

# Body mass index: not a predictor for hiatus hernia of esophagus



**Objectives:** Hiatus Hernia is one of the leading gastrointestinal problems in Pakistan. The study was conducted to establish the association between body mass index (BMI) and hiatus hernia and assess the predictive value of BMI in patients of hiatus hernia and esophagitis.

**Methods:** During this descriptive case series, 372 patients were selected who presented with epigastric pain or refractory GERD. All the patients underwent gastroscopy using Olympus CLV-260 series gastroscope. Endoscopic findings were observed for grades of hiatus hernia (Hill classification) and stages of esophagitis (Savary-Miller classification). BMI was calculated using height and weight of the patients.

**Results:** A chi square test of independence established that the association between BMI & hiatus hernia was significant ( $p < .01$ ) but no significant association was found between BMI and esophagitis ( $p = .14$ ). A series of logistic regression analyses showed that BMI was not a significant predictor of hiatus hernia though age and gender were significant predictors. It was also revealed that normal BMI was a significant predictor of Grade I esophagitis.

**Conclusion:** BMI is not a significant predictor of the grades of hiatus hernia and esophagitis. Further studies need to be conducted to establish stronger predictors of severity of hiatus hernia and esophagitis.

**Keywords:** body mass index, hiatus hernia, esophagitis, endoscopy

## Introduction

Hiatus hernia is a condition characterized by herniation of the upper part of the stomach through the esophageal hiatus because of weakness or a tear in the diaphragm. This is thought to be caused by increased pressure within the abdomen due to heavy lifting, bending over, frequent coughing, sneezing, vomiting, straining or stress [1,2]. Approximately 60% of individuals, aged 50 or older, have a hiatus hernia but only 9% of those are symptomatic [3]

Increased body mass index (BMI) has been historically considered to be the primary cause of esophageal hiatus hernia. In 1999, Wilson et al. concluded through a retrospective analysis that obesity is a significant independent risk factor for hiatus hernia [4]. Despite the diagnostic challenges, this is however accepted that the prevalence of hiatus hernia parallels that of obesity, increasing with age [5]. In a survey of the Asia Pacific population conducted in 2005, a four-fold increase in the prevalence was

observed as compared to 90s while this is also the case in Pakistan although no serial assessment of prevalence has been done [6-8].

The objective of the study was to establish the relation between BMI and hiatus hernia and assess the predictive value of BMI in cases of hiatus hernia. Moreover, the correlation between grades of hiatus hernia and reflux esophagitis was also studied.

## Patients and Methods

During this descriptive case series, 372 patients were enrolled after fulfilling the necessary inclusion and exclusion criteria. The patients, enrolled from either gender, were aged 18 years or above and presented with miscellaneous complaints ranging from epigastric pain, retrosternal burning, refractory gastroesophageal reflux disease (GERD), hematemesis etc. All the patients were excluded from the study that was either pregnant or presented with hepatic encephalopathy, shock or a known history of bleeding disorders.

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These subjects underwent endoscopy after an informed consent using Olympus CLV-260 series gastroscope while lying in left lateral decubitus and supine position. All the patients were given local anesthetic and conscious sedation as part of the procedure and endoscopic findings regarding hiatus hernia (confirmed through endoscopic aspect of the gastroesophageal valve seen from a retroflexed position) and esophagitis were noted. The patients were then discharged from the facility after post-procedural observation period of 2 hours to account for any complications.

Hiatus hernia was classified according to the Hill classification (TABLE 1) [9-11]. Esophagitis was classified according to Savary-

Miller classification on endoscopic view (TABLE 2) [12,13].

## Results

The mean age of participants was 48 years ( $SD=14.2$ ). Normal BMI was most prevalent (36.3%) while grade II and III hiatus hernia were the most common findings in 27.2% and 46% respectively patients. Most of the participants were suffering from Grade II Hiatus Hernia and Grade III Esophagitis (TABLE 3).

A chi square test of independence was performed to examine the association between BMI and Hiatus Hernia as well as Esophagitis (TABLE 4). The association between BMI & Hiatus Hernia was significant,  $\chi^2(9,$

**TABLE 1. Hill classification for esophageal hiatus hernia.**

<b>Grade I</b>	Prominent fold of tissue closely approximates the endoscope at its entry point to the stomach
<b>Grade II</b>	Prominent fold is present but there are occasional episodes of rapid opening and closing of the tissue around the endoscope
<b>Grade III</b>	There is barely a fold present and there is no circular gripping of the endoscope shaft. However, there is no herniation of gastric cardia through this persisting aperture
<b>Grade IV</b>	Herniation is present and squamous epithelium of the distal esophagus can be seen from the retroflexed endoscopic view.

**TABLE 2. Savary-Miller grading of esophagitis based on endoscopic view.**

<b>Grade 1</b>	Single erosion above gastro-esophageal mucosal junction
<b>Grade 2</b>	Multiple, non-circumferential erosions above gastro-esophageal mucosal junction
<b>Grade 3</b>	Circumferential erosion above mucosal junction
<b>Grade 4</b>	Chronic change with esophageal ulceration and associated stricture
<b>Grade 5</b>	Barrett's esophagus with histologically confirmed intestinal differentiation within columnar epithelium

**TABLE 3. Demographic characteristics of hiatus hernia patients (n=372).**

	f	%	M	SD
<b>Age</b>			48.3	14.2
<b>Gender</b>				
Male	171	46		
Female	201	54		
<b>Hiatus Hernia</b>				
Grade I	60	16.1		
Grade II	111	29.8		
Grade III	106	28.5		
Grade IV	95	25.5		
<b>BMI</b>				
Under weight	51	13.7		
Normal	135	36.3		
Over weight	114	30.6		
Obese	72	19.4		
<b>Esophagitis</b>				
Absent	17	4.6		
Present				
Grade I	59	15.9		
Grade II	101	27.2		
Grade III	171	46.0		
Grade IV	24	6.5		

$N=372$ )= $22.56$ , ( $p<.01$ ) but no significant association was found between BMI and Esophagitis,  $\chi^2(9, N=355)=13.63$ ,  $p=.14$ ).

The results of the Chi-square test revealed that there was no significant association between Gender and Hiatus Hernia,  $\chi^2(3, N=372)=5.78$ ,  $p=.12$ ). However, significant association was found between Esophagitis and Hiatus Hernia  $\{\chi^2(12, N= 372) = 103.93, p < 0.01\}$  (TABLE 5).

A series of logistic regression analyses were conducted to determine the predictive ability of levels of BMI (Under-weight, Normal, Over-weight and Obese) for differentiating between grades of Hiatus Hernia (Grade 1, Grade 2, Grade 3 and Grade 4) (TABLE 4) and for differentiating between grades of Esophagitis

(Grade 1, Grade 2, Grade 3 and Grade 4) (TABLE 6).

Table 4 shows that when differentiating between grade 1 and grade 4 of hiatus hernia, the overall model predicted the outcome of hiatus hernia and 16% of the variance was explained for by age, gender and BMI in the overall model. However, only age emerged as the strong significant predictor of hiatus hernia. As the age increased, the likelihood of participants suffering from hiatus hernia also increased. The levels of BMI did not emerge as significant predictor of Hiatus Hernia.

The overall regression model for grade 2 versus grade 4 of hernia was significant and 24% of variance was explained by age, gender

**Table 4. Descriptive statistics for hiatus hernia, esophagitis & bmi.**

		Body Mass Index			
		Under weight	Normal	Over weight	Obese
Hiatus Hernia	Grade I	10	17	16	17
	Grade II	12	41	35	23
	Grade III	6	46	33	21
	Grade IV	23	31	30	11
Esophagitis	Grade I	9	11	23	16
	Grade II	16	38	31	16
	Grade III	23	73	49	26
	Grade IV	3	7	8	6

**Table 5. Descriptive statistics for hiatus hernia by esophagitis and gender (n= 372).**

		Hiatus Hernia			
		I	II	III	IV
Gender	Male	26	61	47	37
	Female	34	50	59	58
Esophagitis	Absent	4	7	5	1
	I	24	24	9	2
	II	20	31	33	17
	III	12	49	55	55
	IV	0	0	4	20

**Table 6. Binary logistic regression predicting hiatus hernia from body mass index.**

Predictors	Hiatus Hernia									
	Grade 1 & Grade 4					Grade 2 & Grade 4				
	B	S.E	OR	95%CI		B	S.E	OR	95%CI	
			LL	UL				LL	UL	
Age	.04***	0.01	1.05	1.02	1.07	0.01	0.01	1.01	0.99	1.03
Gender	0.04	0.31	1.04	0.56	1.92	.61*	0.26	1.85	1.11	3.09
BMI Levels										
Underweight vs Obese	0.03	0.43	1.03	0.44	2.39	0.75	0.39	2.12	0.99	4.51
Normal vs Obese	0.39	0.35	1.48	0.74	2.94	0.03	0.28	1.03	0.59	1.79
Overweight vs Obese	20.02	3834.69	4×108	0		20.99	3860.27	1×1010	0	

Model $\chi^2$ (df)	63.05***(5)					103.95*** (5)				
Cox and Snell R2	0.16					0.24				

Note. (N=372). Dummy coding for grades of hernia; first grade mentioned in heading is "1" and the second grade is "0". Coding for gender (0=men, 1=women), Dummy coding for levels of BMI; first level mentioned is "1" and the second level is "0". S.E = Standard Error, OR = Odd Ratio, CI = Confidence Interval, LL = Lower Limit, UL = Upper Limit.

\* $p < .05$ , \*\*\* $p < .001$

and BMI levels. In addition, the likelihood of suffering from hiatus hernia (Grade 2) was increased in women. The levels of BMI did not emerge as a significant predictor of hiatus hernia. No significant model emerged for the group (Grade 3 versus Grade 4) of Hiatus Hernia.

TABLE 7 shows that the overall model for one group of Esophagitis (Grade 1 versus Grade 4) emerged as significant. 4% of the variance was explained by age, gender and BMI levels in the outcome of esophagitis. Moreover, it was seen that participants having normal BMI had increased likelihood of getting Esophagitis (Grade 1). The overall models for the following two groups of Esophagitis i.e. (Grade 2 versus Grade 4) and (Grade 3 versus Grade 4) were insignificant and all the predictors i.e. age, gender and BMI levels emerged as insignificant for the outcome of Esophagitis.

### Discussion

Hiatus hernia is one of the leading gastrointestinal problems which remain under-diagnosed till date owing to the difficulty in

diagnosing the condition. The current estimated prevalence varies from 10% to 80% of the adults in North America with a general acceptance that hiatus hernia is mainly associated with obesity and age [14,15]. While the prevalence varies in different Asian and European countries, Riaz et al. showed that the students in Pakistan experience more episodes of acid reflux in a week as compared to that in general asian population [16-18].

In 1999, Wilson concluded that BMI was significantly associated with the presence of hiatus hernia along with esophagitis. Multiple logistic regressions indicated that BMI and hiatal hernia were significant factors for the presence of esophagitis but gender and race lacked any effect. This was a retrospective analysis of 1389 patients who underwent gastric analysis and upper GI endoscopy over a period of 20 years from 1974 to 1995. Samuel and Nabe though refuted the findings of Wilson in 2018 when the results of their study proved that a high BMI of 30 Kg/M<sup>2</sup> or above has a negative association with hiatus hernia. They further proposed that

Predictors	Esophagitis													
	Grade 1 & Grade 4				Grade 2 & Grade 4				Grade 3 & Grade 4					
	B	S.E	OR	95%CI		B	S.E	OR	95%CI		B	S.E	OR	95%CI
			LL	UL				LL	UL				LL	
Age	0.02	0.01	1.02	0.99	1.04	0.01	0.01	1.01	0.99	1.03	-0.01	0.01	0.99	0.98
Gender	-0.17	0.31	0.85		1.54	-0.41	0.25	0.67	0.41	1.08	0.37	0.22	1.45	0.94
BMI Levels														
Underweight and Obese	0.34	0.47	1.41	0.56	3.57	-0.42	0.42	0.66	0.29	1.51	-0.09	0.38	0.91	0.43
Normal and Obese	1.25**	0.44	3.51	1.48	8.28	-0.33	0.36	0.72	0.36	1.44	-0.56	0.32	0.57	0.31
Overweight and Obese	0.2	0.38	1.22	0.59	2.56	-0.21	0.36	0.81	0.39	1.64	-0.09	0.32	0.91	0.49

Model $\chi^2$ (df)	14.24* (5)					4.65(5)					10.29 (5)			
Cox and Snell $R^2$	0.04					0.01					0.03			

Note. (N=355). Dummy coding for grades of esophagitis; first grade mentioned in heading is "1" and the second grade is "0". Coding for gender (0=men, 1=women), Dummy coding for levels of BMI; first level mentioned is "1" and the second level is "0". S.E = Standard Error, OR = Odd Ratio, CI = Confidence Interval, LL = Lower Limit, UL = Upper Limit

\* $p < .05$ , \*\* $p < .01$ .

the risk of developing hiatus hernia seems to be higher in women especially those with BMI in the overweight range. They were able to prove that as compared to the obese patients, normal and overweight ranges of BMI had a higher risk of having hiatus hernia [19,20].

In the current study of 372 patients, the results of the Chi-square test revealed that there is significant association between BMI & hiatus hernia ( $p < 0.01$ ) as well as esophagitis and hiatus hernia ( $p < 0.01$ ). However, the results were unable to prove any significant association between gender and hiatus hernia as shown in Tables 2 and 3.

A series of logistic regression analyses were conducted to determine the predictive ability of different levels of BMI to differentiate between grades of hiatus hernia and esophagitis. The levels of BMI did not emerge as a significant predictor of hiatus hernia.

However, only age emerged as a strong significant predictor of hiatus hernia. Analysis showed that an increase in age leads to an increased likelihood of hiatus hernia.

Lee et al. studied the impact of BMI and gender on quality of life in patients who suffered from gastroesophageal reflux disease [21]. They enrolled 173 patients and found out that the patients who were obese were more likely to suffer from erosive esophagitis and hiatal hernia, severe heartburn symptoms which led to poor quality of life. Gender differences were stark in nature with men presenting with severe endoscopic and clinical features but women suffered from a worse influence on mental health. When the results of Lee's study were compared to this study it was seen that patients having normal BMI had increased likelihood of getting esophagitis (Grade 1). The overall models however were insignificant and all the predictors i.e. age, gender and BMI levels emerged as insignificant for the outcome of esophagitis.

In the light of these findings, the historical perspective that a high body mass index is directly proportional to the risk of developing hiatus hernia is somewhat true in the sense that the association is proved in multiple studies but this does not directly translate into a cause and effect model [22,23]. A high BMI does lead to hiatus hernia albeit with no effect on the severity of the problem as evident from different grades of hiatus hernia. While different grades of hernia had no bearing on the esophagitis or stages of esophagitis, this makes for an interesting point that BMI has no predictive value in diagnosing hiatus hernia and the grades of hernia have no bearing on the levels of esophagitis [24].

This poses a difficulty when developing a treatment algorithm for diagnosis and treatment of various grades and stages of hiatus hernia and esophagitis [25,26]. The currently employed treatment regimens might be rendered ineffective if the severity of hiatus hernia and esophagitis is not taken into account [27,28]. An endoscopic study will thus become the cornerstone of any management plan for a patient if it is designed without knowing the grade or stage of hernia and esophagitis. This brings forth the diagnostic challenges facing the diagnosis or management of hiatus hernia and related complications (barrett esophagus being the most important variety)[29,30]. The latest interventional modules will be dependent on follow-up endoscopic studies to document the improvement or worsening in hiatus hernia and subsequent esophagitis [31]. This clearly underlines the importance of developing better predictive tools for hiatus hernia and related complications instead of relying on the age-old model of BMI and symptomatic presentation of the patients to determine the severity and course of management.

Despite the results being statistically valid and showing associations, a large scale multicentre study that enrolls patients from different

ethnicities and regions should be initiated to confirm these findings across different groups and to establish better predictive factors for a healthier outcome in this group of patients.

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## Conclusion

Despite finding an association between BMI and hiatus hernia, there was a lack of predictive value for BMI in cases of hiatus hernia and esophagitis. However, age and gender emerged as possible predictors in certain groups. Further studies need to be conducted to establish stronger predictors to assess severity and grades of hiatus hernia and esophagitis.



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