OPEN ACCESS

ORIGINAL ARTICLE

JMHRS JOURNAL OF MODERN HEALTH AND REHABILITATION SCIENCES

Sonographic Association Between Body Mass Index and Anterior Abdominal Wall Hernias: A Hospital-Based Cross-Sectional Study

[1]Babar Ali[a], [2]Muhammad Umar[a], [3]Rashad Ali[a], [4]Aqsa Aslam[a], [5]Tayyaba Shafiq[a], [6]Laraib Fatima[a], [7]Eisha Riaz[a], [8]Amtul Kafi[a], [9]Javeria Nawab[a]

[a]University Institute of Radiological Sciences and Medical Imaging Technology, The University of Lahore, Lahore, Pakistan

ABSTRACT

Background: Anterior abdominal wall hernias are a common surgical condition with significant morbidity, affecting approximately 4–5% of the global population. Increased body mass index (BMI) is hypothesized to contribute to hernia formation by elevating intra-abdominal pressure and weakening the abdominal wall. Despite its clinical importance, limited research has explored the general association between BMI and all types of anterior abdominal wall hernias.

Objective: This study aimed to evaluate the association between BMI and the occurrence of anterior abdominal wall hernias using sonographic assessment in a hospital-based population.

Methods: A cross-sectional analytical study was conducted at the Department of Radiology, Chughtai Medical Centre, Lahore, from March to September 2024. A total of 200 patients undergoing abdominal ultrasound were enrolled using a convenience sampling method. BMI was categorized into obese (>30 kg/m²) and non-obese (≤30 kg/m²). High-resolution ultrasound (Toshiba Aplio 300, 7–12 MHz linear probe) was used for hernia detection. Data were analyzed using SPSS version 25, with chi-square tests applied for statistical associations.

Results: Among 200 participants (mean age 52.36 ± 15.81 years, mean BMI 29.13 ± 4.49 kg/m²), 24 (12.0%) had anterior abdominal wall hernias. Paraumbilical hernias were most common (13 cases, 6.5%), followed by umbilical (6 cases, 3.0%), incisional (3 cases, 1.5%), and epigastric (2 cases, 1.0%). Hernia prevalence was higher in obese individuals (9.3% vs. 6.5%) and females (14.1% vs. 7.7%), but associations were not statistically significant ($p = 0.6087$, $p = 0.1944$, respectively).

Conclusion: Increased BMI and advancing age were associated with a higher prevalence of anterior abdominal wall hernias, though statistical significance was not established. Sonographic evaluation remains an essential tool for accurate hernia diagnosis, particularly in obese individuals.

Keywords: Abdominal Wall, Abdominal Wall Hernia, Body Mass Index, Hernia, Obesity, Sonography, Ultrasonography.

Correspondence
Babar Ali | babarali0741@gmail.com

Disclaimers
Conflict of Interest: None declared
Data/Supplements: Available on request.
Funding: None
Ethical Approval: Respective Ethical Review Board
Study Registration: 0918/122/12/IX/2023
Acknowledgments: N/A

Article Info
Received: 12 January 2025, *Accepted:* 26 January 2025,
Published Online: 09 February 2025

How to Cite: Ali B, Umar M, Ali R, Aslam A, Shafiq T, Fatima L, Riaz E, Kafi A, Nawab J. Sonographic Association Between Body Mass Index and Anterior Abdominal Wall Hernias: A Hospital-Based Cross-Sectional Study. J Mod Health Rehab Sci. 2025;2(1):17.
Available from: https://jmhrs.com/index.php/jmhrs/article/view/17

Introduction

The anterior abdominal wall plays a vital role in maintaining the structural integrity of the abdominal cavity while facilitating essential functions such as respiration, movement, and organ protection. It comprises multiple layers, including the skin, fascia, muscles, and the parietal peritoneum, all of which work synergistically to provide stability and resistance against intra-abdominal pressure (1). Hernias occur when an internal structure protrudes through a weakened or defective area of the abdominal wall, leading to palpable lumps and potential complications. The most common types of hernias include inguinal, femoral, umbilical, paraumbilical, and incisional hernias, with their prevalence varying according to risk factors such as age, gender, obesity, and previous surgical history (2). Globally, abdominal wall hernias affect approximately 4–5% of the population, with a particularly high incidence in individuals over the age of 50 (3).

Among the various types, inguinal hernias are the most prevalent, accounting for nearly 75% of all hernias, followed by femoral (15%) and umbilical (8%) hernias. The incidence is generally higher in males, largely due to inherent anatomical differences and increased exposure to occupational or physical strain (4). Clinically, hernias present as palpable abdominal masses, which can sometimes be mistaken for intra-abdominal pathology. Ultrasound plays a crucial role in distinguishing hernias from other abdominal wall lesions, particularly in cases where the diagnosis is uncertain. Sonographic imaging enables the dynamic evaluation of hernias, allowing for assessment during activities such as the Valsalva maneuver, which may exacerbate hernia protrusion and aid in detection (5). Additionally, the presence of a positive Carnett sign, where abdominal pain worsens upon tensing of the muscles, can further indicate a superficial lesion, necessitating ultrasound evaluation for confirmation (6).

Different types of hernias exhibit unique characteristics and clinical presentations. Epigastric hernias are small defects located between the breastbone and umbilicus, often asymptomatic but capable of causing mild discomfort. Incisional hernias arise at the site of previous surgical procedures due to weakened scar tissue, frequently leading to large, painful protrusions. Umbilical and paraumbilical hernias result from defects near the navel, with paraumbilical hernias being more prevalent in adults and often containing omental fat or bowel loops. Spigelian hernias, occurring along the lateral abdominal wall, are less common but particularly concerning due to their high risk of strangulation (7). Strangulated hernias represent a critical emergency, where compromised blood supply leads to tissue necrosis, necessitating urgent surgical intervention (8).

Despite their high prevalence, the risk factors contributing to abdominal wall hernias remain a subject of ongoing research. Advanced age, obesity, and increased intra-abdominal pressure are considered significant contributors, with obesity playing a dual role in both hernia formation and recurrence following surgical repair. Excess weight exacerbates intra-abdominal pressure, weakening the abdominal wall and increasing the likelihood of herniation (9). Additionally, obesity complicates hernia management by increasing the risk of surgical complications and recurrence (10). The use of ultrasound has become increasingly valuable in evaluating hernia characteristics, differentiating them from other abdominal wall lesions, and guiding clinical decision-making, particularly in obese individuals where physical examination findings may be obscured (11).

Given the significant clinical burden of abdominal wall hernias and the potential complications associated with delayed diagnosis, this study aims to investigate the sonographic association between anterior abdominal wall hernias and body mass index (BMI). While prior research has focused primarily on incisional hernias and their recurrence in obese individuals, there remains a paucity of data regarding the general relationship between BMI and all types of anterior abdominal wall hernias. This study seeks to fill that gap by systematically evaluating the prevalence, types, and risk factors associated with hernias using ultrasound imaging. The findings will provide valuable insights into the role of BMI in hernia development, potentially informing preventive strategies and improving early detection in high-risk populations.

Materials and Methods

This cross-sectional analytical study was conducted to assess the association between body mass index (BMI) and anterior abdominal wall hernias. The study was carried out in the Department of Radiology, Chughtai Medical Centre (Johar Town), Lahore, Pakistan, over a six-month period from March to September 2024. Ethical approval was obtained from the University of Lahore Ethics Committee (approval number 0918/122/12/IX/2023), and the study adhered to the principles outlined in the Declaration of Helsinki. Informed consent was obtained from all participants or their legal surrogates prior to enrollment in the study.

A total of 200 patients undergoing abdominal ultrasonography were included using a convenient sampling technique. The study population comprised both male and female patients of varying ages, with BMI classifications defining individuals as obese (BMI >30) or non-obese (BMI ≤30). Exclusion criteria included patients with intra-abdominal masses or ascites, pregnant women, and those with a history of prior abdominal surgery, as these factors could confound sonographic findings.

Ultrasound scans were performed using a Toshiba Aplio 300 ultrasound system equipped with a high-frequency (7–12 MHz) linear probe to ensure optimal visualization of the anterior abdominal wall. A certified radiologist

conducted all examinations, ensuring consistency in imaging protocols. Patients were positioned in a supine position with the pelvic region covered to maintain privacy. A coupling gel was applied to the skin surface to minimize air interference, and scanning commenced in the epigastric region, extending across the entire anterior abdominal wall. Both a low-frequency (3.5 MHz) convex probe and a high-frequency linear probe were utilized to enhance diagnostic accuracy. The Valsalva maneuver and coughing were incorporated into the examination to evaluate dynamic changes in hernia protrusion and content.

Data collection was performed using structured data collection sheets, capturing demographic details, clinical presentations, and ultrasound findings. Variables assessed included patient age, BMI, gender, presence and type of hernia, and associated clinical symptoms. Descriptive statistics were used to summarize continuous and categorical variables, with mean, standard deviation, and frequency calculations. The association between hernia occurrence and patient characteristics, including gender, obesity status, and hernia type, was evaluated using the chi-square test. The relationship between hernia content and type was also assessed using statistical analysis. Visual representations such as bar charts and histograms were employed to illustrate key trends.

Data analysis was performed using SPSS version 25, ensuring accurate statistical processing. The chi-square test was applied to determine the significance of associations between categorical variables, with a p-value <0.05 considered statistically significant. The study results were presented in a structured format to facilitate interpretation and support clinical decision-making.

Results

A total of 200 patients were included in the study to assess the association between body mass index (BMI) and anterior abdominal wall hernias. The mean age of the participants was 52.36 ± 15.81 years, with ages ranging from 24 to 80 years. The mean BMI was 29.13 ± 4.48 kg/m², ranging from 16 to 38 kg/m². Among the study population, 135 (67.5%) were female and 65 (32.5%) were male.

Of the total participants, 24 (12%) were diagnosed with anterior abdominal wall hernias. Paraumbilical hernias were the most frequently observed type (13 cases, 6.5%), followed by umbilical hernias (6 cases, 3.0%), incisional hernias (3 cases, 1.5%), and epigastric hernias (2 cases, 1.0%). The majority of hernia cases were identified in female patients (19 cases, 14.07%) compared to male patients (5 cases, 7.69%), but the difference was not statistically significant ($p = 0.1944$). A higher prevalence of hernias was noted among obese individuals (11 cases, 9.32%) compared to non-obese individuals (13 cases, 6.5%), though this association was also not statistically significant ($p = 0.6087$).

Table 1: Age and Body Mass Index (BMI) Distribution of Participants

Variable	Age (years)	BMI (kg/m²)
Mean ± SD	52.36 ± 15.81	29.13 ± 4.49
Range	24 – 80	16 – 38
Median	52.00	30.00

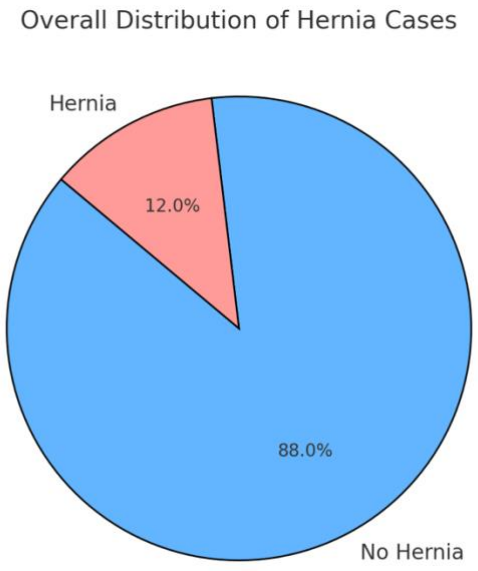

Figure 1: Overall Distribution of Hernia Cases

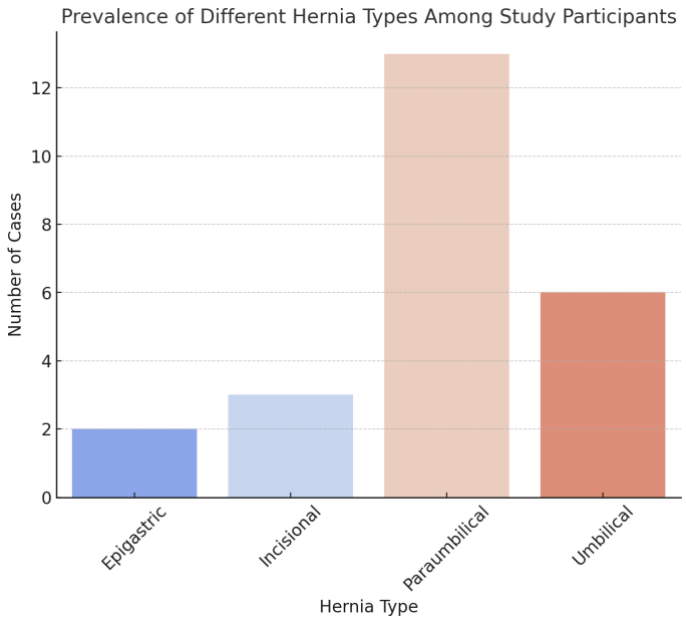

Figure 2: Types of Hernia Diagnosed among Participants

Although the proportion of hernias was slightly higher in obese individuals, the difference was not statistically significant ($p = 0.6087$). A strong association was found between hernia type and hernia occurrence ($p < 0.0001$), with paraumbilical hernias being the most prevalent (Figure 2). A significant association was found between hernia occurrence and other medical findings ($p < 0.0001$), with fatty liver being the most common condition (22.0%).

Table 2: Association Between Gender, Obesity, and Hernia Occurrence

Variable	No Hernia	Hernia	Frequency (%)	p-value
Gender				
Female	116	19	135 (67.5%)	**0.1944**
Male	60	5	65 (32.5%)	
Obesity Status				
Non-Obese (BMI ≤ 30)	71	11	82 (41.0%)	**0.6087**
Obese (BMI > 30)	105	13	118 (59.0%)	
Total	**176 (88.0%)**	**24 (12.0%)**	**200**	

Discussion

The findings of this study reinforced the established association between body mass index (BMI) and anterior abdominal wall hernias, emphasizing the increased prevalence of hernias in individuals with higher BMI and advancing age. A total of 12% of the study participants were diagnosed with anterior abdominal wall hernias, with paraumbilical hernias being the most commonly observed type. While females exhibited a higher frequency of hernias than males, statistical analysis revealed no significant association between gender and hernia occurrence ($p = 0.1944$). Similarly, obesity was more prevalent among patients diagnosed with hernias; however, the difference in hernia occurrence between obese and non-obese individuals was not statistically significant ($p = 0.6087$). These findings were consistent with previous studies that have highlighted the multifactorial nature of hernia development, with obesity and age playing prominent roles in the weakening of the abdominal wall and increased intra-abdominal pressure (12).

Several epidemiological studies have corroborated the role of obesity in hernia formation, particularly incisional and umbilical hernias. A study conducted in Saudi Arabia found a significantly higher prevalence of abdominal wall hernias in individuals with BMI >25, linking obesity to increased intra-abdominal pressure, reduced tissue integrity, and delayed postoperative healing (13). Another study in Russia identified a higher incidence of hernias in men, although it also confirmed obesity as a primary risk factor for umbilical hernias (14). However, the present study did not establish a statistically significant association between gender and hernia prevalence, differing from prior research, which has suggested a male predominance in abdominal wall hernias. This discrepancy could be attributed to sample size variations, regional differences, or lifestyle factors influencing hernia risk. Despite the observed trends, obesity remained a relevant contributing factor, as previous studies have demonstrated a greater likelihood of hernia incarceration and postoperative recurrence in obese individuals (14).

Obesity plays a significant role in increasing intra-abdominal pressure, which not only contributes to hernia formation but is also implicated in adverse pregnancy outcomes such as pre-eclampsia and oligohydramnios. A recent study investigating the association of pre-eclampsia with oligohydramnios using ultrasound demonstrated the impact of vascular dysfunction and hemodynamic alterations in pregnancy, conditions that are also aggravated by high BMI (15). These findings align with the present study, reinforcing the role of excess weight and intra-abdominal pressure in various pathological conditions, including hernia development and obstetric complications. Furthermore, the shared use of ultrasound as a non-invasive diagnostic tool in both studies highlights its versatility in evaluating intra-abdominal pathology, whether in detecting hernias or monitoring fetal well-being (15).

The role of sonography in hernia diagnosis was further substantiated by the study findings, as ultrasound examinations effectively identified and characterized various types of hernias. The ability of real-time ultrasound imaging to assess hernia content, size, and reducibility provided valuable clinical insights, particularly in cases with ambiguous physical examination findings. Prior research has emphasized the advantages of ultrasound over computed tomography (CT) in evaluating small hernias, dynamic changes, and complications such as strangulation and bowel ischemia. However, ultrasound examinations remained operator-dependent, requiring expertise in differentiating hernias from other soft tissue masses such as lipomas, desmoid tumors, or hematomas (16). The present study acknowledged these technical challenges but reaffirmed the utility of sonography as a first-line imaging modality for hernia detection, particularly in obese individuals where physical examination alone might be insufficient.

ISSN Number: 3079-0727 (Print) 3079-0735 (Online)

The study had several strengths, including its standardized imaging protocols, rigorous data collection, and comprehensive statistical analysis. By employing ultrasound as the primary diagnostic tool, the study minimized the risk of misdiagnosis and ensured the accurate classification of hernia types. Furthermore, the inclusion of a diverse patient population with varying BMI and age groups provided a broader perspective on hernia prevalence across different demographics. However, certain limitations were also recognized. The cross-sectional nature of the study limited its ability to establish causation, and the relatively small sample size may have affected the statistical power of associations between BMI, gender, and hernia prevalence. Additionally, the study relied on a single-center sample, which may not fully represent broader population trends. A multicenter study with a larger cohort could provide more definitive conclusions regarding the influence of BMI and other risk factors on hernia development.

Given the increasing prevalence of obesity worldwide, preventive strategies targeting modifiable risk factors such as weight management and core muscle strengthening should be emphasized to reduce the incidence of anterior abdominal wall hernias. Regular screening in high-risk populations, particularly through sonographic evaluation, could aid in early detection and timely intervention, potentially reducing the need for emergent surgical repairs. Future research should explore the long-term impact of BMI reduction on hernia risk and assess the effectiveness of tailored prevention programs in reducing hernia-related complications. A longitudinal study design incorporating postoperative follow-up data would further elucidate the relationship between obesity, surgical outcomes, and recurrence rates. While the present study contributed to the growing body of evidence on the association between BMI and hernia occurrence, ongoing research remains crucial in optimizing management strategies and improving patient outcomes.

Conclusion

The study concluded that increased BMI and advancing age were significant risk factors for anterior abdominal wall hernias, with obesity contributing to increased intra-abdominal pressure and structural weakening of the abdominal wall. Although no statistically significant association was observed between gender and hernia occurrence, paraumbilical hernias were the most frequently identified type. The findings underscored the importance of weight management and early sonographic screening in high-risk populations to mitigate hernia incidence and complications. Given the rising global burden of obesity, integrating preventive healthcare measures and early diagnostic strategies could play a pivotal role in reducing hernia-related morbidity and improving patient outcomes.

Authors' Contributions

ICMJE authorship criteria	Detailed contributions	Authors
Substantial Contributions	Conception or Design of the work	1,2,3,5,7,9
	Data acquisition	2,3,4,6,8
	Data analysis or interpretation	1,3,5,8,9
Drafting or Reviewing	Draft the work	1
	Review critically	1,2,3,4,7,9
Final approval	Final approval of the version to be published.	1,2,3,4,5,6,7,8,9
Accountable	Agreement to be accountable for all aspects of the work.	1,2,3,4,5,6,7,8,9

References

1. Draghi F, Cocco G, Richelmi FM, Schiavone C. Abdominal Wall Sonography: A Pictorial Review. J Ultrasound. 2020;23(3):265-278. doi:10.1007/s40477-020-00435-0.
2. Flynn W, Vickerton P. Anatomy, Abdomen and Pelvis: Abdominal Wall. StatPearls. 2024; Available from: https://www.ncbi.nlm.nih.gov/books/NBK551649/.
3. Pandya B, Huda T, Gupta D, Mehra B, Narang R. Abdominal Wall Hernias: An Epidemiological Profile and Surgical Experience From a Rural Medical College in Central India. Surg J (N Y). 2021;7(1):e41-e46. doi:10.1055/s-0040-1722744.
4. Lassandro F, Iasiello F, Pizza NL, Valente T, Stefano VD, Grassi R. Abdominal Hernias: Radiological Features. World J Gastrointest Endosc. 2011;3(6):110-117. doi:10.4253/wjge.v3.i6.110.
5. Gokhale S. Sonography in Identification of Abdominal Wall Lesions Presenting as Palpable Masses. J Ultrasound Med. 2006;25(9):1199-1209. doi:10.7863/jum.2006.25.9.1199.
6. Mittal T, Kumar V, Khullar R, Sharma A, Soni V, Baijal M, et al. Diagnosis and Management of Spigelian Hernia: A Review of Literature and Our Experience. J Minim Access Surg. 2008;4(4):95-98. doi:10.4103/0972-9941.45204.
7. Pastorino A, Alshuqayfi AA. Strangulated Hernia. StatPearls. 2024; Available from: https://www.ncbi.nlm.nih.gov/books/NBK555972/.
8. Lou L, Teng J, Qi H, Ban Y. Sonographic Appearances of Desmoid Tumors. J Ultrasound Med. 2014;33(8):1519-1525. doi:10.7863/ultra.33.8.1519.
9. Jayaram PR, Pereira FD, Barrett JA. Evaluation of Dynamic Ultrasound Scanning in the Diagnosis of Equivocal Ventral Hernias With Surgical Comparison. Br J Radiol. 2018;91(1088):20180056. doi:10.1259/bjr.20180056.
10. Bedewi MA, El-Sharkawy MS, Al Boukai AA, Al-Nakshabandi N. Prevalence of Adult Paraumbilical Hernia: Assessment by High-Resolution Sonography—A Hospital-Based Study. Hernia. 2012;16(1):59-62. doi:10.1007/s10029-011-0863-4.
11. Lau B, Kim H, Haigh PI, Tejirian T. Obesity Increases the Odds of Acquiring and Incarcerating Noninguinal Abdominal Wall Hernias. Am Surg. 2012;78(10):1118-1121.
12. Mahfouz MEM, Al-Juaid RS. Prevalence and Risk Factors of Abdominal Hernia Among Saudi Population. J Family Med Prim Care. 2021;10(8):3130-3136. doi:10.4103/jfmpc.jfmpc_622_21.
13. Sazhin A, Zolotukhin I, Seliverstov E, Kirienko A, Nikishkov A, Avakiants I, et al. Prevalence and Risk Factors for Abdominal Wall Hernia in the General Russian Population.

Hernia. 2019;23(6):1237-1242. doi:10.1007/s10029-019-01971-3.
14. Iqbal MN, Akhter S, Irfan M. Prevalence of Hernia in Relation to Various Risk Factors in Narowal, Pakistan. Sci Lett. 2015;3(1):29-32.Eigenbrodt AK, Ashina H, Khan S, Diener HC, Mitsikostas DD, Sinclair AJ, et al. Diagnosis and Management of Migraine in Ten Steps. Nat Rev Neurol. 2021;17(8):501-514. doi:10.1038/s41582-021-00510-2
15. ul Hassan T, Nadeem M, Rana MH, Gilani SR, Ghaffar A, Akbar SM. Investigation of the Association of Pre-eclampsia with Oligohydramnios using Ultrasound in Pregnant Women during 32-36 Weeks of Gestation: A Cross Sectional Study: Association of Pre-eclampsia with Oligohydramnios. Journal of Modern Health and Rehabilitation Sciences. 2024 Oct 31:1-5.
16. Monica ML, Antonella M, Gloria A, Diletta C, Nicola M, Ginevra D, Lina B, Silvia P, Andrea G, Vittorio M. Internal hernias: a difficult diagnostic challenge. Review of CT signs and clinical findings. Acta Bio Medica: Atenei Parmensis. 2019;90(Suppl 5):20.

ISSN Number: 3079-0727 (Print) 3079-0735 (Online)