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Research Article

Impact of Age and Body Mass Index on Endoscopically Determined Hiatal Hernia Size and GERD Severity

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Abstract

Background: Hiatal hernia (HH) and gastroesophageal reflux disease (GERD) are common gastrointestinal disorders. While their association is well-established, the specific influence of demographic and anthropometric factors such as age and body mass index (BMI) on the anatomical extent of HH and the severity of resultant GERD requires further elucidation. Understanding these relationships is crucial for risk stratification and targeted management strategies. *Aim:* This study aimed to investigate the impact of age and body mass index (BMI) on endoscopically determined hiatal hernia size and the severity of gastroesophageal reflux disease (GERD) in patients presenting with dyspeptic symptoms. *Methodology:* A descriptive cross-sectional study was conducted on 416 adult patients presenting with dyspeptic symptoms suggestive of hiatal hernia at a tertiary hospital. Data on age and BMI were collected. Upper gastrointestinal endoscopy was performed to determine hiatal hernia size (distance between the Z-line and diaphragmatic indentation) and GERD severity (graded using the Los Angeles Classification). Statistical analyses, including Chi-Square tests and binary logistic regression, were used to assess associations, with $p < 0.05$ considered significant. *Results:* The mean age of part icipants was 44.3 ±14.3 years. A significant association was found between age group and hiatal hernia size ($p = 0.004$), with older age groups tending to have larger hernias. BMI was also significantly associated with hiatal hernia size ($p < 0.001$); higher BMI categories, particularly obesity, were linked to larger hiatal hernias. Furthermore, hiatal hernia size demonstrated a significant positive correlation with GERD severity ($p < 0.001$), with larger hernias associated with higher grades of erosive esophagitis. Specifically, 80.8% of patients with Grade C esophagitis had HH ≥3cm, compared to 5.3% with Grade A. Logistic regression indicated that decreasing age (compared to ≥60 years) and lower GERD grades (compared to Grade C) were associated with smaller HH size. Abdominal tenderness was also a predictor for larger HH. *Conclusion:* Age and BMI are significant factors influencing endoscopically determined hiatal hernia size. Larger hiatal hernias, more prevalent in older and higher BMI individuals, are strongly associated with increased severity of reflux oesophagitis using the Los Angeles Classification. These findings underscore the importance of considering age and BMI in the clinical assessment and management of patients with hiatal hernia and GERD.

Keywords

Age, Body Mass Index, Hiatal Hernia Size, GERD Severity, Endoscopy, Los Angeles Classification

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1. Introduction

Gastroesophageal reflux disease (GERD) and hiatal hernia (HH) pose a large burden on the global healthcare system with bothersome symptoms and potential long-terms complications like erosive esophagitis, Barrett's oesophagus, and oesophageal adenocarcinoma [1, 2]. A hiatal hernia or hiatus hernia is a recognized anatomical abnormality that is characterized by the proximal displacement of the gastroesophageal junction (GEJ) above the diaphragm and frequently occurs with GERD [3]. Normally the GEJ strong anatomy can provide an antireflux barrier but the anatomy of the HH prevents this barrier from working and fails in clearing oesophageal acid, making reflux easier [1]. The "two-sphincter hypothesis" proposes both HH and some functional lower oesophageal sphincter abnormalities contribute independently to GERD, however the size of the hiatal hernia has gained even more prominence as a major factor in determining reflux severity and the degree of associated mucosal injury [1, 4].

The epidemiology and clinical significance of hiatal hernia are an active area of research in which endoscopy is key for diagnosis and classification [3]. Endoscopy permits direct observation and measurement of the hiatal defect by locating the proximal displacement of the Z-line (squamo-columnar junction) from the diaphragmatic indentation [1, 5]. Concurrently, endoscopy also allows assessment of GERD severity using standardized classifications such as the Los Angeles (LA) classification, which assesses the degree of erosive esophagitis based on the size of the mucosal breaks [2]. Even as endoscopic techniques have advanced, our understanding of how patient characteristics determine the anatomical representation of hiatal hernia and the degree of oesophageal mucosal injury is limited. These are important understandings to improve prevention and treatment strategies [6].

Certain factors related to patients including age or body mass index (BMI) may be important factors in the pathophysiology of both hiatal hernia and GERD as well. Generally, with aging, there is a progressive loss of elastic tissues, including the phreno-oesophageal ligament, which anchors the distal oesophagus [7, 8]. This degenerative effect with aging may predispose individuals to the development of hiatal hernias and development of larger hiatal hernias. Perhaps more concretely, intra-abdominal pressure, which is multifactorial and associated with BMI and central obesity, may produce a higher force on the GEJ, resulting in more frequent bouts of herniation and reflux episodes [9, 10]. While there have been many studies on age or BMI related to either HH or GERD, there are only a few studies that assessed the combined or separate impact of age or BMI on the size of HH as assessed by endoscopy and the severity of GERD, graded by standard endoscopic criteria, in multifactorial and different patient cohorts [11, 12].

The rationale for examining the relationships of age and BMI with hiatal hernia size and GERD severity is the potential to provide more accurate risk stratification and tailor treatment. If older age and higher BMI are definitively shown to be associated with larger hiatal hernias and severity of GERD, they would be useful clinical predictors of the disease and assist in decisions regarding lifestyle modifications, medical treatment or surgery. For example, patients with high BMI could be counseled to emphasize weight reduction while older patients could be monitored with greater endoscopic frequency for reflux symptoms. The study by Ray-Offor & Falase [13] in a Nigerian population found erosive esophagitis and the size of hiatal hernia increased with age implying regional significance to these studies. Although, it is important to demonstrate the quantitative association of these demographic or anthropometric variables with the exact endoscopic measures of size of HH and grade of GERD, in order to further the studies.

Thus, this study was designed to specifically evaluate the relationship between patient age, body mass index (BMI), and endoscopically determined characteristics of hiatal hernia and GERD, based on the premise that both increasing age and BMI have significant effects on the development of larger hiatal hernias, and larger hiatal hernias are associated with more severe grades of gastroesophageal reflux disease. Understanding these relationships will add to our understanding of the factors that drive severity in this common clinico-pathological condition and enhance clinical management. The objective of this study was to determine the associations between patient age and BMI with endoscopically determined size of hiatal hernia and severity of gastroesophageal reflux disease (GERD) in adult patients with dyspeptic symptoms.

2. Methodology

This study utilized a descriptive cross-sectional design in order to ascertain the relationship between age, BMI, endoscopically assessed hiatal hernia size, and GERD severity. The study was undertaken at the surgery department of the University of Port Harcourt Teaching Hospital (UPTH), a major referral health service centre for Rivers state and neighbouring regions in Nigeria.

Ethical approval for the study design and protocol was sought and obtained from the Research and Ethics Committee of UPTH. Each participant gave their signed informed consent before they were included in the study. Confidentiality was assured and maintained with respect to the patients throughout the study.

The study population consisted of 416 consecutive adult patients, who presented at the general surgery outpatient clinic, or were referred by the medical outpatient clinic with dyspeptic symptoms suggestive of hiatal hernia, namely, heartburn, regurgitation, and epigastric pain. We adopted a sequential mode of sampling to recruit consecutive patients who met inclusion criteria. Inclusion criteria comprised adult patients

with reflux symptoms who consented in writing to participation in the study. Patients were excluded from the study for refusal of consent or medical instability that rendered them unfit for upper GI endoscopy.

For each participant, demographic data, including age, were recorded. Anthropometric measurements, specifically height (in meters) and weight (in kilograms), were taken to calculate the Body Mass Index (BMI), categorized according to standard World Health Organization classifications (e.g., normal, overweight, obese Class I, II, III).

All recruited patients underwent an upper GI endoscopy procedure, which was standardized across groups. The endoscopies were carried out by experienced endoscopists (the researcher or unit consultant), utilizing a Karl Storz endoscope unit (model TL 100) with a gastroscope (model 13821 PKS). Recruitment started with the patients being assessed, counselled, and standard pre-procedure preparations being completed (e.g., fasting). In addition, for all patients, we used topical pharyngeal anaesthesia (10% Lignocaine spray) and mild sensation (iv diazepam, pentazocine) and amount of discomfort as needed, and any antispasmodics (e.g., buscopan) as well, to enhance patient comfort and procedural success, resulting in a patient in a left lateral decubitus position.

In all endoscopies, we specifically measured to determine if there was a hiatal hernia present, and if so, what size the hiatal hernia was. We noted the distance from the upper incisors to the Z-line (the squamo-columnar junction, A). Then, we noted the distance from the upper incisors to the diaphragmatic indentation (the place where the diaphragmatic crura constricted the oesophagus/stomach, B). To calculate the axial size of the hiatal hernia, we took the difference (B-A) in cm (the distance difference). We placed hiatal hernia sizes in cm and categorised for analysis (e.g., <3 cm vs. greater or equal to 3 cm, or vs. specific cm increments).

The severity of GERD was assessed based on the presence and extent of erosive esophagitis, which was graded according to the Los Angeles (LA) Classification system. This system categorizes esophagitis into Grade A (one or more mucosal breaks ≤5mm, not extending between tops of two mucosal folds), Grade B (one or more mucosal breaks >5mm, not extending between tops of two mucosal folds), Grade C (mucosal breaks continuous between tops of two or more mucosal folds, involving <75% of oesophageal circumference), and Grade D (mucosal breaks involving ≥75% of oesophageal circumference). The presence of other relevant endoscopic findings, such as bile reflux or mucosal prolapse, was also documented.

The data collected were processed in a structured proforma, and analyzed using Statistical Package for Social Sciences (SPSS) version 25. Continuous variables (e.g., age and BMI) were summarized with mean and standard deviation (SD) or shown as categorized variables. Categorical variables (e.g., age groups, BMI categories, hiatal hernia size categories, GERD grades (LA Classification)) were summarized with frequencies and percentages in tables or text. The association between age groups and hiatal hernia size and BMI categories and hiatal hernia size; hiatal hernia size and GERD severity was determined by a Chi-Square test or Fischer's exact test where appropriate based on cell numbers. Binary logistic regression analysis was performed to address predictors of increased hiatal hernia size (e.g., ≥3 cm); age, BMI and GERD grade were included as independent variables where appropriate. Odds ratios (OR) with 95% confidence intervals (CI) were calculated, and a p-value <0.05 was considered statistically significant for all analyses.

3. Results

All 416 participants included in the study had dyspeptic symptoms and underwent an upper gastrointestinal endoscopy. The mean age of the study participants was 44.3 ± 14.3 years, with an age range of 15-88 years. The greatest proportion of participants (31.3%) were in the 40-49 years age group. In terms of Body Mass Index (BMI), 33.2% of participants were normal BMI, 50.1% were overweight, 13.8% were Class I obesity, 2.1% were Class II obesity, and 0.7% were Class III obesity.

The endoscopy indicated a variety of sizes of hiatal hernias. Most participants had a size of 2 cm and 3 cm hiatal hernias (46.9%), and small hernias (1 cm) were present in 2.4% of participants, while 4 cm (2.4%) and 5 cm (0.5%) were less frequent. Reflux esophagitis was a finding for most participants in our study (97.1%). When categorized according to the Los Angeles (LA) Classification, most participants were classified as Grade C esophagitis (56.3%) in the study. Grade B esophagitis was seen in 39.2% of participants, Grade A esophagitis was seen in 4.6% and we did not see any Grade D esophagitis.

Impact of Age on Hiatal Hernia Size

A significant association was observed between age group and hiatal hernia size (p = 0.004), as detailed in Table 1. Participants in older age groups tended to have larger hiatal hernias. For instance, among those aged <20 years, 70.6% had hiatal hernias ≥3cm. In contrast, for the 20-29 years age group, 29.8% had hernias ≥3cm, while for the 40-49 years age group, 50.0% had hernias ≥3cm. Participants aged 50-59 years and ≥60 years showed proportions of 61.1% and 57.9% respectively for hernias ≥3cm.

Table 1. *Association between Age Group and Hiatal Hernia Size.*

AGE GROUP (years)	Hiatal Hernia Size < 3 cm N (%)	Hiatal Hernia Size ≥ 3 cm N (%)	Total N	χ^2/Fisher's Exact	P-value
<20	5 (29.4)	12 (70.9)	17	17.246	0.004*
20–29	33 (70.2)	14 (29.8)	47		
30–39	53 (57.6)	39 (42.4)	92		
40–49	65 (50.0)	65 (50.0)	130		
50–59	21 (38.9)	33 (61.1)	54		
≥60	32 (42.1)	44 (57.9)	76		
Total	209	207	416		

Significant ($p < 0.05$).

Impact of Body Mass Index on Hiatal Hernia Size

Body mass index demonstrated a highly significant association with hiatal hernia size ($p < 0.001$), as shown in Table 2. A trend was observed where increasing BMI categories were associated with a higher prevalence of larger hiatal hernias (≥3 cm). Among participants with normal BMI, 35.3% had hernias ≥3 cm. This proportion increased to 47.6% in overweight individuals. Notably, in obese individuals, the prevalence of larger hernias was substantially higher: 86.0% for Class I obesity, 77.8% for Class II obesity, and 100.0% for Class III obesity.

Table 2. *Association between Body Mass Index Class and Hiatal Hernia Size.*

Body Mass Index Class	Hiatal Hernia Size < 3 cm N (%)	Hiatal Hernia Size ≥ 3 cm N (%)	Total N	χ^2/Fisher's Exact	P-value
Normal	90 (64.7)	49 (35.3)	139	50.001	<0.001*
Overweight	109 (52.4)	99 (47.6)	208		
Class 1 Obesity	8 (14.0)	49 (86.0)	57		
Class 2 Obesity	2 (22.2)	7 (77.8)	9		
Class 3 Obesity	0 (0.0)	3 (100.0)	3		
Total	209	207	416		

*Significant ($p < 0.05$).

Association between Hiatal Hernia Size and GERD Severity

A highly significant association was found between the size of the hiatal hernia and the severity of GERD, as graded by the LA Classification ($p < 0.001$), detailed in Table 3. Larger hiatal hernias were predominantly associated with more severe grades of esophagitis. Among participants with Grade A esophagitis, only 5.3% had a hiatal hernia ≥3 cm. For Grade B esophagitis, this proportion was 10.4%. In stark contrast, among those with Grade C esophagitis, a substantial 80.8% had hiatal hernias ≥3 cm.

Table 3. *Association between GERD Severity (LA Classification) and Hiatal Hernia Size.*

GERD Grade (LA Classification)	Hiatal Hernia Size < 3 cm N (%)	Hiatal Hernia Size ≥ 3 cm N (%)	Total N	χ^2/Fisher's Exact	P-value
Grade A	18 (94.7)	1 (5.3)	19	205.913	<0.001*

GERD Grade (LA Classification)	Hiatal Hernia Size < 3 cm N (%)	Hiatal Hernia Size ≥ 3 cm N (%)	Total N	χ^2/Fisher's Exact	P-value
Grade B	146 (89.6)	17 (10.4)	163		
Grade C	45 (19.2)	189 (80.8)	234		
Total	209	207	416		

*Significant ($p < 0.05$).

Predictors of Increased Hiatal Hernia Size

Binary logistic regression analysis was performed to identify risk factors associated with an increased hiatal hernia size (defined as ≥3cm). The results are summarized in Table 4.

When compared to the reference age group of ≥60 years, younger age groups showed decreased odds of having a larger hiatal hernia. For instance, participants aged 20-29 years had significantly lower odds (OR 0.248, 95% CI 0.075-0.820, p = 0.022) and those aged 30-39 years also had lower odds (OR 0.340, 95% CI 0.128-0.903, p = 0.031) of having a hiatal hernia ≥3cm.

Compared to GERD Grade C (reference), patients with Grade A (OR 0.017, 95% CI 0.002-0.139, p < 0.001) and Grade B (OR 0.033, 95% CI 0.017-0.064, p < 0.001) esophagitis had significantly lower odds of having a larger hiatal hernia. The odds ratios for BMI categories relative to Class 3 obesity were not fully interpretable as presented (all 0.000, p=0.999), suggesting poten; tial issues with model stability due to small numbers in the reference category or multicollinearity, requiring cautious interpretation for BMI from this specific regression model output. However, the chi-square test (Table 2) strongly supported the association. Abdominal tenderness was also found to be a significant predictor of increased hiatal hernia size (OR 2.120, 95% CI 1.145-3.925, p = 0.017).

Table 4. *Risk Factors Associated with Increased Hiatal Hernia Size (≥3cm).*

Variables	Odds Ratio	95% C.I. Odds Ratio	P-value
Age group (years)			
<20	3.616	0.646 – 20.239	0.144
20–29	0.248	0.075 – 0.820	0.022*
30–39	0.340	0.128 – 0.903	0.031*
40–49	0.419	0.167 – 1.051	0.064
50–59	0.773	0.268 – 2.230	0.634
≥60	*Reference*		
GERD Grade			
Grade A	0.017	0.002 – 0.139	<0.001*
Grade B	0.033	0.017 – 0.064	<0.001*
Grade C	*Reference*		
Body Mass Index Class (vs. Class 3 Obesity)			
Normal	0.000	0.000	0.999
Overweight	0.000	0.000	0.999
Class 1 Obesity	0.000	0.000	0.999
Class 2 Obesity	0.000	0.000	0.999
Class 3 Obesity	*Reference*		
Abdominal tenderness	*2.120*	*1.145 – 3.925*	*0.017**

*Significant ($p < 0.05$).

4. Discussion of Results

This study shows the effect of age and body mass index (BMI) on endoscopically determined hiatal hernia (HH) size and gastroesophageal reflux disease (GERD) severity. Both increasing age and higher BMI are independently associated with larger hiatal hernias. Older individuals and those with higher BMI, especially in the obese categories, were more likely to have hiatal hernias ≥3 cm. This is in line with existing literature that age related degeneration of the phreno-oesophageal ligament and increased intra-abdominal pressure from excess body weight contribute to the development and progression of hiatal hernias [7] [9]. Ray-Offor and Falase [13] also found increasing hiatal hernia size with aging in a Nigerian population, which supports our age-related findings. The strong dose response relationship between BMI categories and HH size in our study (Table 2) shows the mechanical role of adiposity in disrupting GEJ integrity [14].

Also, a key finding of this study is the strong positive correlation between hiatal hernia size and GERD severity based on the severity of reflux oesophagitis or erosive oesophagitis as graded by the Los Angeles Classification. Patients with larger hiatal hernias (≥3 cm) mostly had more severe forms of erosive esophagitis (Grade C) while those with smaller hernias or no significant hernia had milder (Grade A or B) or no esophagitis. This strong association shows that the anatomical defect size of a hiatal hernia is a major determinant of the degree of oesophageal mucosal damage. This is in line with the understanding that larger hernias are associated with more profound disruption of the anti-reflux barrier, greater volumes of refluxate and impaired oesophageal clearance mechanisms [1, 4]. The logistic regression analysis also supported this, showing much lower odds of having a large HH for patients with Grade A or B esophagitis compared to Grade C.

The implication of these relationships—age and BMI influencing HH size and HH size influencing GERD severity—is significant for clinical practice. It means age and BMI can be used as risk indicators for more severe GERD through larger hiatal hernias. While age is non-modifiable, BMI is a modifiable risk factor. The strong association between obesity (especially Class I and above) and larger HH size (Table 2) shows the benefit of weight management not only for GERD symptoms but also for the anatomical substrate (HH size) that drives severe esophagitis [15]. Our study showed 100% of participants with Class 3 obesity had HH ≥3cm.

The findings also contribute to the broader understanding of the relationship between hiatal hernia size, specific clinical symptoms, and endoscopic mucosal changes. While the core investigation centred on the relationships between age, BMI, HH size, and GERD severity, studies has also shown a predominant association between regurgitation and increasing hernia size [16]. The regression analysis performed herein additionally showed abdominal tenderness to be a predictor of larger HH. This suggests that the increased HH size, driven by the influences of age and BMI established in this research, not only leads to more severe endoscopic mucosal changes (erosive oesophagitis) but also likely correlates with more pronounced or specific clinical symptoms. For instance, abdominal tenderness as a predictor of larger HH might reflect more severe local inflammation or mechanical strain associated with larger hernias [17].

Comparing our findings to other populations, studies like that by Weitzendorfer et al. [10] also found obesity to be frequently associated with hiatal hernia and GERD. The consistency across different populations strengthens the generalizability of these risk factors. However, the observation in our study that 2cm and 3cm hernias were predominant and that even these sizes were significantly associated with GERD severity aligns with studies suggesting that hernias ≥2cm are clinically relevant [5]. The high prevalence of Grade C esophagitis (56.3%) in our symptomatic cohort, particularly in those with larger hernias, underscores the significant mucosal impact of these anatomical and demographic factors in the studied population [18, 19].

5. Conclusion

This study shows that increasing age and higher BMI are major determinants of larger hiatal hernia size in adult patients with dyspepsia. Hiatal hernia size is a key factor directly linked to GERD severity with larger hernias strongly associated with higher grades of erosive esophagitis as per Los Angeles Classification. Age and BMI are risk factors for anatomical and pathological severity of hiatal hernia-GERD. Therefore, these should be considered in clinical evaluation, risk stratification and management planning of patients with GERD symptoms. Weight management in overweight and obese patients may play a crucial role in reducing GERD severity by potentially affecting hiatal hernia size. Further longitudinal studies are needed to look into the effect of interventions like weight loss on hiatal hernia size and GERD outcomes. Healthcare providers should emphasize early endoscopy in symptomatic older patients and those with higher BMI to diagnose and intervene early and prevent progression to more severe oesophageal mucosal disease.

6. Ethical Considerations

The study was done according to the principles of the Declaration of Helsinki. Ethical approval for the study protocol was obtained from the Research and Ethics Committee of the University of Port Harcourt Teaching Hospital before the start of the study (UPTH/ADM/90/S.II/VOL.XI/1037). All participants were informed about the purpose of the study, procedures, risks and benefits. They were told that participation was voluntary and they could withdraw at any time without prejudice to their medical care. Written informed consent was obtained from each participant before they were included in the

study and before any procedure including upper gastrointestinal endoscopy was done. Patient confidentiality was maintained. All data collected were anonymized using unique study identifiers to protect patient privacy. The data was stored securely and access was restricted to the research team. The study will contribute to medical knowledge and patient care and no financial compensation was given to the participants for their participation. Any discomfort or preventable complications from the endoscopic procedure was managed by the medical team. The study did not involve any experimental intervention that will add additional risk beyond what is associated with standard clinical diagnostic procedure for their symptoms.

Abbreviations

HH	Hiatal Hernia
GERD	Gastroesophageal Reflux Disease
BMI	Body Mass Index
GEJ	Gastroesophageal Junction

Author Contributions

Victor Wagozie: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Writing – original draft, & writing–review & editing

Patrick Okechukwu Igwe: Data curation, Formal Analysis, Funding acquisition, writing– original draft, writing– review & editing

Conflicts of Interest

The authors declare no conflicts of interest.

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