

PREVALENCE AND RISK FACTORS OF GASTROESOPHAGEAL REFLUX DISEASE  
AMONG ADULTS ATTENDING PRIMARY HEALTH CARE CENTERS

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## ABSTRACT

**Background:** Gastroesophageal reflux disease (GERD) is a common gastrointestinal disorder that may substantially affect quality of life. Its occurrence is influenced by demographic, anthropometric, lifestyle, dietary, and clinical factors. Primary health care provides an important setting for identifying probable GERD and associated modifiable risk factors. **Objectives:** To determine the prevalence of probable gastroesophageal reflux disease among adults attending selected primary health care centers in Mosul and to identify demographic, lifestyle, dietary, anthropometric, and clinical factors associated with GERD. **Patients and methods:** A cross-sectional study was conducted among 250 adults aged  $\geq 18$  years attending Al Rabee Primary Health Care Center, Al-Mansour Primary Health Care Center, and Al Shabkhoun Primary Health Care Center in Mosul from September 2024 to May 2026. Ethical approval was obtained first from the Nineveh Directorate of Health. Data were collected using a structured questionnaire, anthropometric measurements, and the Gastroesophageal Reflux Disease Questionnaire (GerdQ). A GerdQ score  $\geq 8$  was considered suggestive of probable GERD. Associations were assessed using appropriate statistical tests and binary logistic regression. **Results:** The estimated prevalence of probable GERD was 33.6% (84/250). Heartburn (85.7%) and acid regurgitation (79.8%) were the most frequent symptoms. Probable GERD was significantly associated with smoking ( $P=0.024$ ), physical inactivity ( $P=0.019$ ), late-night meals ( $P=0.022$ ), frequent spicy foods ( $P=0.016$ ), frequent fatty/fried foods ( $P=0.018$ ), obesity ( $P=0.002$ ), increased waist circumference ( $P=0.009$ ), and previous gastrointestinal disorders ( $P=0.006$ ). In multivariable analysis, obesity (aOR=2.31, 95% CI 1.29–4.14), physical inactivity (aOR=1.88, 95% CI 1.07–3.31), smoking (aOR=1.94, 95% CI 1.02–3.70), late-night meals (aOR=1.91, 95% CI 1.07–3.42), frequent fatty/fried foods (aOR=1.83, 95% CI 1.04–3.22), and previous gastrointestinal disorder (aOR=2.47, 95% CI 1.25–4.89) remained independently associated with probable GERD. **Conclusions:** The estimated prevalence of probable GERD among adults attending the selected primary health care centers was 33.6%. Obesity, physical inactivity, smoking, late-night meals, frequent fatty/fried-food consumption, and previous gastrointestinal disorders were independently associated with probable GERD. These findings support the role of primary care in symptom-based identification and lifestyle risk assessment.

**KEYWORDS:** Gastroesophageal reflux disease; GerdQ; prevalence; risk factors; primary health care; obesity; lifestyle.

## 1-INTRODUCTION

Gastroesophageal reflux disease is a common chronic gastrointestinal disorder characterized by the reflux of gastric contents into the esophagus, resulting in troublesome symptoms and/or complications. It is frequently encountered in primary health care and may

present with typical symptoms such as heartburn and regurgitation, as well as chest discomfort, epigastric symptoms, sleep disturbance, and other manifestations. The pathophysiology of GERD is multifactorial and involves dysfunction of the gastroesophageal junction, transient relaxation of the lower esophageal sphincter,

impaired esophageal clearance, alterations in gastric contents, and individual susceptibility to reflux-related symptoms.<sup>[1]</sup>

GERD represents an important and increasing global health problem. Recent analyses of the Global Burden of Disease 2021 study estimated that the number of people living with GERD increased from approximately 450.8 million in 1990 to 825.6 million in 2021. During the same period, incident cases increased from approximately 180.0 million to 324.1 million, demonstrating a substantial increase in the overall burden of the disease. The global age-standardized prevalence rate in 2021 was approximately 9838.6 per 100,000 population, and projections suggest that the number of affected individuals will continue to increase in coming decades.<sup>[2]</sup>

The prevalence of GERD varies considerably between populations and geographical regions, partly because of differences in diagnostic definitions, symptom frequency thresholds, study populations, and assessment methods. A large systematic review and meta-analysis demonstrated substantial international variation in the prevalence of gastroesophageal reflux symptoms, with obesity, increasing age, smoking, and the use of non-steroidal anti-inflammatory drugs or aspirin among the factors associated with higher prevalence.<sup>(3)</sup> These variations indicate that GERD is influenced not only by biological mechanisms but also by demographic characteristics, lifestyle, dietary patterns, and environmental factors.

Recent population-based evidence has further demonstrated the importance of potentially modifiable risk factors. A 2024 population-based study found that GERD was associated with several demographic, behavioral, nutritional, physical activity, and anthropometric characteristics. Obesity and abdominal adiposity are particularly relevant because increased intra-abdominal pressure may promote gastroesophageal reflux and increase exposure of the esophageal mucosa to gastric contents.<sup>[4]</sup> The increasing prevalence of overweight and obesity worldwide may therefore contribute to the growing burden of GERD.

Lifestyle and dietary behaviors have also been investigated as possible contributors to GERD. Smoking, physical inactivity, irregular eating patterns, large meals, late meals, and consumption of particular foods and beverages may be associated with reflux symptoms in susceptible individuals. However, the relationship between individual dietary items and GERD is not uniform, and the effects may differ between populations and individuals. Consequently, assessment of dietary habits and lifestyle characteristics remains important when investigating GERD in community and primary health care populations.<sup>[3-4]</sup>

Gastroesophageal reflux disease can adversely affect health-related quality of life, sleep, work productivity, and daily activities. Persistent reflux may also result in complications including erosive esophagitis, peptic esophageal stricture, and Barrett's esophagus. Barrett's esophagus is clinically important because it represents a recognized precursor lesion for esophageal adenocarcinoma.<sup>[5]</sup> Therefore, identification and appropriate management of patients with persistent or clinically significant reflux symptoms are important components of primary and secondary prevention.

The diagnosis of GERD is commonly based on a combination of characteristic symptoms, clinical assessment, and, when indicated, objective investigations. Current clinical guidance recommends that patients presenting with typical heartburn and regurgitation without alarm features may initially be managed using an appropriate clinical approach, whereas patients with alarm symptoms or inadequate response to initial treatment may require further investigation. Upper gastrointestinal endoscopy and ambulatory reflux monitoring are important diagnostic tools in selected patients, but they are not required for every individual presenting with uncomplicated typical symptoms.<sup>[6]</sup>

Symptom-based questionnaires may provide a practical approach for identifying individuals with probable GERD in primary health care and epidemiological studies. The Gastroesophageal Reflux Disease Questionnaire (GerdQ) is a validated six-item questionnaire developed to assist in the assessment of GERD-related symptoms. A systematic review and meta-analysis published in 2023 found that GerdQ has moderate diagnostic accuracy and may be useful as a simple and accessible tool for assessing patients with suspected GERD, although it should not be considered a replacement for objective testing when definitive diagnosis is required.<sup>[7]</sup>

The role of primary health care in the identification of GERD is particularly important because many patients initially seek medical attention for gastrointestinal symptoms through family physicians and primary care clinicians. A recent study conducted among adults attending primary health care services in Bahrain specifically demonstrated the feasibility of assessing the prevalence and risk factors of GERD in a primary care population, highlighting the relevance of demographic characteristics, lifestyle behaviors, and clinical factors in this setting.<sup>[8]</sup>

In Iraq, information regarding the prevalence of GERD and its associated risk factors among adults attending primary health care centers remains limited, particularly in Mosul. Local assessment of the disease is important because dietary habits, obesity, smoking, physical activity, healthcare-seeking behavior, and other lifestyle characteristics may differ between populations. Establishing the magnitude of GERD and identifying its

associated factors could assist family physicians in improving early recognition, lifestyle counseling, appropriate management, and referral of patients requiring further evaluation. Therefore, the present study was conducted to determine the prevalence and risk factors of gastroesophageal reflux disease among adults attending primary health care centers in Mosul, with particular emphasis on demographic characteristics, anthropometric measurements, lifestyle behaviors, dietary factors, and relevant medical conditions.

## 2-PATIENTS AND METHODS

Ethical approval for the study was obtained first from the Nineveh Directorate of Health, and the study was subsequently conducted in accordance with the approved research protocol. Written informed consent was obtained from all participants before enrollment, after explaining the purpose and procedures of the study. This cross-sectional study was conducted among 250 adults attending three primary health care centers in Mosul, Nineveh Governorate, Iraq: Al Rabee Primary Health Care Center, Al-Mansour Primary Health Care Center, and Al Shabkhoun Primary Health Care Center, during the period from September 2024 to May 2026. Adults aged 18 years and above who attended the selected centers during the study period and agreed to participate were included. Participants who were unable to provide reliable information or who had incomplete essential data were excluded from the analysis.

Data were collected using a structured questionnaire designed to obtain information regarding demographic characteristics, lifestyle habits, dietary practices, anthropometric measurements, medical history, medication use, and symptoms suggestive of gastroesophageal reflux disease. Demographic information included age, sex, residence, marital status, educational level, and occupation. Lifestyle characteristics included smoking status, physical activity, sleep habits, and perceived psychological stress. Dietary information included the frequency of consumption of spicy and fatty foods, coffee, tea, carbonated beverages, chocolate, citrus foods, large meals, and meals consumed close to bedtime. Relevant medical history included diabetes mellitus, hypertension, dyslipidemia, previous gastrointestinal disorders, and other chronic diseases. Information regarding the use of medications, particularly acid-suppressive therapy and other medications potentially associated with gastrointestinal symptoms, was also recorded.

Assessment of gastroesophageal reflux disease was performed using the GerdQ. The questionnaire consists of six symptom- and behavior-related items assessing the frequency of heartburn, regurgitation, epigastric pain, nausea, sleep disturbance related to reflux symptoms, and use of additional medication for relief of symptoms. Each item was scored according to the established GerdQ scoring system, and the total score was calculated for each participant. A GerdQ score of  $\geq 8$  was considered suggestive of gastroesophageal reflux disease for the purpose of screening and epidemiological assessment.

Anthropometric assessment included measurement of body weight and height using standardized equipment, with participants wearing light clothing and without shoes. Body mass index was calculated by dividing body weight in kilograms by the square of height in meters ( $\text{kg}/\text{m}^2$ ). Participants were categorized according to standard body mass index categories. Waist circumference was measured using a non-stretchable measuring tape at the appropriate anatomical level with the participant standing upright and breathing normally.

All collected data were checked for completeness and consistency before statistical analysis. Continuous variables were expressed as mean  $\pm$  standard deviation, while categorical variables were presented as frequencies and percentages. The prevalence of probable gastroesophageal reflux disease was calculated among the study participants. Associations between GERD and categorical variables were assessed using the Chi-square test or Fisher's exact test, as appropriate. For continuous variables, an independent-samples t-test or an appropriate non-parametric test was used according to data distribution. Binary logistic regression analysis was performed to identify independent factors associated with GERD, with results presented as adjusted odds ratios with 95% confidence intervals. A P value  $< 0.05$  was considered statistically significant. Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS).

## 3-RESULTS

The 250 participants had a mean age of  $43.8 \pm 13.5$  years, with ages ranging from 18 to 76 years. The mean body mass index was  $28.4 \pm 5.2 \text{ kg}/\text{m}^2$ , indicating that overweight was common in the study population. The mean waist circumference was  $94.1 \pm 12.8 \text{ cm}$ , suggesting a considerable prevalence of central adiposity among adults attending the selected primary health care centers. As shown in table 1.

**Table 1: Age, anthropometric measurements, and selected characteristics of the study participants (n=250).**

| Variable                                   | Mean $\pm$ SD   | Range     |
|--------------------------------------------|-----------------|-----------|
| Age (years)                                | $43.8 \pm 13.5$ | 18–76     |
| Body mass index ( $\text{kg}/\text{m}^2$ ) | $28.4 \pm 5.2$  | 18.0–43.9 |
| Waist circumference (cm)                   | $94.1 \pm 12.8$ | 62–131    |

The largest proportion of participants belonged to the 40–49-year age group, accounting for 25.2% of the sample, followed by those aged 30–39 years (22.0%) and 50–59 years (21.2%). Participants aged 60 years or older

represented 14.4% of the sample. Females constituted 56.8% of participants compared with 43.2% males. As shown in table 2.

**Table 3: Distribution of study participants according to age group and sex (n=250).**

| Characteristic  | Frequency | Percentage (%) |
|-----------------|-----------|----------------|
| Age 18–29 years | 43        | 17.2           |
| Age 30–39 years | 55        | 22.0           |
| Age 40–49 years | 63        | 25.2           |
| Age 50–59 years | 53        | 21.2           |
| Age ≥60 years   | 36        | 14.4           |
| Male            | 108       | 43.2           |
| Female          | 142       | 56.8           |

Physical inactivity was reported by 54.8% of participants. Almost half reported frequent consumption of fatty or fried foods (46.4%), while 40.4% reported frequent spicy-food consumption. Tea was the most frequently consumed beverage (67.6%), followed by

coffee (51.2%). Late-night meals were reported by 37.6% of participants, providing an important lifestyle characteristic for subsequent assessment of its relationship with GERD symptoms. As shown in table 3.

**Table 3: Distribution of participants according to selected lifestyle and dietary factors (n=250).**

| Factor                                | Frequency | Percentage (%) |
|---------------------------------------|-----------|----------------|
| Smoking                               | 59        | 23.6           |
| Physical inactivity                   | 137       | 54.8           |
| Frequent spicy-food consumption       | 101       | 40.4           |
| Frequent fatty/fried-food consumption | 116       | 46.4           |
| Coffee consumption                    | 128       | 51.2           |
| Tea consumption                       | 169       | 67.6           |
| Carbonated beverages                  | 72        | 28.8           |
| Late-night meals                      | 94        | 37.6           |

More than two-thirds of participants were either overweight or obese. Overweight participants represented 36.8% of the sample, while obesity was present in 34.4%. Only 26.0% had a normal body mass

index, whereas 2.8% were underweight. These findings indicate a substantial burden of excess body weight within the primary care population. As shown in table 4.

**Table 4: Distribution of study participants according to body mass index category (n=250).**

| BMI category                | Frequency | Percentage (%) |
|-----------------------------|-----------|----------------|
| <18.5 kg/m <sup>2</sup>     | 7         | 2.8            |
| 18.5–24.9 kg/m <sup>2</sup> | 65        | 26.0           |
| 25.0–29.9 kg/m <sup>2</sup> | 92        | 36.8           |
| ≥30.0 kg/m <sup>2</sup>     | 86        | 34.4           |

The estimated GerdQ results showed that 84 participants (33.6%) had a score of ≥8 and were therefore classified as having probable gastroesophageal reflux disease. The remaining 166 participants (66.4%) had scores below 8.

Thus, the estimated prevalence of probable GERD in this primary health care population was 33.6%. As shown in table 5.

**Table 5: Distribution of participants according to Gastroesophageal Reflux Disease Questionnaire (GerdQ) score and probable GERD (n=250).**

| GerdQ category | Frequency | Percentage (%) |
|----------------|-----------|----------------|
| GerdQ <8       | 166       | 66.4           |
| GerdQ ≥8       | 84        | 33.6           |
| Total          | 250       | 100.0          |

Among the 84 participants classified as having probable GERD, heartburn was the most frequently reported symptom (85.7%), followed by acid regurgitation

(79.8%) and epigastric discomfort (65.5%). Sleep disturbance related to reflux symptoms was reported by 45.2%, while nausea and the use of additional

medication for symptom relief were less frequent. As shown in table 6.

**Table 6: Distribution of GERD symptoms among participants with probable GERD (n=84).**

| Symptom                                         | Frequency | Percentage (%) |
|-------------------------------------------------|-----------|----------------|
| Heartburn                                       | 72        | 85.7           |
| Acid regurgitation                              | 67        | 79.8           |
| Epigastric discomfort                           | 55        | 65.5           |
| Sleep disturbance due to symptoms               | 38        | 45.2           |
| Nausea                                          | 31        | 36.9           |
| Use of additional medication for symptom relief | 29        | 34.5           |

Probable GERD was significantly associated with smoking, physical inactivity, late-night meals, frequent spicy-food consumption, and frequent fatty or fried-food consumption. In contrast, age  $\geq 50$  years and female sex were not significantly associated with GERD in this

estimated analysis. These findings suggest that several potentially modifiable lifestyle and dietary factors may contribute to reflux symptoms in the studied population. As shown in table 7.

**Table 7: Association between selected demographic and lifestyle factors and probable GERD (n=250).**

| Factor                     | GERD n (%) | No GERD n (%) | P value      |
|----------------------------|------------|---------------|--------------|
| Age $\geq 50$ years        | 35 (41.2)  | 54 (32.5)     | 0.184        |
| Female sex                 | 52 (61.9)  | 90 (54.2)     | 0.268        |
| Smoking                    | 27 (32.1)  | 32 (19.3)     | <b>0.024</b> |
| Physical inactivity        | 55 (65.5)  | 82 (49.4)     | <b>0.019</b> |
| Late-night meals           | 40 (47.6)  | 54 (32.5)     | <b>0.022</b> |
| Frequent spicy foods       | 43 (51.2)  | 58 (34.9)     | <b>0.016</b> |
| Frequent fatty/fried foods | 48 (57.1)  | 68 (41.0)     | <b>0.018</b> |

Obesity was significantly more common among participants with probable GERD than among those without GERD, with 47.6% versus 27.7%, respectively. Increased waist circumference was also significantly

associated with probable GERD. These findings support an association between excess adiposity, particularly central obesity, and reflux symptoms. As shown in table 8.

**Table 8: Association between body mass index, waist circumference, and probable GERD (n=250).**

| Variable                        | GERD n (%) | No GERD n (%) | P value |
|---------------------------------|------------|---------------|---------|
| BMI $\geq 30$ kg/m <sup>2</sup> | 40 (47.6)  | 46 (27.7)     | 0.002   |
| BMI $< 30$ kg/m <sup>2</sup>    | 44 (52.4)  | 120 (72.3)    |         |
| Increased waist circumference   | 51 (60.7)  | 70 (42.2)     | 0.009   |
| Normal waist circumference      | 33 (39.3)  | 96 (57.8)     |         |

Participants with probable GERD had significantly higher mean body mass index and waist circumference than participants without GERD. The mean body mass index was  $30.1 \pm 5.1$  kg/m<sup>2</sup> in the GERD group compared with  $27.5 \pm 5.0$  kg/m<sup>2</sup> in the non-GERD group,

while the corresponding mean waist circumferences were  $99.0 \pm 12.4$  cm and  $91.6 \pm 12.3$  cm, respectively. Both differences were statistically significant. As shown in table 9.

**Table 9: Comparison of mean anthropometric measurements between participants with and without probable GERD (n=250).**

| Variable                 | GERD (Mean $\pm$ SD) | No GERD (Mean $\pm$ SD) | P value          |
|--------------------------|----------------------|-------------------------|------------------|
| BMI (kg/m <sup>2</sup> ) | $30.1 \pm 5.1$       | $27.5 \pm 5.0$          | <b>&lt;0.001</b> |
| Waist circumference (cm) | $99.0 \pm 12.4$      | $91.6 \pm 12.3$         | <b>&lt;0.001</b> |

Previous gastrointestinal disorders were significantly more frequent among participants with probable GERD than among those without GERD (25.0% versus 10.8%,  $P=0.006$ ). Diabetes mellitus, hypertension, and dyslipidemia showed higher frequencies among participants with GERD, but the estimated differences

did not reach statistical significance. As shown in table 10.

**Table 10: Association between selected medical conditions and probable GERD (n=250).**

| Medical condition                  | GERD n (%) | No GERD n (%) | P value      |
|------------------------------------|------------|---------------|--------------|
| Diabetes mellitus                  | 17 (20.2)  | 20 (12.0)     | 0.091        |
| Hypertension                       | 24 (28.6)  | 30 (18.1)     | 0.059        |
| Dyslipidemia                       | 20 (23.8)  | 25 (15.1)     | 0.093        |
| Previous gastrointestinal disorder | 21 (25.0)  | 18 (10.8)     | <b>0.006</b> |

Multivariable logistic regression identified obesity, physical inactivity, smoking, late-night meals, frequent fatty or fried-food consumption, and previous gastrointestinal disorders as independent predictors of probable GERD. Obesity showed the strongest estimated

association, with participants having a body mass index  $\geq 30$  kg/m<sup>2</sup> having approximately 2.3-fold higher odds of probable GERD. Age  $\geq 50$  years was not an independent predictor after adjustment for the other variables. As shown in table 11.

**Table 11. Independent predictors of probable GERD by binary logistic regression analysis (n=250).**

| Variable                                   | Adjusted OR | 95% CI    | P value      |
|--------------------------------------------|-------------|-----------|--------------|
| Obesity (BMI $\geq 30$ kg/m <sup>2</sup> ) | 2.31        | 1.29–4.14 | <b>0.005</b> |
| Physical inactivity                        | 1.88        | 1.07–3.31 | <b>0.029</b> |
| Smoking                                    | 1.94        | 1.02–3.70 | <b>0.043</b> |
| Late-night meals                           | 1.91        | 1.07–3.42 | <b>0.029</b> |
| Frequent fatty/fried foods                 | 1.83        | 1.04–3.22 | <b>0.036</b> |
| Previous gastrointestinal disorder         | 2.47        | 1.25–4.89 | <b>0.009</b> |
| Age $\geq 50$ years                        | 1.34        | 0.76–2.36 | 0.310        |

#### 4- DISCUSSION

The present study estimated that 84 of 250 adults had a GerdQ score  $\geq 8$ , giving a prevalence of probable GERD of 33.6%. This represents a substantial symptom burden in the primary health care population. The estimate is very close to the pooled prevalence of 33% reported by a 2025 meta-analysis of 22 cross-sectional studies from Saudi Arabia involving 18,487 participants. That analysis also identified smoking, fast-food consumption, spicy foods, non-steroidal anti-inflammatory drug use, and tea or coffee consumption among commonly reported risk factors.<sup>[9]</sup> The similarity may reflect regional similarities in dietary patterns and lifestyle, although differences in sampling and diagnostic definitions should be considered.

The present prevalence was lower than the 41.5% reported among 385 adults attending primary health care centers in Bahrain. The Bahrain study used the same GerdQ threshold of  $\geq 8$  and therefore provides a particularly relevant primary-care comparison.<sup>[10]</sup> Differences may reflect variation in population characteristics, obesity prevalence, dietary practices, health-seeking behavior, and inclusion of previously diagnosed GERD. Conversely, an endoscopy-based prospective study from Al Khobar, Saudi Arabia, found endoscopically defined GERD in 20.1% of 303 symptomatic patients, while non-erosive reflux disease was identified in 28.1%.<sup>[11]</sup> The lower endoscopic prevalence compared with the present GerdQ-based estimate is expected because questionnaire-defined probable GERD and objectively confirmed GERD are not equivalent outcomes.

Heartburn was the most frequent symptom among participants classified as having probable GERD (85.7%), followed by acid regurgitation (79.8%) and

epigastric discomfort (65.5%). This pattern is consistent with the central role of heartburn and regurgitation in clinical recognition of GERD. A 2023 systematic review and meta-analysis of 13 studies involving 11,166 participants reported pooled sensitivity of 66.9% and specificity of 65.2% for a GerdQ cutoff of  $\geq 8$ .<sup>[12]</sup> Therefore, the 33.6% estimate should be interpreted as probable or questionnaire-defined GERD rather than objectively confirmed disease.

Obesity was significantly associated with probable GERD in the present study. Nearly half of the GERD group were obese (47.6%) compared with 27.7% of participants without GERD, and obesity remained independently associated after adjustment (aOR=2.31, 95% CI 1.29–4.14). Mean BMI and waist circumference were also significantly higher in the GERD group. These findings are consistent with the 2024 population-based study from Iran involving 9,631 adults, in which visceral adiposity measures and waist-related indices were associated with higher odds of GERD.<sup>[13]</sup> Increased abdominal adiposity may increase intra-abdominal pressure and promote reflux.

Physical inactivity was significantly associated with probable GERD and remained an independent predictor (aOR=1.88, 95% CI 1.07–3.31). A 2024 systematic review and meta-analysis including 33 studies and 242,850 participants found an inverse association between physical activity and GERD, with a pooled relative risk of 0.80 for GERD among physically active individuals.<sup>[14]</sup> More recent prospective evidence from the UK Biobank also found that high physical activity was independently associated with lower incident GERD risk.<sup>[15]</sup> Although the cross-sectional design cannot establish causality, the consistency with longitudinal and

meta-analytic evidence supports physical activity as an important lifestyle factor.

Smoking was significantly associated with probable GERD and remained independently associated after adjustment (aOR=1.94, 95% CI 1.02–3.70). This agrees with the 2024 Iranian population-based study, in which current smokers had approximately 23% higher odds of GERD than non-smokers after adjustment for age and sex.<sup>[13]</sup> A large prospective cohort published in 2025 also found that never smoking was independently associated with lower incident GERD risk (HR=0.84, 95% CI 0.81–0.88).<sup>[15]</sup> These findings support smoking cessation as a relevant preventive intervention in primary care.

Late-night meals, frequent spicy-food consumption, and frequent fatty or fried foods were significantly associated with probable GERD. Late-night meals remained independently associated (aOR=1.91, 95% CI 1.07–3.42), while frequent fatty/fried-food consumption also remained significant (aOR=1.83, 95% CI 1.04–3.22). The 2025 Saudi meta-analysis identified fast-food consumption and spicy foods among commonly reported GERD-associated factors, while the Bahrain primary-care study found that sleeping within one hour after dinner was significantly associated with GERD.<sup>[9,10]</sup> These findings support counseling about meal timing, meal size, and individual dietary triggers.

Previous gastrointestinal disorders were significantly more frequent among participants with probable GERD and remained independently associated (aOR=2.47, 95% CI 1.25–4.89). Diabetes, hypertension, and dyslipidemia were more frequent in the GERD group but did not reach statistical significance in this estimated analysis. The Bahrain study reported a significant association between GERD and hypertension, whereas the Saudi endoscopy-based study found that other comorbidities were independently associated with GERD.<sup>[10-11]</sup> Differences may reflect participant selection, disease definitions, sample size, and diagnostic methods.

The use of GerdQ was appropriate for a primary health care screening study because it is brief, standardized, and feasible without endoscopy. However, the findings should be interpreted within the limitations of symptom-based diagnosis. The 2024 Lyon Consensus 2.0 emphasizes that conclusive GERD diagnosis may require objective evidence from endoscopy and/or ambulatory reflux monitoring, particularly when symptoms are atypical, persistent despite treatment, or when long-term or invasive management is being considered.<sup>[16]</sup> Participants with alarm symptoms or persistent/refractory symptoms should therefore be assessed clinically and referred for appropriate diagnostic evaluation.

The findings indicate that GERD assessment in primary care should include symptom assessment together with evaluation of body mass index, central adiposity, smoking, physical activity, meal timing, and dietary

habits. Lifestyle counseling can be integrated into routine family medicine care. The 2025 prospective cohort evidence suggests that a combination of healthy lifestyle behaviors is associated with progressively lower incident GERD risk, supporting a broader preventive approach.<sup>[15]</sup>

The study has several limitations. First, its cross-sectional design prevents establishing temporal or causal relationships. Second, the sample was limited to adults attending three primary health care centers in Mosul, which may limit generalizability to the wider Iraqi population. Third, dietary, lifestyle, and symptom information was largely self-reported and may be affected by recall or reporting bias. Fourth, GERD was assessed using GerdQ rather than endoscopy or ambulatory reflux monitoring; therefore, the reported 33.6% represents probable questionnaire-defined GERD and should not be interpreted as objectively confirmed disease. Finally, the results are estimated/hypothetical and must be replaced with the actual statistical output from the 250 participants before scientific submission or publication.

## 5- CONCLUSION AND RECOMMENDATION

The estimated prevalence of probable GERD among adults attending the selected primary health care centers in Mosul was 33.6%. Probable GERD was associated with obesity, increased central adiposity, physical inactivity, smoking, late-night meals, and frequent consumption of fatty or fried foods. Obesity, physical inactivity, smoking, late-night meals, frequent fatty/fried-food consumption, and previous gastrointestinal disorders remained independently associated with probable GERD after multivariable adjustment. These findings indicate that GERD represents a relevant primary-care health problem and that assessment of reflux symptoms should be accompanied by evaluation of modifiable lifestyle and anthropometric factors. Primary health care physicians should consider systematic symptom-based assessment of adults with suspected GERD using a validated tool such as GerdQ, together with assessment and counseling regarding obesity, central adiposity, smoking, physical inactivity, meal timing, and dietary habits. Patients with alarm symptoms, atypical presentations, persistent symptoms despite appropriate management, or suspected complications should be referred for further diagnostic evaluation according to contemporary GERD diagnostic pathways. Further multicenter studies involving larger and more representative Iraqi populations are recommended, preferably using longitudinal designs and, where feasible, objective diagnostic methods such as upper gastrointestinal endoscopy and ambulatory reflux monitoring to validate symptom-based estimates.

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