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A population-based survey of the association between systemic hypertension and obstructive sleep apnea among the general population in Saudi Arabia

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ABSTRACT

Background: Obstructive sleep apnea (OSA) is a common disorder that is considered one of the secondary causes of hypertension. Hypertension affects approximately 50 % of people with OSA. **Aim:** The purpose of this study is to evaluate the relationship between systemic hypertension and OSA in Saudi Arabia's general population. **Methods:** A descriptive cross-sectional survey was conducted. Participants who had been diagnosed with hypertension aged 18 years or more and living in Saudi Arabia were included. An electronic questionnaire was used for data collection. **Results:** We retrieved 509 responses from participants whose ages ranged from 18 to more than 44 years, with a mean age of 37.9 ± 11.2 years old. OSA was diagnosed among 269 (53.7%) of the study patients. 59.6% of male patients had OSA compared to 49.1% of female patients, with a statistically significant difference ($P=0.019$). 64.2% of hypertensive patients with a secondary level of education complained of OSA compared to 44.7% of others with a lower level of education ($P=0.001$). A total of 67.5% of the study patients complained of snoring during sleep which was significantly higher among patients with OSA (79.6%) than those without (53.4%); ($P=0.001$). Complaints of headache most of the time were significantly higher among patients with OSA than others without (84.4% vs. 69.8%, respectively; $P=0.001$). **Conclusion:** According to the current study, there was a significant prevalence of OSA among hypertensive patients (more than half of the patients), particularly among men, patients with high body mass indexes, smokers and patients with a history of the condition in their families.

Keywords: Obstructive sleep apnea, hypertension, relations, prevalence, Saudi Arabia

1. INTRODUCTION

Obstructive sleep apnea (OSA) is a moderately public sleep disorder that is featured by recurring episodes of the incomplete or complete ruin of the higher air route thru sleep (Caples et al., 2005). This airway collapse mostly causes acute imbalances in gas exchange and recurrent awakenings from sleep (Caples et al., 2005; Punjabi et al., 2008; Ho & Brass, 2011). OSA disorder is associated with many health consequences. Neglected OSA leads to high daytime tiredness, mental dysfunction, sleepiness with decreased work performance and a significant effect on health related quality of life (Withrow et al., 2019; Moyer et al., 2001; Gonsalves et al., 2004). In the general population, the prevalence of OSA with related day time sleepiness is about 3 to 7% among adult males and 2 to 5% for adult females. OSA prevalence varies in different population subgroups, such as overweight or obese people, those of a minority race and the older population (Punjabi et al., 2008; Senaratna et al., 2017).

Many studies also recommended that obstructive sleep apnea may have a role in the development of cardio vascular disease (Peker et al., 2006), systemic hypertension (Peppard et al., 2000) and abnormalities in glucose metabolism (Punjabi et al., 2005). Obstructive sleep apnea is insidious and patients are often unaware of the associated symptoms. The main clinical presentations include loud snoring, observed breathing pauses during sleep, poor sleep quality and disproportionate daytime sleepiness (Bonsignore et al., 2018; Kline et al., 2017; Pascoe et al., 2021).

High blood pressure is a rising health problem that is mostly ignored (Flynn et al., 2017). OSA and hypertension have more shared characteristics. Both are frequently undiagnosed and accompanying with advanced hazard of cardio vascular diseases. Above all, the outstanding epidemiology makes it most improbable that this association may be insignificant. OSA is considered one of the secondary causes of hypertension (Chobanian et al., 2003). Hypertension affects approximately 50 % of people with OSA and contrarily that, about 40 % of hypertensive patients may have OSA (Calhoun et al., 2010). There is reliable epidemiological evidence that systemic hypertension and sleep disordered breathing are significantly associated. So, the current study aimed to assess the association between systemic hypertension and OSA among the general population in Saudi Arabia.

2. METHODOLOGY

Study Design

A descriptive cross-sectional study was conducted.

Study Population and Sampling

A survey targeting all hypertensive patients in Saudi Arabia was conducted during the period from 13/9/2021 to 2/11/2021 participants who had medically diagnosed hypertension aged 18 years or more and living in Saudi Arabia were included. Normotensive respondents were excluded.

Data collection tool

An electronic questionnaire was used for data collection. The study questionnaire was constructed by the researchers after intensive literature review and consulting experts on the study issue till the final format was obtained. The study questionnaire included patients' demographic data, work data, medical family history, smoking, body mass index assessment, diagnosis of OSA and effect of OSA on patients' day time activities and sleep. The study questionnaire was uploaded online using social media platforms by the researcher and their relatives in the Aseer region till no more new answers were obtained.

Pilot study

The researcher conducted a pilot study on 20 Saudi individuals. The pilot study helped in finalization of the study questionnaire and assessment of the reliability of its statements. Data collected with in the pilot study were not being included in the main study.

Data entry and analysis

All collected data were coded and verified before data entry into a personal computer. Data entry and statistical analysis were conducted using the Statistical Package of Social Sciences (SPSS version 23). Descriptive statistics, (e.g., mean, frequency) were calculated. Frequency and percent distribution was done for all variables, including hypertensive patients' personal data, qualification, body mass index, medical history, regular anti-hypertensive drug intake, smoking status and house hold history of OSA and diagnosed with OSA. Also, the effect of OSA on patients' life and sleep were tabulated by their history of OSA complaint.

Cross tabulation was used to assess the distribution of patients' complaints of OSA and their bio-demographic data. Tests of significance, e.g., Chi-test were applied. P-values less than 0.05 were considered as statistically significant.

Ethical considerations

Prior to start of data collection, all necessary official approvals were secured from the research ethics committee of Najran University, southern Saudi Arabia, with letter number (46/1/21/NU/DS) on 04/03/2021. All physicians were informed that their participation is optional. All collected data were kept confidential.

3. RESULTS

A total of 509 hypertensive patients completed the study questionnaire. Participants' age ranged from 18 to more than 44 years, with a mean age of 37.9 ± 11.2 years old. Of all, 288 (56.6%) participants were females, 374 (73.5%) were married, while 94 (18.5%) were single. As for educational level, 234 (46%) had a secondary level of education and 234 (46%) were university graduates or post graduate degree holders. Considering BMI, 154 (30.3%) had overweight, 132 (25.9%) were obese and morbid obesity was detected among 116 (22.8%). An exact of 160 (31.4%) participants had a family history of OSA. Taking anti-hypertensive drugs regularly was reported among 400 (79.8%) patients and 162 (32.3%) patients had other co-morbidities. A total of 103 (20.6%) patients were smokers (table 1).

Figure 1 shows the prevalence of OSA among hypertensive patients in Saudi Arabia. OSA was diagnosed among 269 (53.7%) of the study patients, while 232 (46.3%) had no history of OSA.

Table 2 shows the obstructive sleep apnea among hypertensive patients in Saudi Arabia. A total of 59.6% of male patients had OSA compared to 49.1% of female patients, with statistically significant difference (P=0.019). Also, 64.2% of hypertensive patients with secondary level of education complained of OSA compared to 44.7% of others with lower level of education (P=0.001). OSA was diagnosed among 49.5% of patients work at civil jobs versus 70.7% of others at military sector (P=0.005). Additionally, 69.2% of hypertensive patients with overweight complained of OSA in comparison to 36.2% of other with morbid obesity and 47% of patients with normal weight (P=0.001). Also, OSA was diagnosed among 58% of patients who had anti-hypertensive drug regularly versus 36.6% of those who did not (P=0.001). Exact of 65% of smokers complained of OSA versus 50.8% of non smokers (P=0.010). Besides, 80% of patients with family history of OSA complained of the disease compared to 39.5% of others with no family history (P=0.001).

Table 3 shows the effect of OSA among hypertensive patients in Saudi Arabia. A total of 67.5% of the study patients complained of snoring during sleep which was significantly higher among patients with OSA (79.6%) than those without (53.4%); (P=0.001). Also, complaining of headache most times was significantly higher among patients with OSA than others without (84.4% vs. 69.8%, respectively; P=0.001). Additionally, 25.3% of patients with OSA were exposed to accidents due to tiredness compared to 18.5% of other patients with no OSA (P=.049). Other factors, including frequent wake up during sleep, morning mouth dryness and congestion, were insignificantly higher among patients with OSA than others.

Table 1 Bio-demographic of hypertensive study participants, Saudi Arabia

Bio-demographic data	No	%
Age in years		
18-29	167	32.8%
30-44	206	40.5%
> 44	136	26.7%
Gender		
Male	221	43.4%
Female	288	56.6%
Marital status		
Single	94	18.5%
Married	374	73.5%
Divorced / widow	41	8.1%

Educational level		
Below secondary	41	8.1%
Secondary	234	46.0%
University / above	234	46.0%
Work		
Not working / retired	242	47.5%
Civil sector	192	37.7%
Military sector	75	14.7%
BMI		
Underweight	24	4.7%
Normal weight	83	16.3%
Overweight	154	30.3%
Obese	132	25.9%
Morbid obesity	116	22.8%
Family history of OSA		
Yes	160	31.4%
No	185	36.3%
Not sure	164	32.2%
Have anti-hypertensive drug regularly		
Yes	400	79.8%
No	101	20.2%
Have other co-morbidity		
Yes	162	32.3%
No	339	67.7%
Smoker		
Yes	103	20.6%
No	398	79.4%

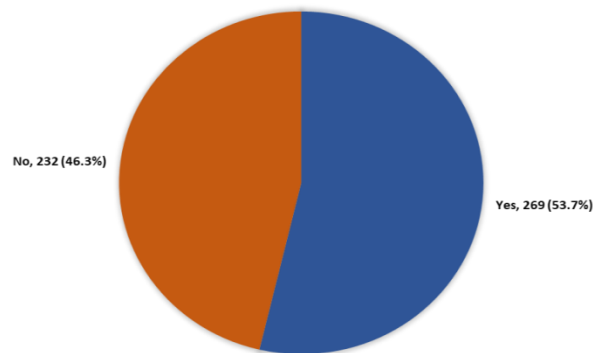


Figure 1 Prevalence of obstructive sleep apnea among hypertensive patients in Saudi Arabia

Table 2 Obstructive sleep apnea among hypertensive patients in Saudi Arabia

Bio-demographic data	Diagnosed with OSA				P-value
	Yes		No		
	No	%	No	%	
Age in years					.135
18-29	77	48.4%	82	51.6%	
30-44	121	58.7%	85	41.3%	
> 44	71	52.2%	65	47.8%	
Gender					.019*
Male	130	59.6%	88	40.4%	
Female	139	49.1%	144	50.9%	
Marital status					.072
Single	48	55.2%	39	44.8%	
Married	206	55.2%	167	44.8%	
Divorced / widow	15	36.6%	26	63.4%	
Educational level					.001*
Below secondary	17	44.7%	21	55.3%	
Secondary	147	64.2%	82	35.8%	
University / above	105	44.9%	129	55.1%	
Work					.005*
Not working / retired	121	51.7%	113	48.3%	
Civil sector	95	49.5%	97	50.5%	
Military sector	53	70.7%	22	29.3%	
BMI					.001**
Underweight	11	45.8%	13	54.2%	
Normal weight	39	47.0%	44	53.0%	
Overweight	101	69.2%	45	30.8%	
Obese	76	57.6%	56	42.4%	
Morbid obesity	42	36.2%	74	63.8%	
Have anti-hypertensive drug regularly					.001*
Yes	232	58.0%	168	42.0%	
No	37	36.6%	64	63.4%	
Have other co-morbidity					.179
Yes	94	58.0%	68	42.0%	
No	175	51.6%	164	48.4%	
Smoker					.010*
Yes	67	65.0%	36	35.0%	
No	202	50.8%	196	49.2%	
Family history of OSA					.001*
Yes	128	80.0%	32	20.0%	
No	70	39.5%	107	60.5%	
Not sure	71	43.3%	93	56.7%	

P: Pearson X² test \$: Exact probability test * P < 0.05 (significant)

Table 3 Effect of OSA among hypertensive patients in Saudi Arabia

Effect	Total		Diagnosed with OSA				p-value
			Yes		No		
	No	%	No	%	No	%	
Snoring during sleep	338	67.5%	214	79.6%	124	53.4%	.001*
Frequent wake up during sleeping	261	52.1%	142	52.8%	119	51.3%	.738
Sleepiness & tiredness during day time	265	52.9%	138	51.3%	127	54.7%	.442
Lack of concentration during day time	274	54.7%	142	52.8%	132	56.9%	.357
Morning mouth dryness and congestion	220	43.9%	119	44.2%	101	43.5%	.874
Have headache most times	389	77.6%	227	84.4%	162	69.8%	.001*
Exposed to RTA due tiredness	111	22.2%	68	25.3%	43	18.5%	.049*

*P: Pearson X² test *P < 0.05 (significant)*

4. DISCUSSION

OSA is associated with hypertensive patients. Both diseases often exist together as nearly half of patients with HTN have associated OSA and current evidence strengthens the concept that OSA is the most dominant secondary sponsor of elevated blood pressure among patients with resistant HTN (Pedrosa et al., 2011). Some population-based surveys showed an association between the higher apneahypopnea index and elevated BP, both initially and also with repeated measures during follow-up (Young et al., 1997). On the other hand, isolated systolic hypertension among elderly patients was not concurrent with OSA in any age group (Haas et al., 2005).

The current study showed that more than half (53.7%) of hypertensive patients were diagnosed with OSA. The most reported symptoms among patients with OSA were snoring during sleep (more than three quarters of the patients), having headaches most daytime, while only one quarter of them experienced accidents due to daytime sleepiness and fatigue. Lack of concentration during daytime and sleepiness and frequent wakeup during sleep were reported among half of the hypertensive patients with OSA besides the effect of hypertension which explains this high percentage of those who experienced accidents (one out of each four patients). The other study estimated an increased risk for incident HTN among patients with OSA compared with normotensive controls and in this second study, the OSA-HTN where age and obesity were not confounders. Also, follow-up of this patient cohort revealed a dose response relationship between the severity of OSA and the cumulative incidence of HTN (Marin et al., 2011). Due to long follow-up period, the second study delivers relatively strong epidemiological evidence implicating OSA as a factor in the development of HTN.

In the current study, 69.2% of hypertensive patients with overweight complained of OSA in comparison to 36.2% of other with morbid obesity and 47% of patients with normal weight (P=0.001). This hypothesis regarding the relation between systematic hypertension and OSA is confounded by many variables, especially obesity and age. Recently, two cohort studies focused on these hypotheses in the non hypertensive population and with different findings as one of them found that after adjusting for relevant confounders OSA was not associated with having systolic HTN (Cano-Pumarega et al., 2011). In the current study, a total of 59.6% of male patients had OSA compared to 49.1% of female patients, with statistically significant difference (P=0.019). According to Lin et al., (2008) numerous population-based research have revealed that men are more likely than women to suffer from obstructive sleep apnea, and this difference is frequently visible in the clinical environment. Men are thought to be more susceptible to the disease than women are due to a variety of biological factors. Variations in weight, upper airway structure, respiratory control, estrogen and age have all been believed to play a part, though the precise mechanisms remain unknown.

In our study, exact of 65% of smokers complained of OSA versus 50.8% of non smokers (P=0.010). Besides, 80% of patients with family history of OSA complained of the disease compared to 39.5% of others with no family history (P=0.001). Punjabi, (2008), stated the factors that increase vulnerability for the disorder include age, male sex, obesity, family history, menopause, craniofacial

abnormalities and certain health behaviors such as cigarette smoking and alcohol use. In the current study, OSA was diagnosed among 58% of patients who had anti-hypertensive drug regularly versus 36.6% of those who did not ($P=0.001$). These findings were consistent with many literature findings. A longitudinal study suggests that persons with moderate to severe OSA (apnea-hypopnea index (AHI) > 15 h⁻¹) are as significant leading cause of hypertension. Patients with severe OSA recorded a 3.2-fold up surge in the probabilities of emerging hypertension equated with individuals' horn of OSA (Peppard et al., 2000). Marin et al., (2012) reported that the adjusted risk for Individuals with OSA who were unsuitable for treatment (HR=1.33), denied CPAP therapy (HR=1.96) and failed to comply with CPAP treatments all had greater occurrence hypertension (HR=1.78), while the HR was lower in patients with OSA who were treated with CPAP therapy (HR=0.71).

Our study also matches previous findings that revealed an independent association between OSA and increased cardio vascular disorders (Marin et al., 2005; Young et al., 2008; Punjabi et al., 2009; Yaggi et al., 2005). The association between neglected OSA and higher risk for having new on set hypertension was confirmed even after adjustment for probable confounders such as BMI weight change. These findings are agreeable with others that assure OSA as a chief cause of vascular dysfunction in obesity (Ip et al., 2004; Narkiewicz et al., 1998; Jelic et al., 2010). Additionally, in our study, patients with OSA were more likely to experience accidents brought on by fatigue at a rate of 25.3% compared to patients without OSA at a rate of 18.5% ($P=.049$). According to Sabil et al., (2021), the risk of a car accident has seemed to be due to multiple hazard factors in patients who have just been diagnosed with OSA and its assessment process might also take into account a number of factors, including the patient's conscience sleepiness behind the vehicle, the frequency of accidents linked to sleepiness, body anthropometry, expert status and inadequate sleep protests.

5. CONCLUSIONS AND RECOMMENDATIONS

In conclusion, the current study showed that OSA prevalence was high among hypertensive patients (more than half of the patients), particularly male patients, patients with high BMI, smokers and patients with a family history of OSA. Loud snoring during sleep, daytime sleepiness, fatigue and lack of concentration were the main complaint that caused a high rate of accidents. The relation between OSA and systematic hypertension may be bidirectional, where both can lead to each other, especially with a change in weight or advance in age. A larger scale study with a sufficient follow-up period is recommended to confirm the association between these disorders and to clarify the potential positive and negative confounders of the relation.

Informed consent

Written & Oral informed consent was obtained from all individual participants included in the study. Additional informed consent was obtained from all individual participants for whom identifying information is included in this manuscript.

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Author contributions

We certify, as authors, that we have participated sufficiently in the intellectual content, conception and design of this work or the analysis and interpretation of the data (when applicable), as well as the writing of the manuscript, to take public responsibility for it and have agreed to have our name listed as a contributor. All persons who have made substantial contributions to the work reported in the manuscript.

Ethical approval

The study was approved from the research ethics committee of Najran University, southern Saudi Arabia, with letter number (46/1/21/NU/DS) on 04/03/2021.

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Conflict of interest

The authors declare that there is no conflict of interests.

Data and materials availability

All data sets collected during this study are available upon reasonable request from the corresponding author.

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