

Risk assessment of obstructive sleep apnea among gastroesophageal reflux disease patients in Taif, Saudi Arabia

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ABSTRACT

Background: Previous studies have reported the association between gastroesophageal reflux disease (GERD) and obstructive sleep apnea (OSA). **Objectives:** The aim of the present study was to assess the prevalence of GERD among Saudi population, and to determine the risk of OSA among those diagnosed with GERD in Taif city of Saudi Arabia. **Materials and Methods:** A cross-sectional online survey was done among 843 Saudi participants using a questionnaire by collecting demographic data, weight, height, blood group, and having a previous nose or throat surgery. The GERD questionnaire and the sleep apnea symptom index were used to determine GERD and OSA prevalence. **Results:** The prevalence of GERD and OSA was 17.6% and 2.4%, respectively. A significantly higher prevalence of GERD was found among males, those with age >50 years, employees and obese participants, and those having OSA. Participants with an age >50 years and males, had a significantly higher prevalence of OSA. Being a male and older age were predictors for GERD, and the presence of GERD was an independent predictors for OSA. **Conclusion:** Future population-based studies including a representative sample of the population should be done to confirm the revealed association between GERD and OSA. It is necessary to assess GERD in patients with OSA in clinical practice.

Keywords: Apnea, gastroesophageal, obstructive, risk, Saudi, sleep

Introduction

Obstructive sleep apnea (OSA) is a common disorder characterized by repetitive upper airway narrowing during sleep leading to arousal and oxygen desaturation.^[1] In previous studies, the prevalence of OSA was found to be 24% in males and 9% in females.^[2] It was reported that its prevalence was common in both developed and developing countries and it was increasing in the last 20 years.^[2]

In Saudi Arabia, the prevalence of OSA was about 8.8% (12.8% in males, 5.1% in females).^[3] A study conducted

in the western region in Saudi Arabia found that about 28% of the community were at a higher risk of developing OSA, and more than one-half of the participants suffered gastroesophageal reflux disease (GERD).^[4] Another study done in Riyadh city in 1265 individuals found a prevalence of GERD of 45.4%.^[5]

Risk factors for OSA were reported to be advancing in age, male gender, genetics, smoking, and alcohol intake^[6] but the most important risk factor was obesity,^[7] which is also an important risk factor for GERD.^[8]

GERD is a growing health problem characterized by entering of gastric contents to the lower esophagus damaging esophageal

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mucosa causing unpleasant symptoms such as regurgitation and/or heartburn.^[9]

Different studies reported that GERD is more common in patients with OSA than in normal population,^[10-12] and more severe OSA is directly connected to GERD.^[13]

The present study aimed at assessing the prevalence of GERD among Saudi population and to determine the risk of OSA among those diagnosed with GERD in Taif city, Saudi Arabia.

Materials and Methods

Study design and time frame

A cross-sectional study was carried out from April to May 2019.

Study setting: Taif city

Sampling, population, and study instrument: An online survey was done using a questionnaire that includes four parts: (1) The first part included items to collect sociodemographic data (gender, age, marital status, occupation, residence, and education), (2) The second part included items regarding (weight, height, blood group, and having a previous nose or throat surgery). The body mass index (BMI) was calculated as follows: (BMI = the weight in kg divided by the height in m²). Participants were classified as underweight if their body mass index (BMI) was <18.5 kg/m², having normal weight if (18.5–24.9 kg/m²), over-weight if (25–29.9 kg/m²), and obese (if their BMI was ≥30 kg/m²).^[14] (3) The third part included the gastroesophageal reflux disease questionnaire (GERDQ). The questionnaire included 6 questions about (1) presence of burning feeling behind the breast bone (heartburn), (2) having stomach contents moving up to the throat or mouth (regurgitation), (3) having pain in the middle of the upper stomach area having, (4) nausea, (5) having trouble getting a good night's sleep because of heartburn or regurgitation, (6) and previous need for over-the-counter medicine for heartburn or regurgitation.^[14-17] Each of the 6 items was asked about their frequency per week and every item had four options with the following score:

- Score 0: Occurs on 0 days
- Score 1: Occurs on 1 day
- Score 2: Occurs on 2–3 days
- Score 3: Occurs on 4–7 days

After summation of every item score for every participant, a participant with a score ≥8 was considered having GERD. This score cutoff value was used in other studies and had good sensitivity and specificity in the identification of esophagitis and the exclusion of functional heartburn.^[15-18]

(4) The fourth part of the survey included items of the sleep apnea symptom index to determine sleep-related symptoms of obstructive sleep apnea (OSA). This index included 3 questions, and the participants were asked about the frequency of their

occurrence in the last month. These questions were about: (1) snorting or gasping, (2) loud snoring, and (3) breathing stops, choke, or struggle for breath. Every question had the following options with the following score:

- Score 0: Never
- Score 1: Rarely, less than once a week
- Score 2: 1–2 times a week
- Score 3: 3–4 times a week
- Score 4: 5–7 times a week

A mean score of less than 1 was considered as “never” having sleep apnea symptoms, 1 <2 was considered as “rarely” had sleep apnea symptoms and a mean score of ≥2 was considered as “often” having sleep apnea symptoms.^[19,20]

The inclusion criteria according to the instructions given to the participants were all ages and both sexes. The exclusion criteria were all patients who underwent any surgery to treat OSA as turbinate reduction, uvulo-palato-pharyngoplasty (UPPP), tonsillectomy, tongue reduction, genioglossus advancement, maxillomandibular advancement, hypoglossal nerve stimulation, or tracheostomy. The exclusion criteria also included any patient who underwent any surgery to treat GERD is fundoplication or hiatal hernia repair.

Ethical considerations

The Research Ethics Committee of Taif University approved the study. Written consents were obtained from the participant.

Statistical analysis

Analysis of the collected data was done using the SPSS statistical program. Numbers and percentages were used for expressing the qualitative data and the Chi-square (χ^2) test was applied for testing the relationship between variables. The binary logistic regression analysis which is a statistical tool to analyze the independent predictors with its odds ratios for a binary outcome (GERD and OSA prevalence) was done. A statistical significance was considered with a *P* value of <0.05.

Results

The present study was done on 756 participants through an online survey. The number of those diagnosed with GERD was 133 (17.6%), and those diagnosed with OSA was 18 (2.4%).

Of the participants, 56.3% were females, 64.7% were married, 38.6% belonged to the age group of (18–29 years), 73.1% had a university education or above, and 39.4% were employees. Participants with 88.95 were living in Taif city, and most of the participants had blood group B- (43.1%). Only 31.5% of the participants were obese and 9.3% of them underwent nose or throat surgery [Table 1].

Table 2 shows that a significant difference was present between those diagnosed to have GERD regarding their age, gender,

Table 1: Descriptive data of the participants

Variable	No. (%)
Age	
<18 years	18 (2.4)
18-29 years	292 (38.6)
30-49 years	281 (37.2)
50-70 years	136 (18)
>70 years	29 (3.8)
Gender	
Male	330 (43.7)
Female	426 (56.3)
Education	
Primary	55 (7.3)
Preparatory and secondary	148 (19.6)
University and above	553 (73.1)
Occupation	
Employee	298 (39.4)
Student	212 (28)
No work	138 (18.3)
Retired	108 (14.3)
Residence	
Inside Taif	672 (88.9)
Outside Taif	84 (11.1)
Marital status	
Married	489 (64.7)
Unmarried	267 (35.3)
Blood group	
A+	264 (34.9)
A-	12 (1.6)
B+	72 (9.5)
B-	13 (1.7)
O+	326 (43.1)
O-	40 (5.5)
AB+	26 (3.4)
AB-	3 (0.4)
BMI	
Obese	238 (31.5)
Not obese	518 (68.5)
Previous nose or throat surgery	
Yes	70 (9.3)
No	686 (90.7)

occupation, BMI, and having OSA. Participants with older age (>50 years) showed a significantly higher percent of having GERD compared to younger age groups ($P = <0.05$). Male participants had a higher percent of those having GERD compared to females (22.1% vs. 14.1%). Employees showed also a significantly higher percent of those having GERD when compared to students, those with no work and retired participants (22.5% vs. 12.7%, 15.2% and 16.7%) ($P = <0.05$). Obese participants had a significantly higher prevalence of those having GERD compared to nonobese (22.7% vs. 15.3%). Participants with GERD showed also a significantly higher prevalence of those having OSA (55.6% vs. 16.7%). A nonsignificant difference was found between those diagnosed to have GERD regarding their education, residence, marital status, blood group, and having a nose or throat surgery previously ($P = >0.05$).

Table 3 shows that by doing binary logistic regression analysis to detect the independent predictors for GERD among

Table 2: Relationship between GERD and age, gender, education, occupation, residence, marital status, blood group, BMI, previous nose, or throat surgery and OSA among the participants

Variable	GERD		Chi-square test	P		
	Present No. (%)	Absent No. (%)				
Age						
<18 years	1 (5.6)	17 (94.4)	18.27	0.001		
18-29 years	35 (12)	257 (88)				
30-49 years	53 (18.9)	228 (81.1)				
50-70 years	35 (25.7)	101 (74.3)				
>70 years	9 (31)	20 (69)				
Gender						
Male	73 (22.1)	257 (77.9)	8.28	0.004		
Female	60 (14.1)	366 (85.9)				
Education						
Primary	9 (16.4)	46 (83.6)	0.06	0.96		
Preparatory and secondary	26 (17.6)	122 (82.4)				
University and above	98 (17.7)	455 (82.3)				
Occupation						
Employee	67 (22.5)	231 (77.5)	8.96	0.03		
Student	27 (12.7)	185 (87.3)				
No work	21 (15.2)	117 (84.8)				
Retired	18 (16.7)	90 (83.3)				
Residence						
Inside Taif	117 (17.4)	555 (82.6)	0.13	0.71		
Outside Taif	16 (19)	68 (81)				
Marital status						
Married	93 (19)	396 (81)	1.94	0.16		
Unmarried	40 (15)	227 (85)				
Blood group						
A+	41 (15.5)	223 (84.5)	12.05	0.09		
A-	3 (25)	9 (75)				
B+	22 (30.6)	50 (69.4)				
B-	1 (7.7)	12 (92.3)				
O+	54 (16.6)	272 (83.4)				
O-	6 (15)	85 (85)				
AB+	6 (23.1)	20 (79.9)				
AB-	0 (0.0)	3 (100)				
BMI						
Obese	54 (22.7)	184 (77.3)			6.22	0.013
Not obese	79 (15.3)	439 (84.7)				
Previous nose or throat surgery						
Yes	13 (18.6)	57 (81.4)	0.05	0.82		
No	120 (17.5)	566 (82.5)				
OSA						
Present	10 (55.6)	8 (44.4)	18.28	<0.001		
Absent	123 (16.7)	614 (83.3)				

studied participants, we found that being a male and with older age-independent predictors for GERD.

Table 4 shows that a significant difference was present between those diagnosed to have OSA according to their age and gender ($P = <0.05$). Participants with an age of 50 years and older showed a significantly higher percent of having OSA compared to younger age groups ($P = <0.05$). Male participants also had a significantly higher percent of those having OSA compared to females (3.6% vs. 1.4%), ($P = <0.05$).

Table 3: Binary logistic regression analysis regarding the risk factors for GERD among studied participants

Variable	GERD			Significance
	Beta	Wald	Odd's Ratio	
Age	-0.3	15.01	0.73	<0.001
Gender	0.4	3.9	1.49	0.04
Occupation	0.15	2.53	1.16	0.11
BMI	0.45	5.1	0.02	1.57

Table 4: Relationship between OSA and age, gender, education, occupation, residence, marital status, blood group, BMI, and previous nose or throat surgery among studies participants (No. 18)

Variable	OSA		Chi-square test	P
	Present No. (%)	Absent NO. (%)		
Age				
<18 years	0 (18)	0 (100)	13.1	0.011
18-29 years	3 (1)	288 (99)		
30-49 years	6 (2.1)	275 (97.9)		
50-70 years	6 (4.4)	130 (95.6)		
>70 years	3 (10.3)	26 (89.7)		
Gender				
Male	12 (3.6)	317 (96.4)	3.99	0.04
Female	6 (1.4)	420 (98.6)		
Education				
Primary	2 (3.6)	53 (96.4)	1.1	0.57
Preparatory and secondary	2 (1.4)	146 (98.6)		
University and above	14 (2.5)	538 (97.5)		
Occupation				
Employee	11 (3.7)	287 (96.3)	5.69	0.12
Student	5 (2.4)	206 (97.6)		
No work	0 (0.0)	138 (100)		
Retired	2 (1.9)	106 (98.1)		
Residence				
Inside Taif	18 (2.7)	653 (97.3)	2.3	0.12
Outside Taif	0 (0.0)	84 (100)		
Marital status				
Married	13 (2.7)	476 (97.3)	0.44	0.05
Unmarried	5 (1.9)	261 (98.1)		
Blood group				
A+	5 (1.9)	259 (98.1)	4.61	0.7
A-	0 (0.0)	12 (100)		
B+	1 (1.4)	71 (98.6)		
B-	0 (0.0)	13 (100)		
O+	9 (2.8)	317 (97.2)		
O-	1 (2.6)	38 (97.4)		
AB+	2 (7.7)	24 (92.3)		
AB-	0 (0.0)	3 (100)		
BMI				
Obese	8 (3.4)	230 (96.6)	1.42	0.23
Not obese	10 (1.9)	507 (98.1)		
Previous nose or throat surgery				
Yes	3 (4.3)	67 (95.7)	1.19	0.27
No	15 (2.2)	670 (97.8)		

Table 5 shows that by doing binary logistic regression analysis to detect the independent predictors for OSA among studied

participants, the presence of GERD was independent predictors for OSA while age and gender were not independent predictors for it.

Discussion

The present study was a cross-sectional study done by an online survey method using a pretested questionnaire. The overall prevalence of GERD in our study was found to be 17.6% and OSA was 2.4%.

The prevalence of GERD in the present study is similar to that reported in a study done in Pakistan (18.3%).^[21] In the same time, it is lower than that reported in studies done on among Indonesian medical doctors (27.4%),^[22] and Iran (24%),^[23] respectively. However, this prevalence is higher than that observed in other studies done in India^[24] and Japan^[25] (7.6%, and 1.6–16.3%, respectively).

According to studies done in Saudi Arabia, the prevalence in the present study was much lower than that reported in a study done on 464 university students where more than half of students suffer from GERD.^[4] This was explained by the presence of multiple risk factors among the studied participants being university students that were obesity, stress, and smoking. It is also lower than that observed in another study done in Riyadh among where GERD prevalence was 45.4%. In this study, the prevalence was higher among older, obese, and smoker participants.^[5] This could be explained by the inclusion of a larger sample size through using a self-reported GerdQ as Riyadh city was divided into four quadrants, and a shopping mall was chosen randomly from every quadrant.

In our study, the prevalence of GERD was found comparatively more in people who are above the age of 50 years and there was a statistically significant relationship between the increase in age and prevalence of GERD. In addition, being with older age was an independent predictor for GERD. Moreover, the prevalence of OSA was higher in people aged above 50 years. The increasing prevalence could be explained on the basis that as age increases there is increased acid exposure, decreases in intra-abdominal lower esophageal sphincter length, increase in esophageal dysmotility, esophageal nociception, and increasingly ineffective peristalsis compared to people with younger age.^[10] The same findings was revealed from other national^[5] and international studies.^[21,22]

The prevalence of GERD was found to be higher in male compared to female in our study and being a male was an independent predictor for GERD. GERD is generally categorized in two types: reflux esophagitis and non-erosive reflux disease (NERD), based on endoscopy.^[11] The reflux esophagitis is reported to be higher in males whereas the NERD is common in females.^[11-13] Studies suggest that a decrease in estrogen after menopause might be related to the rise in the incidence and severity of GERD.^[26] However, the actual mechanism of estrogen that increases the severity of GERD is unclear. This result was reported in other studies.^[27]

Table 5: Binary logistic regression analysis regarding the risk factors for OSA among studied participants (No. 18)

Variable	OSA			Significance
	Beta	Wald	Odd's Ratio	
Age	0.29	3.38	1.33	0.06
Gender	-0.07	1.48	0.22	0.92
GERD	1.83	14.28	6.24	<0.001

On the other hand, other studies showed a higher prevalence of GERD among males but without statistically significant difference.^[22]

The high prevalence of OSA among males was also reported in previous studies.^[28,29] Our findings showed that the education levels of the participants did not have any association with the prevalence of GERD as well as with OSA. The same nonsignificant relationship between the education level and prevalence of GERD was observed in other studies.^[22] However, a study was done by Wang *et al.*, reported that people with higher educational level had a lower prevalence of GERD.^[30] Another study done among twins claimed that lower educational level increased the risk of GERD in females than males.^[31] Other contrasting data to our findings come from a study done by Foroughi *et al.*, which reports that people with low levels education (illiterate) had a significantly higher prevalence of OSA than with those with high educational level.^[32]

We observed that there was a statistically significant association seen with the occupation, where those who are employed and retired had more prevalence of GERD. However, there was no association of occupation seen with OSA. A study conducted in Hungary reported that professional opera choristers, professional wind players, and glassblowers' had higher prevalence of heartburn, regurgitation and hoarseness.^[33] Similarly, with OSA, another study done in Sweden reported increased risk in males who were sales agents, seamen, drivers, engine and motor operators, and cooks. In women, it was more prevalent in divers.^[34]

Obesity is always considered as a risk factor for GERD and OSA.^[34] In our study, the prevalence of GERD was higher in obese compared to nonobese and it was statistically significant. This could be explained on the basis that in obese people, there could nutcracker esophagus and nonspecific motility disorder due to deposition of fat tissues, which could lead to prolonged esophageal acid.^[35,36] Increase in the intra-abdominal pressure due to abdominal obesity could also be the reason for the increased prevalence of GERD obese individuals.^[36]

The association between GERD and obesity was reported in other studies and explained also by the insufficiency of the barrier to gastric reflux and the increasing intra-abdominal pressure. The alteration of bile and pancreatic function in obese patients are correlated with the composition of the refluxate products which are more toxic for the esophagus.^[22,37]

The same association was found in other Saudi studies wherein overweight and obese participants had a higher prevalence of GERD.^[4,5]

In the present study, we did not find any association between obesity and OSA but this finding is in contrast to many other studies that reported obesity as a strong risk factor for OSA.^[38] In a similar study done in Saudi Arabia, individuals with a BMI ≥ 30 had a higher prevalence of OSA.^[3] The increased risk of OSA in obese people may be due to the difference in the distribution of adipose tissues predominantly in the neck, trunk, and abdominal viscera areas.^[39] In the current study, we did not find any relationship between nose or throat surgery with GERD and OSA. A meta-analysis conducted by Wu *et al.* reported that isolated nasal surgery significantly improved apnea-hypopnea index (AHI) and Epworth sleep scale (ESS).^[40]

Another interesting finding in our study is that married people showed a slightly higher prevalence than unmarried without statistical significance. This finding is supported by another study done in South Korea that reported a higher prevalence in married and divorced than unmarried individuals.^[41] This may be explained on the basis of age-related differences in unmarried individuals could belong to a younger age group that married or divorced ones.^[42] In our study, we did not find a relationship between GERD and OSA with any of the blood groups. This finding is supported by another study done in Saudi Arabia.^[9]

GERD and OSA are considered to be comorbid disorders and the relationship is often bidirectional.^[1,2] In the current study, we observed a strong correlation between GERD and OSA as by doing binary logistic regression analysis GERD was found to be an independent predictor for OSA.

The association between GERD and OSA was proved by previous studies that showed that the prevalence of GERD in OSA patients was significantly higher than the general population.^[10,43] Studies have found that patients with OSA suffer more frequent nocturnal reflux symptoms than patients without OSA, a matter that was explained by the ability of OSA to develop nocturnal GERD as the apneic episodes were found to be associated with increased arousal movement and increased transdiaphragmatic pressure and low intrathoracic pressure.^[44] Moreover, in a recent meta-analysis done in 2019, it was proved that a total of 2699 patients from seven articles were included which further concluded that there was a significant correlation between GERD and OSA.^[45]

Limitations

Some of the limitations of our study could be addressed before generalizing our findings. Firstly, the target population did not cover the whole Saudi population as it was an online survey. Another limitation is that we did not categorize the types of GERD and OSA as the prevalence of different types of both

disorders is reported to be different across different age groups and gender.

Conclusion

The present study was an online survey done to assess the prevalence of GERD among a sample of 843 Saudi participants and to determine the risk of OSA among those diagnosed with GERD in Taif city, Saudi Arabia. The survey included the GERD questionnaire and the sleep apnea symptom index. The prevalence of GERD and OSA was 17.6% and 2.4%, respectively and a significantly higher prevalence of GERD was found among males, those with age >50 years, employees and obese participants, and those having OSA. Participants with an age >50 years and males had a significantly higher prevalence of OSA. Being a male and with older age were predictors for GERD, and the presence of GERD was independent predictors for OSA. The study concluded the association between GERD and OSA and calls for future population-based studies that include a representative sample of the population to confirm the revealed results of this study. In addition, the study necessitates the need for assessment of GERD in patients with OSA in clinical practice.

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Conflicts of interest

There are no conflicts of interest.

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