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Original Article

Effects of gastroesophageal reflux episodes on sleep quality in a Saudi population

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Abstract: Background: Gastroesophageal reflux disease (GERD) is a chronic medical condition caused by retrograde flow of gastric contents into the esophagus, resulting in both symptoms and complications. Several studies have revealed a direct relationship between GERD and sleep disturbance. Among patients with frequent heartburn, the majority reported difficulty in initiating or maintaining sleep throughout the night. Nocturnal GERD has been proven to affect sleep quality, causing sleep fragmentation, which may be reflected in patients' daytime activity and cognitive function. Objectives: This study aimed to determine the effects of GERD on sleep quality in a Saudi population. Methods: Using an observational cross-sectional analysis, this study investigated 1543 respondents from the general population of Saudi Arabia. We used self-administered questionnaires consisting of four main domains: consent, sociodemographic data, GERD symptoms, and sleep quality. SPSS (version 23.0) was used to perform descriptive and association analyses (chi-square test, McNamar's test). These statistical methods were used to reasonably interpret the observed findings. Results: This cross-sectional study revealed that 38.4% of the study population had GERD; however, only 11.3% had a confirmed diagnosis. However, 61.6% of the patients did not have any symptoms suggestive of acid reflux. Patients with GERD symptoms had a significantly higher percentage of episodes of waking up from sleep because of a burning sensation and a shorter mean sleep time (< 6 h, $P < 0.05$) than non-GERD patients. Moreover, compared to non-GERD participants, patients with GERD had a significantly higher number of nights with difficulty sleeping due to severe pain, shorter duration of bedtime, and more waking up during sleep ($P \leq 0.05$). Furthermore, patients with GERD also had a significantly lower rating of sleep in terms of depth, restfulness, or quality the previous night than non-GERD patients ($P \leq 0.05$). Conclusion: Although GERD is a common disorder, it is often underdiagnosed. GERD has a significant negative effect on sleep quality.

Keywords: Gastroesophageal reflux, sleep quality, acid reflux

Introduction

The chronic medical illness known as gastroesophageal reflux disease (GERD) is brought on by the retrograde passage of stomach contents into the esophagus [1]. GERD may cause esophageal signs and symptoms such as heartburn, regurgitation, water brash, chest pain or discomfort, dysphagia, burps, epigastric pain, nausea, and bloating. Extraesophageal signs and symptoms include coughing, hoarseness, throat clearing, discomfort or burning of the throat, wheezing, and trouble sleeping [2]. These symptoms are frequent during the day and may cause a person to awaken at night [3].

GERD is typically diagnosed after an empirical trial with an acid-suppressing drug and the consequent relief of the classic symptoms, heartburn and acid regurgitation. Taking into consideration that modifying some lifestyle habits and/or avoiding risk factors alone may alleviate or terminate these symptoms [1, 2]. An increased risk of GERD has been associated with a high body mass index (BMI), insufficient physical activity (PA), dietary practices, alcohol and smoking, frequent use of non-steroidal anti-inflammatory drugs (NSAIDs) such as aspirin, and sleeping positions. Additionally, among the dietary causes are the increased consumption of fatty meals and several types of beverages,

such as tea, coffee, and fizzy drinks [4, 5]. Debilitating, long-lasting conditions hinder socialization, disrupt sleep, and interfere with productivity and physical exercise. Barrett's esophagus, esophageal stricture, and esophageal cancer are possible medical complications [2].

It has been hypothesized that eating practices, including portion size, food acidity, and mealtime, may also cause GERD, particularly when it comes to sleep [6]. Numerous studies have been conducted to determine the incidence of GERD in different countries. According to estimates, the prevalence of GERD is 32.8%, 20%, and 15.6% in Nigeria, Japan, and India, respectively [7-9]. Additionally, 28.7% of the Saudi Arabian population has been diagnosed with GERD [10]. Moreover, Proton pump inhibitors (PPIs) have been shown to effectively improve GERD symptoms, nocturnal GERD-related sleep disruptions, and next-day activity in clinical trials. Patients may be recommended to have surgery if medication does not provide sufficient symptomatic relief. Although proton pump inhibitors (PPIs) are useful treatments for GERD, a first-line therapy for nocturnal GERD has not yet been identified and requires further research and medical trials [25].

Several studies have reported a direct link between GERD and sleep disturbance. Most patients with regular heartburn reported having difficulty falling asleep or staying asleep overnight. Nocturnal GERD has been shown to affect sleep quality, resulting in fragmented sleep that may affect daytime activity and cognitive function [4]. Additionally, according to statistics from the US National Health and Wellness Survey, 19% of respondents who reported having heartburn at least twice a month had trouble sleeping [4]. Moreover, sleep disorders, including obstructive sleep apnea (OSA) syndrome may make GERD worse [11].

This study aimed to determine the effects of GERD on sleep quality in a Saudi population, which has not been previously studied.

Participants and methods

Study design

This observational cross-sectional study was conducted in Saudi Arabia from September to November 2022.

Study population

The inclusion criteria were all Saudi people or residents of Saudi Arabia for more than 6 months, aged 18 years and above. The main exclusion criteria were participants younger than 18 years of age, non-Saudis or non-residents of Saudi Arabia, pregnant women, patients with stomach or esophageal cancer, and patients with terminal illness.

Sample size and sampling technique

Using a confidence level (CI) of 95% and a margin of error of 5%, the minimum sample size calculated using the Raosoft online sample size calculator was 1000 participants. A non-probability sampling technique was used.

Data collection

A data collection sheet was formulated using a validated self-administered questionnaire regarding GERD symptoms [2], as well as Sleep Quality and Sleep Habits Questionnaires [3], to establish a correlation between GERD symptoms and quality of sleep in the population of Saudi Arabia. An online questionnaire was distributed in Arabic and English via social media platforms.

The questionnaire included four sections. The first section contained the consent form. The second section contained demographic data (sex, age group, marital status, educational level, region, BMI, and comorbidities such as asthma, OSA, heart failure, and hypothyroidism). The third section was obtained from a self-administered questionnaire that contained common symptoms related to GERD, medications used to relieve GERD symptoms, preferred food, predisposing factors, complications, and medical care needs [2]. The fourth section was obtained from the Sleep Quality and Sleep Habits Questionnaires [3].

Instruments

GERD-related questions: This is a pre-designed questionnaire that included GERD-related questions, such as whether the participants had been diagnosed with GERD or were only experiencing symptoms, and the severity of the symptoms. Moreover, whether they are exposed to risk factors such as overeating (habit),

Table 1. Distribution of studied participants according to their demographics, BMI, chronic diseases, and having GERD (Population Size [N]: 1543)

Variable	N (%)
Gender	
Male	896 (58.1)
Female	647 (41.9)
Age	
Young (18-30)	984 (63.8)
Middle Age (31-65)	539 (34.9)
Elderly (≥ 66)	20 (1.3)
Chronic diseases	
No	1130 (73.2)
Yes	413 (26.8)
If yes, specify: (No. of participants: 413)	
Hypothyroidism	114 (27.6)
HTN	154 (37.2)
DM	143 (34.6)
OSA	26 (6.2)
Asthma	104 (25.1)
CVS	19 (4.6)
Having GERD	
Having GERD symptoms but not officially diagnosed	418 (27.1)
No	951 (61.6)
Yes	174 (11.3)
BMI mean ± SD	26.04 ± 6.8

BMI, body mass index; GERD, Gastroesophageal reflux disease; HTN, Hypertension; DM, diabetes mellitus; OSA, Obstructive sleep apnea; CVS, cardiovascular diseases; SD, standard deviation.

stress and anxiety, stomach ulcers, stomach quantification, delayed stomach emptying, dietary factors, use of analgesics before sleep, physical inactivity, and having a meal near bedtime. Furthermore, if they are awakened from sleep by GERD symptoms, if they are experiencing GERD complications, if they have a family history of GERD, and finally, management of GERD among cases [2].

Sleep quality questionnaire: This was a self-administered questionnaire. Nine questions were formulated to assess individuals' perceptions of their sleep quality and behaviors related to sleep quality. These questions focused on the previous night's sleep and included questions such as "How many times did you wake up during the night?" and "Was your sleep restless or restful?" (Rated from 1 = most restless to 5 = most restful). The subjective measure of overall sleep quality was calculated based on a 5-point Likert scale. Other variables considered were the number of hours spent in bed, number of hours asleep, number of awakenings, and time taken to fall asleep [3].

Ethical considerations

Ethical approval was obtained from the Institutional Review Board (IRB) Jeddah (approval number: A01400). All participants provided consent, and data confidentiality was assured.

Statistical analysis

Data were analyzed using SPSS version 26. To test the relationship between variables, qualitative data were expressed as numbers and percentages, and the chi-square test (χ^2) was used. Quantitative data was expressed as mean and standard deviation (Mean ± SD) and compared using t-test. Non-parametric variables were tested using the Mann-Whitney test. Statistical significance was set at $P < 0.05$.

Results

Demographic distribution

The study included 1543 participants. Of them, 58.1% were males and 63.8% had an age ranging-18-30 years. The mean BMI of the participants was 26.04 ± 6.8 kg/m^2. Of the participants, 11.3% had a confirmed diagnosis of GERD, 27.1% were experiencing symptoms but were not officially diagnosed, and 61.6% were free of GERD symptoms. Approximately 27% of the study population had chronic diseases, of which hypertension (HTN) was the most common (37.2%) (**Table 1**).

Distribution according to complications

Of the 174 patients with GERD, the most common complication was hiatal hernia (14.9%), and only 82.1% reported an improvement in GERD symptoms after treatment (**Table 2**).

Table 2. Distribution of patients with GERD according to complications and treatment outcome (Number of participants [No.]: 174)

Types of complications	No. (%)
Narrowing of the esophagus	23 (13.2)
Possible carcinogenic changes (Barrett's esophagus)	7 (4)
Open sore (ulcer)	20 (11.5)
Hiatus hernia	26 (14.9)
Improvement after treatment	143 (82.1)

GERD, Gastroesophageal reflux disease.

Difference between patients with GERD and non-GERD based on history

Table 3 shows that patients with GERD had a significantly higher percentage of family history of GERD with analgesics, especially before going to sleep ($P \leq 0.05$). Furthermore, patients with GERD had a significantly higher percentage of stress and anxiety, pregnancy (in females), or having a meal one hour before sleep ($P \leq 0.05$).

Difference between patients with GERD and non-GERD based on sleep quality

Table 4 shows that patients with GERD had more frequent awakening due to the burning sensation, shorter sleep time, and more difficult sleep due to severe pain (< 6 h) than non-GERD patients over the previous week ($P \leq 0.001$, < 0.001, < 0.033, respectively). Furthermore, based on previous night data, patients with GERD had a shorter bedtime, more frequent awakening from sleep, and more nights with difficulty sleeping ($P = 0.003$, 0.001, and 0.001, respectively). Patients with GERD also had a significant lower rating of sleep the previous night in terms of depth, restfulness, or quality than non-GERD patients ($P = 0.008$, 0.005, and < 0.001, respectively).

Figure 1 shows that among patients with GERD, those with open sores (ulcers) had a significantly higher percent of wake up from sleep because of a burning sensation than those not suffering from this complication ($P \leq 0.016$). Furthermore, patients with GERD with esophageal narrowing had a significantly increased frequency of waking up from sleep the previous night compared to those without narrowing ($P \leq 0.047$) (**Figure 2**).

Discussion

This study demonstrated a high prevalence of GERD and a close association between GERD and sleep disturbance. This cross-sectional study revealed that 38.4% of the study population had GERD, whereas 61.6% did not have any symptoms suggestive of acid reflux from the stomach to the esophagus. Although the study demonstrated that 38.4% of patients had GERD symptoms, only 11.3% had a confirmed diagnosis of GERD. Nevertheless, our study showed that patients with GERD symptoms had a significantly higher percentage of episodes of waking from sleep because of a burning sensation and a shorter mean sleep time (< 6 h) ($P \leq 0.05$) than non-GERD patients. Moreover, patients with GERD had a significantly higher number of nights with difficulty sleeping due to severe pain, shorter duration of time in bed, and more waking up during sleep than non-GERD patients ($P \leq 0.05$). Furthermore, GERD patients with GERD also had a significantly lower rating of sleep in terms of depth, restfulness, or quality in the previous night than non-GERD patients ($P \leq 0.05$).

The prevalence of GERD symptoms in Saudi Arabia was reported to be 45.4% based on a recent survey [12]. Similarly, our study showed that GERD is very common in the Saudi population, reaching 38.4%. GERD and sleep disturbance are common health problems; hence, the relationship between GERD and sleep disturbance is expected to be bidirectional. Patients with GERD were found to have more frequent awakening due to burning sensation, shorter sleep time, and more nights of difficult sleep due to severe pain than non-GERD patients ($P \leq 0.001$, < 0.001, and < 0.033, respectively). Patients with GERD also had a significantly lower rating of sleep at night before the questionnaire in terms of depth, restfulness, or quality compared to non-GERD patients ($P = 0.008$, 0.005, and < 0.001, respectively). The literature also revealed a strong association between GERD and sleep disturbance. Iwakura et al. studied 350 participants; 124 had GERD and they reported that sleep disturbances were significantly higher in patients with GERD, affecting 54% compared to 39.3% of patients without GERD [13]. Dickman

Table 3. Difference between patients with GERD and non-GERD patients according to medical history

Variables	GERD		χ^2	*p*-value
	No No. (%)	Yes No. (%)		
Is there any family history of GERD?				
No	1098 (80.2)	95 (54.6)	57.71	< 0.001
Yes	271 (19.8)	79 (45.4)		
Do you use analgesics especially before going to sleep?				
No	1212 (88.5)	133 (76.4)	20.19	< 0.001
Yes	157 (11.5)	41 (23.6)		
If the question above answered yes, then what type of analgesics do you use? (No.: 198)				
Paracetamol (Panadol - Fevadol - Adol - Solpadine - etc.)	174 (12.7)	29 (16.7)	19.35	< 0.001
Paracetamol analgesic (Panadol - Fevadol - Adol - Solpadeine - etc.), non-steroidal analgesic (Rofenac - Aspirin - Ibuprofen - Naproxen - etc.)	19 (1.4)	9 (5.2)		
Non-steroidal analgesic (Rofenac - Aspirin - Ibuprofen - Naproxen - etc.)	54 (3.9)	12 (6.9)		
What's your preferred food? (Check all that apply)				
Coffee, tea, and chocolate	1042 (76.1)	129 (74.1)	0.32	0.566
Soft Drinks	295 (21.5)	35 (20.1)	0.18	0.664
Hot foods	588 (43)	72 (41.4)	0.15	0.693
Take away meals	579 (42.3)	79 (45.4)	0.61	0.435
Fatty meals	478 (34.9)	53 (30.5)	1.35	0.244
Specific herbs	236 (17.2)	20 (11.5)	3.68	0.055
Predisposing factors for GERD				
Eating much (habit)	217 (15.9)	28 (16.1)	0.007	0.935
Suffering from stress and anxiety	482 (35.2)	79 (45.4)	6.93	0.008
Suffering from stomach ulcers	66 (4.8)	12 (6.9)	1.38	0.239
Pregnancy (in females)	82 (6)	18 (10.3)	4.83	0.028
History of quantification of stomach	156 (11.4)	21 (12.1)	0.06	0.793
Suffering from a delayed stomach emptying	105 (7.7)	18 (10.3)	1.5	0.22
Time of dinner?				
One hour before sleeping	255 (18.6)	44 (25.3)	9.98	0.019
Two hours before sleeping	451 (32.9)	67 (38.5)		
Three hours before sleep	447 (32.7)	44 (25.3)		
Five hours before sleep	216 (15.8)	19 (10.9)		
Do you do sport activities for at least 30 min a day?				
No	778 (56.8)	109 (62.6)	2.14	0.144
Yes	591 (43.2)	65 (37.4)		

GERD, Gastroesophageal reflux disease.

Table 4. Difference between patients with GERD and non-GERD according to sleep pattern (No.: 1543)

Variable	GERD		χ^2	*p*-value
	No No. (%)	Yes No. (%)		
Did you wake up from sleep because of a burning sensation? (last week)				
No	1174 (85.8)	82 (47.1)	15.15	< 0.001
Yes	195 (14.2)	92 (52.9)		
Sleep duration				
< 6 h	372 (27.2)	56 (32.2)	2.55	0.276
6-9 h	708 (51.7)	88 (50.6)		
> 9 h	289 (21.1)	30 (17.2)		
(Mean ± SD)	7.08 ± 3.32	6.52 ± 3.5	2.13*	0.033
Number of nights you have difficulty sleeping due to severe pain (during the past week)?	0.35 ± 0.81	1.53 ± 1.41	14.19*	< 0.001
Duration of bedtime (Mean)	7.11 ± 2.42	6.56 ± 2.27	2.98*	0.003
How many minutes did it take you (before going to sleep) last night?	36.62 ± 69.08	39.18 ± 65.52	1.09	0.276
How many times did you wake up during your sleep last night?	1.69 ± 2.72	2.11 ± 2.34	3.22*	0.001
Did you have difficulty falling asleep last night?				
No	992 (72.5)	104 (59.8)	12.08	0.001
Yes	377 (27.5)	70 (40.2)		
Please rate the quality of your sleep last night by circling a number from 1 to 5 on each of the scales below?				
Please rate your sleep last night in terms of depth	3.47 ± 1.09	3.24 ± 1.08	2.69*	0.008
Please rate how long you slept last night	3.42 ± 1.14	3.36 ± 1.16	0.61	0.539
Please rate your restful sleep last night	3.47 ± 1.15	3.21 ± 1.17	2.79*	0.005
Please rate your sleep quality last night	3.41 ± 1.15	3.06 ± 1.15	3.61*	< 0.001
How relieved did you feel this morning after waking up?	3.28 ± 1.22	3.17 ± 1.16	1.14*	0.253

GERD, Gastroesophageal reflux disease; SD, standard deviation. *Mann-Whitney test.

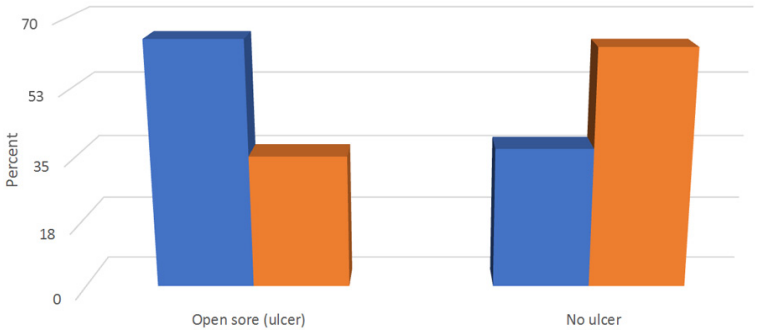

Figure 1. Relationship between open sore (ulcer) as a GERD complication and waking up from sleep because of a burning sensation in patients with GERD (No.: 174). N.B.: $\chi^2 = 5.76$, *p*-value = 0.016. GERD, Gastroesophageal reflux disease.

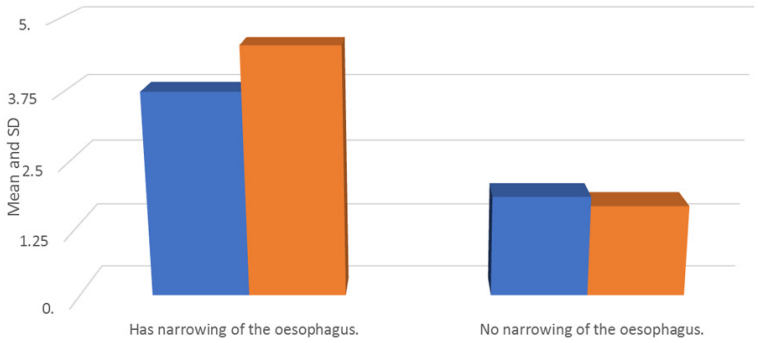

Figure 2. Relationship between narrowing of the esophagus as a GERD complication and frequency of waking up from sleep (previous night) in patients with GERD (No.: 174). N.B.: Mann Whitney test = 0.19, *p*-value = 0.047. GERD, Gastroesophageal reflux disease; SD, standard deviation.

et al. reported that disorders initiating and maintaining sleep and more frequent awakenings were positively associated with the severity of GERD symptoms ($r = 0.33$, $P < 0.05$; and $r = 0.4$, $P < 0.01$ respectively) [3]. Furthermore, they reported a significant link between sleep quality and pH monitoring data; participants with poorer sleep quality had longer acid reflux events ($r = -0.34$, $P < 0.05$) [3]. Other studies showed sleep disturbances are more likely to occur in patients with acid regurgitation with odds ratio of 1.48 (95% CI, 1.17-1.86) [14]. Similarly, insomnia, sleeplessness, and problems falling asleep were higher in patients with GERD, with odds ratio of 3.2 (95% CI, 2.7-3.7), 3.3 (95% CI, 2.9-3.8), 3.1 (95% CI, 2.5-3.8), respectively [15].

Interestingly, our study revealed that patients with GERD complications were more likely to have disturbed sleep than those without complications. This suggests that sleep-related disorders are more pronounced in patients with more severe GERD, leading to complications such as ulceration and stricture. Dickman et al. showed that sleep initiation and maintenance disorders were positively related to the severity of the GERD symptom index [3]. Furthermore, they reported that participants with poor sleep quality had longer acid reflux events [3]. In this study, we also demonstrated that patients with GERD and open ulcers had a significantly higher percentage of waking up from sleep because of a burning sensation than those without this complication ($P \leq 0.016$). Similarly, GERD patients with esophageal narrowing had a significantly increased frequency of waking from sleep compared to those with GERD without narrowing ($P \leq 0.047$). Not surprisingly, other studies have shown that the treatment of GERD symptoms improves sleep quality. Johnson and coworkers in a large multicenter randomized double-blind placebo-controlled trial utilizing esomeprazole 40 mg, 20 mg, or placebo for 6 weeks in 675 adults with GERD-related sleep disturbance, demonstrated that GERD-associated sleep disturbance was resolved in 73% of esomeprazole-treated patients [16]. Therefore, it is important to take a holistic approach in treating patients with sleep disorders, and controlling GERD symptoms should be considered when dealing with these patients. Unfortunately, the effect of GERD treatment on the associated sleep disorders was not addressed in the current study. Having a holistic treatment approach in treating sleep disorders is of great significance, as patients with sleep disorders are likely to suffer from gastrointestinal regurgitation, and the relationship between the two can be bidirectional. Studies have demonstrated that patients with sleep disturbances are more likely to suffer from severe GERD and report a higher preva-

lence of non-erosive reflux disease [17]. In a large multicenter longitudinal cohort study of 15,314 patients with sleep-disordered breathing, 24.9% had GERD [18]. The authors demonstrated that BMI, daytime sleepiness, insomnia, hypertension, and asthma were strong predictors of nighttime heartburn [18]. In addition, some studies have reported a high prevalence of GERD among patients with OSA reaching 58-62% [19, 20]. Conversely, studies by Kim et al. and Morse et al., did not demonstrate significant association between OSA and GERD [21, 22]. Nevertheless, Bortolotti and coworkers have showed that OSA treatment improved GERD symptoms [23]. More objectively, continuous esophageal pH monitoring in 16 patients with OSA before and after 1 week of continuous positive airway pressure (CPAP) treatment demonstrated a significant reduction in the upright and supine acid contact time after CPAP treatment. In fact, eighty-one percent of the patients had a reduction in supine acid contact time to within the normal range [24].

Our study has some limitations. The small number of patients involved in the study and the fact that it was performed at one center are clear limitations of this study. Another limitation is the lack of objective testing for sleep disturbance, as the study depended on questionnaires and patient responses. Future studies should include objective testing, which may be time-consuming.

In summary, our study demonstrated a significant association between GERD and sleep disorders in a large study involving 1543 patients. Our study demonstrated that patients with GERD have more nights with difficulty sleeping, shorter duration of time in bed, and more waking up during sleep, with restlessness, poor sleep quality, and less deep sleep. In addition, our study showed that patients with GERD with complications such as ulceration or stricture are likely to be more affected and have more disturbed sleep than those with GERD without complications. This suggests that the severity of GERD is positively related to disturbed sleep. This highlights the importance of considering other conditions that may disturb sleep, such as GERD, which can be easily targeted when treating sleep disorders.

Disclosure of conflict of interest

None.

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