



# Natural Sciences Engineering & Technology Journal (NASET Journal)

Journal Homepage: <https://nasetjournal.com/index.php/nasetjournal>

## Association between Body Mass Index, Waist Circumference and Gastroesophageal Reflux Disease Questionnaire Scores: A Cross-Sectional Study

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### ARTICLE INFO

#### Keywords:

Abdominal obesity  
Body mass index  
Gastroesophageal reflux disease  
Overweight  
Waist circumference

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All authors have reviewed and approved the final version of the manuscript.

<https://doi.org/10.37275/nasetjournal.v2i1.14>

### ABSTRACT

The prevalence of gastroesophageal reflux disease (GERD) has continued to increase in Asian countries in recent decades. Many studies have revealed that obesity in general or abdominal obesity causes a significant increase in the risk of GERD symptoms. This study aimed to determine the relationship between body mass index (BMI) and waist circumference with the incidence of GERD in the adult population of Palembang city. This study was observational research with a cross-sectional design. The population was all adults ( $\geq 20$  years) of Palembang. The number of samples was 400 people. Data were taken from a self-completed questionnaire, distributed through social media, then analyzed using logistic regression analysis. Among 400 subjects in the study, there were 81 subjects (20.3%) diagnosed with GERD, 43 subjects (10.8%) were overweight, 79 subjects (19.8%) were obese, and 160 subjects (40%) had abdominal obesity. There was a significant relationship between obesity and diagnosis of GERD ( $p=0,001$ ; OR =2,799; CI 95% = 1,545-5,069). In contrast, there was no significant relationship between being overweight and diagnosis of GERD. There was also no significant relationship between abdominal obesity and diagnosis of GERD. Obesity has a significant association with the diagnosis of GERD, but the absence of an association between overweight and diagnosis of GERD implies that increased BMI is not an independent risk factor in diagnosis of GERD.

### 1. Introduction

Gastroesophageal reflux disease (GERD) is considered a common, chronic digestive disease in the United States and Europe.<sup>1</sup> In the past few decades, the prevalence of GERD has continued to increase steadily in Asian countries.<sup>2</sup> A systematic review study showed a variation in its prevalence, 18.1-27.8% (North America), 8.8-25.9% (Europe), 2.5-7.8% (East Asia), 8.7-33.1% (Middle East), 11.6% (Australia), and 23% (South America).<sup>1</sup>

Overweight and obesity are terms used to define excessive body fat deposits that cause negative health

impacts.<sup>2</sup> Just like GERD, the incidence of overweight and obesity continues to increase continuously. Surveys from 2007 to 2018 in Indonesia showed an increase in the prevalence of overweight in adults aged more than 18 years from 8.6% to 13.6%, while the prevalence of obesity increased from 10.5% to 21.8%.<sup>3</sup>

Epidemiological studies in various countries show a rapid increase in the incidence of both diseases globally. An association between the increasing prevalence of both obesity and GERD has also been hypothesized. Most studies focusing on the association between obesity and GERD have revealed

that obesity can lead to a significantly increased risk of GERD symptoms.<sup>4,5</sup> Considering the association between the increased prevalence of GERD, both in terms of symptoms and complications such as erosive esophagitis, Barrett's esophagus, esophageal adenocarcinoma, and obesity, further studies on the association between these two conditions are needed.

Epidemiological trends observed from studies of obesity and GERD have led to speculation about possible mechanical changes occurring in the upper gastrointestinal tract that may play a role in the association of these two variables.<sup>6</sup> Individuals with obesity can experience extrinsic gastric compression by surrounding fatty tissue, causing increased intragastric pressure which then causes relaxation of the LES, as well as increased stress and anatomic disruption of the gastroesophageal junction. This anatomic disruption can then lead to a hiatal hernia. Support for this hypothesis is still low in epidemiological studies.<sup>2</sup>

Many studies have examined the relationship between GERD with obesity and abdominal obesity.<sup>2,7</sup> However, until now, the data generated is still very varied. More research is needed to examine the relationship between variables to ascertain the nature of the relationship. This study aimed to determine the relationship between body mass index (BMI) and waist circumference with the incidence of GERD in the adult population of Palembang city.

## **2. Methods**

The research conducted is an analytic observational study with a cross-sectional study design. Data were collected by consecutive sampling totaling 400 data from residents of Palembang city through the distribution of a self-completed questionnaire via Google form, collected from October to November 2020. Male and female subjects aged 20 years and over who were domiciled in Palembang at the time of the study were included, while subjects who were pregnant or had masses in the abdominal or pelvic cavity were excluded. This study has received approval from the ethical committee of the Faculty of

Medicine, Universitas Sriwijaya, with protocol number 035-2020.

The dependent variable in this study was the diagnosis of GERD, which was established through the gastroesophageal reflux disease questionnaire (GERD-Q), which is a simple validated communication tool developed to identify and treat GERD patients, with a positive predictive value of 92% for GERD. The questionnaire included questions for GERD symptoms (diagnosis) and disease impact, including questions about reflux symptoms, sleep disturbances, and use of over-the-counter medications.<sup>8</sup>

The independent variables of the study were body mass index and waist circumference taken by anthropometric measurements by the subject, which the subject then filled into the self-completed questionnaire that was distributed. Subjects will fill in their weight and height on the questionnaire, and the BMI is then calculated by calculating weight (kg) divided by the square of body height (m<sup>2</sup>). Subjects were also directed to measure waist circumference with a tape measure at the approximate midpoint between the lower border of the last palpable rib and the top of the iliac crest, about 1cm above the umbilicus measured horizontally in cm.

The data obtained will be processed and analyzed using the SPSS 26.0 for windows program. The statistical analysis used was binary logistic regression analysis with GERD-Q score as the nominal dependent variable and BMI and waist circumference as independent nominal variables with adjustments for other variables such as gender, age, alcohol history, smoking history, history of consumption of caffeine products, such as coffee and tea, history of NSAID consumption and duration of NSAID consumption was considered to influence statistical analysis.

## **3. Results and Discussion**

Of the 400 subjects, the female gender represents 56.8% of the research subjects. The majority were in the age group of 20-29 years (65.8%). As many as 40% of subjects had abdominal obesity, the majority of subjects had normal weight with a percentage of

61.3%, subjects with excess body weight had a percentage of 10.8% (n = 43) and subjects who were overweight had obesity with a percentage of 19.8% (n=79). The majority of research subjects did not consume alcohol (n=344, 86%). Consumption of caffeine products appears to be relatively evenly distributed, with the highest frequency of consumption 0-1 times/week (n=91, 22.8%). The majority of subjects did not use NSAIDs (76.8%). Subjects who took NSAIDs 1-3 times/week represented 21.3% (n=93) of the total respondents, and of the 93 respondents who took NSAIDs, 68 respondents (17.3% of the total respondents) took NSAIDs with a duration of <5 years.

The results of the research conducted found that the respondents who were diagnosed with GERD from 400 respondents amounted to 81 people (20.3%). These results are close to the prevalence of GERD sufferers in North America (18.1-27.8%), Europe (8.8-25.9%), and South America (23%).<sup>8-10</sup> The same study, as well as several other studies, showed a lower prevalence, such as in East Asia (2.5-7.8%), Australia (11.6%), Singapore (10.5 ± 2.0%), and Israel (12.5%).<sup>5-7</sup> There are also differences in studies in Saudi Arabia, with a prevalence of 28.7%.<sup>8</sup> When the multivariate analysis was performed for each classification of BMI and waist circumference, a statistically significant relationship was found between body mass index and GERD, especially for the reference category (BMI < 25.00) and obesity (BMI > 27.00). There was no statistically significant relationship between being overweight (BMI 25.00-27.00) and GERD. However, this study observed a higher percentage of overweight subjects (PR=1.056) and obese subjects (PR=2.645) who were diagnosed with GERD compared to those with normal weight (BMI<25.00).

Of the eight variables tested (gender, age group, BMI classification, abdominal obesity, frequency of alcohol consumption, frequency of caffeine consumption, frequency of NSAID consumption, and duration of NSAID consumption), there are two variables that have a significant relationship with the incidence of GERD (predictor factor), namely age group

and BMI classification. The age group had a p-value = 0.000 (P<0.05), and the BMI classification had a p-value of 0.00, indicating that each variable had a significant partial effect on the diagnosis of GERD.

When the multivariate analysis was performed, the adjusted p-value showed a statistically significant relationship between BMI and GERD (p = 0.021) and the age group with GERD (p=0.000). Other variables, namely gender, abdominal obesity, frequency of alcohol consumption, frequency of caffeine consumption, frequency of NSAID consumption, and duration of NSAID consumption, did not show a statistically significant relationship with the diagnosis of GERD. The categorical covariates of body mass index and age group variables were then defined.

In the body mass index variable, a statistically significant relationship was between obesity and GERD with an increased risk of 2.799 times (95% CI:1.545-5.609, p=0.001) compared to subjects with normal weight (BMI < 25.00). This study not only observed an increase in the incidence of GERD in the age group of 40-49 years (estimated OR=3.723, 95% CI: 1.804-7.681), 50-59 years (estimated OR=3.782, 95% CI: 1.886-7.587) and 60 years (estimated OR=9.180, 95% CI: 2.435-34.605) compared to the age group 20-29 years, but also increased risk (estimated OR) from the age group 40-49 years to the age group 60 years. The age group of 30-39 years did not show a significant value (p = 0.234). The absence of this statistical relationship suggests that an increase in body mass index may not be an independent risk factor for the diagnosis of GERD and that there are other factors that contribute to an increase in the diagnosis of GERD in obese individuals.<sup>11-13</sup> The same observation was seen in the relationship between abdominal obesity and the diagnosis of GERD.

The results of multivariate analysis using logistic regression resulted in an adjusted p-value that did not show a significant relationship with abdominal obesity as a predictor of GERD incidence with an estimated OR=1.123. These results indicate that abdominal obesity does not significantly increase the risk of GERD incidence compared to those who do not have

abdominal obesity. Similar results were also observed from the relationship between overweight and GERD diagnosis, with an estimated OR = 0.993 (95% CI: 0.414-2.384, p =0.988). These results indicate that being overweight does not have a significant or significant relationship with GERD. Being overweight did not significantly increase the risk of GERD incidence compared to subjects who were not overweight. Interestingly, these results showed that overweight subjects (BMI 25.00-27.00) showed no association with GERD, compared to subjects in the normal weight group, while obese (BMI >27.00) showed significant association with GERD with the diagnosis of GERD (p value=0.001, estimated OR=2.799, 95% CI: 1.545-5.069). The absence of a statistical relationship between overweight and GERD suggests that an increase in body mass index may not be an independent risk factor for the diagnosis of GERD and that other predictors may play a role in the increased diagnosis of GERD in obese subjects.

Until now, there is still a conflicting theory regarding the relationship of obesity, as measured by body mass index and waist circumference, with the pathophysiology of GERD, with various relevant previous studies showing varying results.<sup>14,15</sup> Epidemiological trends observed from a study of obesity and GERD raised the hypothesis about possible mechanical changes occurring in the upper gastrointestinal tract that might play a role in the association of these two variables. Individuals with obesity can experience extrinsic gastric compression by surrounding fatty tissue, causing increased intragastric pressure, which then causes relaxation of the LES, as well as increased stress and anatomic disruption of the gastroesophageal junction. This anatomic disruption can then lead to a hiatal hernia. Support for this hypothesis is still low in epidemiological studies.<sup>5</sup>

The findings of this study add to the growing literature regarding the association between BMI and GERD. Many studies have examined the relationship between GERD with obesity and abdominal obesity.<sup>15-</sup>

<sup>17</sup> However, until now, the data generated is still very

varied. There are research studies that fail to identify an association between GERD and obesity. One study showed no difference in esophageal pH compared with normal-weight subjects.<sup>16</sup> Similarly, another study found no improvement in reflux symptoms after weight reduction.<sup>17</sup>

#### 4. Conclusion

Although obesity has a significant relationship with the incidence of GERD, the absence of an association between being overweight and a diagnosis of GERD implies that an increase in body mass index is not an independent risk factor for a diagnosis of GERD. There are other predictors that play a role in an increase in the diagnosis of GERD in obese subjects.

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