-urban transitional community with a mix of formal employment, trading, and subsistence farming which means repetitive spinal loading is common, making the relationship between adiposity and LBP more detectable than in purely sedentary populations. The proximity to the institution also allowed for logistical support, ethical approval, and use of anthropometric equipment without excessive travel costs.

The primary objective of this study was to investigate the relationship between specific anthropometric indices namely waist circumference (WC), waist-to-height ratio (WHtR), and hip-to-height ratio (HHtR) and the prevalence of perceived lower back pain (LBP) among middle-aged adults in Ekpoma, Edo State, Nigeria.

The findings aim to inform local healthcare strategies, guiding interventions tailored to the unique needs of this community. Furthermore, by examining the relationship between anthropometric indices such as waist circumference, waist-to-height ratio, and hip-to-height ratio and LBP prevalence, the study seeks to contribute to the broader understanding of how body composition influences musculoskeletal health. This research could lead to more effective preventive measures and management strategies, ultimately enhancing the quality of life for individuals affected by LBP in Ekpoma and similar settings.

Materials and methods

Research Design

This study adopted a cross-sectional descriptive survey design.

Study Population

The research was conducted in Ekpoma, the administrative headquarters of Esan central Local Government Area in Edo State, Nigeria. Ekpoma has a population of approximately 34,244 and features a demographic structure heavily involved in subsistence farming, trading, and manual labor. Its geographic coordinates are approximately 6°54'N latitude and 5°56'E longitude. The town represents a semi-urban Nigerian community with limited existing data on musculoskeletal disorders and obesity-related health outcomes.

The study population comprised middle-aged adults (aged 40–60 years) residing in Ekpoma. This age group was selected due to its high susceptibility to musculoskeletal conditions, including LBP, and is considered vulnerable to the accumulation of central body fat.

Selection Criteria

Inclusion Criteria

- Residents of Ekpoma who have lived in the community for at least one year.
- Adults aged 40 to 60 years.
- Individuals who provided informed consent.
- Those not undergoing current treatment for chronic back conditions or obesity-related interventions.

Exclusion Criteria

- Those with known congenital or traumatic spinal deformities.
- Pregnant women, due to confounding anthropometric measurements.
- Individuals who have undergone spinal surgery within the past 12 months.
- Individuals with acute LBP from a specific traumatic incident (e.g., fall, accident) within the past 2 weeks (to avoid confounding acute mechanical pain with chronic biomechanical pain).
- Individuals unwilling or unable to provide informed consent.

The sample size was determined using Cochran's formula for descriptive studies:

$n = Z^2\ Pq/\ e^{\wedge 2}$

Where:

- n = minimum sample size
- Z = standard normal deviate at 95% confidence level (1.96)
- p = estimated prevalence of LBP in Nigeria (e.g., 0.5 for a conservative estimate)

• q = 1 – p

• e= margin of error (0.07)

$n = (1.96)^2 * 0.5 * 0.5 / 0.05^\wedge 2$

To accommodate for non-response and incomplete data, the sample size was rounded up to 223 participants. The following four-stage sampling procedure was employed to select 223 participants:

1. Stage One (Stratification of Ekpoma into Wards):

Ekpoma town was divided into its 12 existing administrative wards based on the local government area registry. Each ward was considered a stratum to ensure geographical representation across the entire town.

2. Stage Two (Random Selection of Households per Ward):

From each of the 12 wards, a systematic random sampling method was used to select households. A list of all households in each ward was obtained from the ward councilor's office.

3. Stage Three (Selection of One Eligible Middle-Aged Adult per Household):

In each selected household, all adults aged 40–60 years were listed. One eligible participant was then selected using simple random sampling. If a selected household had no eligible adult, the immediate next household was substituted.

4. Stage Four (Enrollment and Consent):

The selected individual from each household was approached, the study objectives were explained, and written informed consent was obtained. If the selected individual refused to participate, the next randomly selected adult from the same household or the next household was substituted.

The following instruments were used for data collection:

A semi-structured questionnaire was used to collect information on:

- Socio-demographic characteristics (age, gender, occupation, education)
- Lifestyle factors (physical activity, smoking, alcohol use)
- Perceived lower back pain using a standardized pain scale (e.g., Visual Analog Scale)
- Duration and intensity of pain

Standardized techniques were used in accordance with WHO (2008) guidelines:

- Waist Circumference (WC): Measured using a non-elastic tape at the midpoint between the lower margin of the last palpable rib and the top of the iliac crest.
- Hip Circumference (HC): Measured around the widest portion of the buttocks with the greater trochanter as a landmark

- Height: Measured using a stadiometer with the participant standing upright without shoes.
- Weight: Measured using a digital scale.

From these values, the following were calculated:

- Waist-to-Height Ratio (WHtR) = Waist Circumference (cm) / Height (cm)
- Hip-to-Height Ratio (Hip-to-Height Ratio) = HC (cm) / Height (cm)

The instruments were pretested among 20 middle-aged adults in a neighboring community. Feedback from this pilot study led to minor modifications in wording and formatting. Content validity was ensured through expert review by professionals in anatomy, public health, and epidemiology. Reliability was tested through test-retest with a Pearson correlation coefficient of 0.82.

Data Collection Method

Assessment of Perceived Lower Back Pain

Lower back pain (LBP) was assessed using two complementary tools:

1. Structured Questionnaire:

Participants were asked: "Have you experienced any pain or discomfort in the lower back region (lumbar area, below the ribs and above the buttocks) in the past 12 months?" (Yes/No). "If yes, on how many days in the past 12 months did you experience this pain?" (Categorical: <30 days, 30–90 days, >90 days)

"Does the pain interfere with your daily activities (e.g., farming, trading, walking, bending)?" (Yes/No)

2. Visual Analog Scale (VAS):

A 10-cm horizontal VAS, labeled "0 = No pain" at the left end and "10 = Worst possible pain" at the right end, was used. Each participant was shown the scale and asked: "Please mark on this line the point that best represents your average lower back pain over the past 2 weeks." The distance from 0 to the marked point was measured in centimeters using a standard ruler, giving a pain score from 0 to 10.

Trained research assistants and health workers carried out the fieldwork over a period of four weeks. Prior to data collection, participants were briefed about the study objectives and consent was obtained. Privacy and confidentiality were ensured. Anthropometric measurements were taken twice and averaged to ensure accuracy. Respondents completed the questionnaire with assistance when necessary (especially for those with low literacy).

Validity

Content validity of the structured questionnaire was established by subjecting the draft instrument to expert review by two professionals: an anatomist (assessment of biomechanical relevance) and an epidemiologist (assessment of question clarity and avoidance of bias). Each expert independently rated each item for relevance, clarity, and comprehensiveness using a 4-point scale. Items with a Content Validity Index (CVI) below 0.78 were either modified or removed.

Face validity was assessed by administering the questionnaire to 10 middle-aged adults (not part of the main study) to ensure questions were understood as intended. Minor wording adjustments were made based on their feedback. Construct validity of the anthropometric measurements (WC, WHtR, HHtR) was ensured by following standardized WHO protocols, which are internationally validated for assessing central adiposity.

Reliability

Test-retest reliability of the questionnaire was assessed using a pilot study conducted among 20 middle-aged adults in a neighboring community (Irrua) who did not participate in the main study. The same questionnaire was administered twice, two weeks apart. The Pearson correlation coefficient for overall scores was $r = 0.82$, indicating good temporal stability.

For anthropometric measurements, intra-rater reliability was assessed by taking two repeated measurements on 20 participants (10% of the pilot sample) one hour apart by the same researcher. The Intraclass Correlation Coefficient (ICC) for WC was 0.94, for HC was 0.91, and for height was 0.97, indicating excellent reliability. Inter-rater reliability was assessed by having two trained research assistants independently measure the same 20 participants; the ICC between their measurements was 0.89 for WC and 0.87 for HC.

Method of Data Analysis

Data were coded and entered into Statistical Product & Service Solutions (SPSS) version 26 for analysis. Descriptive statistics (frequencies, percentages, mean, standard deviation) were used to describe the demographic characteristics of participants, determine the prevalence of perceived LBP.

Descriptive statistics (mean ± standard deviation) were used to calculate mean WC, WHtR, and HHtR values.

Pearson's correlation coefficient (r) was used to examine the relationship between WC, WHtR, HHtR and perceived LBP.

Independent samples t-test was used to compare anthropometric indices and LBP scores between males and females.

Inferential statistics included: Chi-square tests for associations between categorical variables. Multiple linear regression analysis to identify predictors of perceived LBP. Statistical significance was set at $p < 0.05$.

Ethical Considerations

Ethical clearance was obtained from the Ethical Review Board of Ambrose Alli University with ethical approval number 152/25. Informed consent was obtained from all participants. Confidentiality and anonymity were assured, and participants were informed of their right to withdraw at any stage without consequences. All procedures adhered to the ethical principles of the Declaration of Helsinki (2013 revision).

Results and Discussion

Demographic Characteristics of Respondents

A total of 223 middle-aged adults (aged 40–60 years) participated in the study. Table **1** shows their age, sex, occupation, and educational background.

Table: **1** Demographic Profile of Participants

Variable	Frequency (n = 223)	Percentage (%)
Age 40–49	118	51.5
Age 50–60	105	48.5
Male	93	45.6
Female	130	54.4
Employed (Formal)	44	34.0
Farmer/Trader	71	40.4
Self-employed	108	25.5
No formal education	64	15.1
Primary/Secondary	87	44.2
Tertiary	72	40.7

Respondents were asked if they had experienced LBP in the past 12 months.

The results in Table 1 revealed that 63.6% of respondents experienced lower back pain within the past year.

This high prevalence confirms a substantial burden of lower back pain among middle-aged adults in Ekpoma, mirroring earlier Nigerian reports (Adegoke *et al*. 2008) and Omokhodion (2002). From an anatomical standpoint, the lumbar spine is susceptible to degenerative stress due to cumulative axial loading and weakened soft tissue integrity in middle adulthood (Standring 2020; Snell 2012).

Table 2: Anthropometric Indices of Respondents (Mean ± SD)

Measurement	Mean ± SD
Waist Circumference (cm)	91.8 ± 11.6
Waist-to-Height Ratio	0.54 ± 0.06
Hip-to-Height Ratio	0.60 ± 0.05

As shown in Table 2, the average waist circumference of respondents was 91.8 cm, while the mean waist-to-height ratio (Waist-to-Height Ratio) was 0.54 and hip-to-height ratio (Hip-to-Height Ratio) was 0.60. These values exceed several internationally recognized thresholds for central adiposity. According to Ashwell and Hsieh (2005), a Waist-to-Height Ratio above 0.5 is a clear indication of elevated metabolic and biomechanical risk. Anatomically, central mass accumulation increases forward pull on the lumbar spine, which predisposes to spinal misalignment and increased intradiscal pressure (Moore *et al*. 2018).

Table 3: Pearson's correlation between Waist Circumference, Waist-to-Height Ratio, Hip-to-Height Ratio and perceived LBP.

Variable	Correlation Coefficient (r)	p-value	Interpretation
Waist Circumference	0.476	<0.001	Moderate positive correlation
Waist-to-Height Ratio	0.511	<0.001	Moderate positive correlation
Hip-to-Height Ratio	0.228	0.002	Weak positive correlation

The findings in Table 3 demonstrate a statistically significant positive correlation between Waist Circumference (r = 0.476), Waist-to-Height Ratio (r = 0.511), Hip-to-Height Ratio (r = 0.228), and perceived LBP. Waist-to-Height Ratio showed the strongest correlation, indicating its superior utility as a predictor of lumbar stress and pain. Biomechanically, this suggests that abdominal fat shifts the body's center of gravity anteriorly, requiring the spinal extensors to overwork in maintaining postural stability, which aligns with McGill (2007) load-intolerance theory.

According to the data presented in Table 4, females exhibited significantly higher values for Waist Circumference, Waist-to-Height Ratio, Hip-to-Height Ratio, and LBP scores compared to their male counterparts. This observation supports the findings of Bjorntorp (1997) and Wells (2007), who noted gender differences in fat distribution and spinal curvature. Anatomically, women typically have a broader pelvis and more pronounced lumbar lordosis, which can increase shearing forces at the lumbosacral junction when coupled with central adiposity. These differences highlight the need for sex-specific clinical interventions in the management and prevention of LBP.

Table 4: Independent t-test to determine gender differences in Anthropometry and LBP Scores

Variable	Male (Mean ± SD)	Female (Mean ± SD)	t-value	p-value
Waist Circumference (cm)	88.2 ± 9.7	94.7 ± 12.2	-5.73	<0.001
Waist-to-Height Ratio	0.52 ± 0.06	0.56 ± 0.07	-4.89	<0.001
Hip-to-Height Ratio	0.58 ± 0.04	0.61 ± 0.05	-5.14	<0.001
LBP Score (VAS)	4.3 ± 1.2	5.1 ± 1.4	-4.25	<0.001

The findings have three direct implications for middle-aged adults in Ekpoma: High LBP burden (63.6%) means that nearly two out of every three adults aged 40–60 years in this community are likely experiencing chronic lumbar discomfort that may limit their ability to engage in subsistence farming, trading, and manual labor—primary occupations in Ekpoma.

WHtR as the strongest predictor ($r = 0.511$) implies that a simple tape measure (waist circumference divided by height) can identify individuals at risk before they develop disabling LBP. A WHtR ≥ 0.54 (the mean value in this study) may serve as a locally relevant cutoff for early intervention. Gender disparity (females had significantly higher WC, WHtR, HHtR, and LBP) suggests that women in Ekpoma face a double burden: higher central adiposity (likely from multiple childbirths, hormonal changes, and less leisure-time physical activity) and higher pain reporting. This calls for gender-targeted ergonomic and weight management programs.

Thus, the findings are not generalizable to all Nigerian populations but are highly relevant to semi-urban, agrarian communities with similar demographic, occupational profiles and healthcare access characteristics.

Conclusion

This study provides evidence that waist anthropometric indicators—particularly Waist Circumference and Waist-to-Height Ratio—are strongly associated with lower back pain in middle-aged adults in Ekpoma. Waist-to-Height Ratio emerged as the most reliable predictor, reinforcing its role as a clinical tool in musculoskeletal screening. The data also revealed gender disparities in risk, necessitating tailored preventive strategies. The results reinforce anatomical and biomechanical theories explaining how fat distribution alters spinal alignment and load-bearing capacity, lading to chronic Lower back pain.

Based on the findings:

Primary healthcare providers in Ekpoma and similar settings should adopt Waist Circumference and Waist-to-Height Ratio measurements as part of routine musculoskeletal assessments.

Public health initiatives should consider gender differences in fat distribution when designing ergonomics, exercise, or weight management programs. Adults aged 40–60 should be educated about the impact of central obesity on spinal health and Lower Back Pain risk.

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***Conflicts of Interest*:** The authors declare no conflict of interest

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