Journal of Pioneering Medical Sciences
Received July 27, 2023 Accept November 05 , 2023 Publish November 16, 2023.
Volume 12, Issue 1, Pages 24-29

DOI https://doi.org/10.61091/jpms20231216

Prevalence of Obstructive Sleep Apnea in Gulf Countries - A Literature Review

Mansour Khater Alzahrani[1,*]
[1]Department of Family and Community Medicine, College of Medicine, Majmaah University, Majmaah 11952, Saudi Arabia

Corresponding author: Mansour Khater Alzahrani (e-mail: m.alzahrani@mu.edu.sa).

©2023 the Author(s). This is an open access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0

Abstract Obstructive sleep apnea (OSA) is a medical condition distinguished by repetitive occurrences of the partial or complete blockage of the upper airway while an individual is asleep. This obstruction leads to a decrease in airflow, known as hypopnea, or a complete absence of airflow, known as apnea, lasting for a minimum of 10 seconds. In the Kingdom of Saudi Arabia (KSA), it was found that 33% of middle-aged males and 39% of middle-aged women were identified as having a high risk of OSA. OSA exhibits a higher occurrence in males, with an estimated prevalence of 4% in men compared to 2% in women, resulting in a male-to-female ratio of 2:1. This condition has been identified as a significant factor leading to diminished quality of life and poor work productivity. The overall knowledge level was determined to be low for 80.7% of the Saudi population in a recent study on awareness of OSA and the factors that determine their awareness level. As a result, there is a level of awareness that has to be improved and addressed in Gulf countries. Thus, the present review discusses the distinct features of OSA and focuses on its prevalence in the countries included in the Gulf Corporation Council(GCC).

Key Words Sleep apnea, Obstructive sleep apnea, Saudi Arabia, GCC, Gulf countries

1. Introduction

Obstructive sleep apnea (OSA) is a medical condition that is distinguished by repetitive occurrences of the partial or complete blockage of the upper airway while an individual is asleep. This obstruction leads to a decrease in airflow, known as hypopnea, or a complete absence of airflow, known as apnea, lasting for a minimum of 10 seconds. These episodes are typically accompanied by either a state of heightened brain activity or a decline in the level of oxygen saturation in the bloodstream [1]. The occurrence of recurrent instances of upper airway obstruction during sleep can lead to sleep fragmentation and the inability to achieve restorative sleep. Individuals with OSA may have symptoms such as fatigue, excessive daytime sleepiness, insomnia, or morning headaches [2]–[4]. However, it is important to note that a significant number of individuals with OSA may not exhibit any noticeable symptoms [5], [6]. In the Kingdom of Saudi Arabia (KSA), it was found that 33% of middle-aged males and 39% of middle-aged women were identified as having a high risk of OSA [5], [6]. OSA exhibits a higher occurrence in males, with an estimated prevalence of 4% in men compared to 2% in women, resulting in a male-to-female ratio of 2:1 [7]. This condition has been identified as a significant factor leading to diminished quality of life and poor work productivity [8], [9].

OSA has been found to be correlated with a higher prevalence of hypertension, type 2 diabetes mellitus, atrial fibrillation, heart failure, coronary heart disease, stroke, and mortality [10]–[13]. Apnea hypopnea index (AHI) quantifies the severity of OSA by representing the number of apnea and hypopnea events per hour of sleep. This metric represents the mean frequency of notable respiratory disruptions per hour of sleep and is assessed using polysomnography (PSG) in various forms. Additional diagnostic techniques, such as assessing nasal airflow, respiratory effort, and occurrences of oxygen desaturation in blood during sleep (as shown in type 3 or 4 sleep studies), have demonstrated a satisfactory level of accuracy in diagnosing sleep disorders [14]. OSA can be identified by two methods: home-based or laboratory-based sleep testing. Furthermore, there are various effective treatments that can be employed to address this condition. Continuous positive airway pressure is widely regarded as the gold standard treatment for obstructive sleep apnea [15]. The present review discusses the distinct features of OSA and focuses on its prevalence in the countries included in the Gulf Corporation Council(GCC).

2. Prevalence of OSA in GCC

Multiple studies have shown that OSA is a disorder that has a very high prevalence rate, not only in the general population but also in particular illness-associated and population subgroups. According to the findings of comprehensive research, the overall prevalence was anything from 9-38 percent of the population. As people got older, their risk of having the condition rose, reaching as high as 90% in males and 78% in women in some elderly communities [16]. The GCC is a political and economic alliance consisting of six countries in the Middle East. These countries are Saudi Arabia, Kuwait, the United Arab Emirates (UAE), Qatar, and Bahrain. Numerous studies have revealed that OSA is prevalent in the GCC countries. According to a research from the World Health Organization (WHO), Kuwait has the second highest prevalence of OSA, which is closely followed by other Middle Eastern countries, specifically Qatar, Saudi Arabia, and UAE [17]. Whereas there are no studies available on prevalence of OSA in Bahrain. A few OSA studies concerning GCC are as follows:

Saudi Arabia

In a cross-sectional study at a sleep center within the King Abdul-Aziz University Hospital, Alshehri et al. estimated the impact of obesity on the severity of OSA by evaluating the relationship between OSA and BMI. They discovered that the prevalence of OSA was higher in patients who were obese (77.7%) than in patients who were not obese (22.3%). According to the PSG report's findings, patients who were obese had greater AHIs than non-obese individuals, which is a predictor of severe OSA [18]. A conservative estimate of at least 8.8% (12.8% in males and 5.1% in women) was determined for the total prevalence of OSA, according to a study by Wali OS et al. Age, gender, obesity, and hypertension were found to be independent risk factors for OSA in their multivariate study. They came to the conclusion that Saudi Arabians had an OSA rate and risk factors that are comparable to those found in Western research [19]. Another study conducted in Riyadh on the prevalence of OSA in middle-aged Saudi men discovered that 52.3% of the participants snore, 11.3% experienced breathing pauses more than once a week, and around 33.3% were classified as high risk OSA patients. They also came to the conclusion that the risk for OSA and the prevalence of snoring are comparable to those found in the US [20]. 19.3% of pregnant women and 16.6% of the control group were found to be at high risk for OSA in a recent, comparable study conducted among pregnant women in Saudi Arabia [21]. The next study from Saudi Arabia examined gender differences in a sample of 191 women and 193 men with OSA. It was a descriptive survey. When it came to the age at which OSA was diagnosed, they discovered that women were significantly older than men. This was attributed to the post-menopausal state in women, and they also found that women had a higher Body mass index (BMI) and a higher prevalence of comorbid conditions like diabetes, asthma, hypertension, insomnia, and cardiac disease. Men also experienced greater and more frequent episodes of apnea/hypopnea, but these were primarily observed in non-REM (non-rapid eye movement) sleep [22]. A 2020 study conducted on school children from west Saudi Arabia found that around 23% of Saudi schoolchildren are at risk of sleep-disordered breathing [23]. The presence of obstructive sleep apnea (OSA) was investigated in pilots and first officers working for Saudi-based airlines in a cross-sectional study in 2021, and it was discovered that 69% of the sample population had OSA by using home sleep testing. The majority of which had mild OSA (64%), with 5% having moderate OSA (2.5%) and 5% having severe OSA (2.5%) [24]. The overall knowledge level was determined to be low for 80.7% of the total sample and good for merely 19.3%, according to a study that was conducted in 2019 and analysed the Saudi population's awareness of obstructive sleep apnea and the factors that determine their awareness level. As a result, there is a level of awareness that has to be improved and addressed in Saudi Arabia [25].

Oman

In order to ascertain the percentage of young Omani adults who admit to daytime sleepiness while driving and to look into correlations between gender, daytime sleepiness, and OSA risk, Al-Abri MA et al. in 2018 discovered that 25.2% of them admitted to daytime sleepiness while driving at least once a month [26]. An estimate of the prevalence of OSA in Oman's severe asthma patients from 2022 revealed a significant prevalence of OSA (32.37%) in these patients [27]. A comparable study came to the conclusion that men were more likely than women to have significant Apnea-hypopnea index (AHI). The data show that there is a gender difference in the prevalence of OSA and that obesity is a major risk factor for Omani males, whereas age is a risk factor for women. There was a significant correlation between AHI and BMI among men compared to women [28].

United Arab Emirates (UAE)

The prevalence rate of OSA syndrome (OSAS) was found to be 20.9% in a study conducted in Dubai. The study also examined the relationship between obesity and OSA and the prevalence of OSA symptoms and risk in the primary health care setting. Of the respondents, 22.9% of the males and 19.5% of the females were at high risk for OSAS. The average age of the female respondents who were at high risk for OSAS was 39.95 years [29]. A 2022 study evaluated the severity of high-risk Sleep-disordered breathing (SDB) in children and adolescents seeking paediatric dental care and found that a total of 12.3% of children in the sample were at high-risk of SDB [30].

Qatar

The Epworth Sleepiness Scale was utilised in a Qatari investigation to determine the predictive risk factors impacting the development of OSA based on whether or not snoring was the main complaint. They found that, at 84%, men

made up the majority of snorer patients, while women made up only 21.5%. Additionally, it was discovered that neck circumference, particularly in the male population, was a statistically significant risk factor for OSA rather than fat, and that men had the bulk of these OSA episodes more frequently than women. In contrast, among Qatari women, BMI was a predictor of both the severity of OSA and the course of the condition [31]. Patients with OSA were documented, together with their risk factors, in a different study conducted in Qatar. They discovered that 55% of the patients who were referred had been diagnosed with OSA, and that men were more likely than women to have OSA [32]. Another Qatar study was in agreement with a male predominance [33].

Kuwait

The frequency of individuals in Kuwait's working population who are classified as being at high risk for OSA was calculated by Al-Qattan H et al in 2021. They discovered that 20% of participants were considered to be at high risk for OSA overall, with a higher percentage of male individuals than female subjects meeting this criterion, however the difference did not reach statistical significance. Moreover, patients who were older and obese had a higher incidence of OSA. Longer television viewing sessions, lower self-perceived physical health, and current smoking status were all linked to an increased prevalence of a high risk for OSA. However, increased participation in high-intensity physical exercise and longer nightly sleep duration were associated with declining trends in the prevalence of elevated risk for OSA. The participants at high risk for OSA had higher rates of depression, diabetes, hypertension, and insomnia disorder than those at low risk. According to this study, 1/5 of working individuals in Kuwait were thought to be at high risk for OSA, and the prevalence varied depending on lifestyle and personal characteristics [34]. In their assessment of the prevalence of OSA in Kuwaiti patients with stable uncontrolled asthma, Shaarawy H et al. discovered that 15 of the 60 patients in their research had OSA [35]. Khogali FW et al in 2021, has performed a review and summary of the literature on obesity and OSA in GCC, concluding that obesity is becoming more common in the region and that there is a clear link between obesity and OSA and the emergence of consequences from the disease [36].

3. Risk Factors

Age

Sleep-related issues such trouble falling asleep, nighttime awakenings, and sleep quantity grow more common with age [37]. In a landmark study conducted by Ancoli-Israel et al., it was observed that a significant proportion of individuals aged 65 to 99 years exhibited OSA. Specifically, the study found that 70% of men and 56% of women in this age group met the diagnostic criteria for OSA, which was defined as an AHI of 10 or more occurrences per hour [38]. The findings derived from the Sleep Heart Health Study, which is community-based, indicate a progressive rise in the prevalence of disease as individuals advance in age, ultimately reaching a state of stability beyond the age of 60 years [39]. In other cohorts, moderate to severe OSA prevalence remains essentially steady during the sixth decade of life. Fat deposition in the parapharyngeal area, soft palate lengthening, and changes in body components around the pharynx may explain the age-related rise in prevalence. Whether OSA in elderly people is different from that in middle-aged adults is still debated [40], [41].

Obesity

Medical sleep evaluations often identify excess body weight in over 60% of patients. Global epidemiologic research have shown body weight as the biggest risk factor for OSA. A one standard deviation body mass index (BMI) difference was related with a 4-fold increase in illness prevalence in the Wisconsin Sleep Cohort research [42]. In addition, data from the Sleep Heart Health Study, the Wisconsin Sleep Cohort Study, and the Cleveland Family Study demonstrate that an increase in body weight over time can accelerate the progression of OSA or contribute to the development of moderate to severe disease. Although obesity and OSA are linked, there is disagreement over whether particular body habitus measurements (such as neck and waist circumferences) that indicate a central as opposed to peripheral distribution of fat are linked to a higher risk of obstructive sleep apnea even after adjusting for body mass index [43]. Given that the pathophysiology of OSA is closely related to obesity, with an estimated 58% of moderate to severe cases attributable to a BMI greater than or equal to 25 kg/m2, effective strategies to achieve long-term weight loss are urgently required to curb the epidemics of obesity and obstructive sleep apnea [44].

Sex

It is well known that men are more susceptible to OSA than women. Several clinical trials have suggested that men to women ratios in individuals referred for clinical evaluation are 5 to 8:144. Several reasons explain the sex discrepancies between clinic- and population-based research. First, OSA may affect women differently than men, with women not reporting loud snoring, nocturnal snorting or gasping, or witnessed apneas. According to referral centre studies, women with OSA report more exhaustion and lack of vitality than males [45]–[47]. Additionally, the different responses of the bed partner to the symptoms of obstructed breathing during sleep may also play a role in the clinical underrecognition of the disorder in women. Ultimately, it is plausible that healthcare providers may exhibit a diminished level of suspicion when it comes to contemplating OSA in males compared to females, potentially due to the prevailing belief that this condition primarily affects men. Regardless of the cause, the lack of awareness of OSA holds importance in the field of public health. This is due to the fact that a delayed diagnosis and treatment of this condition in women can lead to substantial medical morbidity and an escalation in healthcare expenses [48]. In addition to prevalence, women and men

have different PSG sleep and breathing patterns. Finally, exogenous androgen therapy in men and women can worsen OSA, despite minimal controlled data. The physiological basis supporting male sex as an independent OSA risk factor needs more in-depth research.

Race

Several limitations must be taken into account when interpreting the data linking race to an increased risk for OSA. Firstly, comorbid medical conditions, such as obesity, are more prevalent in minority populations. These factors, in conjunction with a low socioeconomic status and disadvantages in health care, could explain the higher prevalence of OSA [49]–[51]. Thus, ethnicity may serve as a proxy for other predisposing factors, and any additional risk observed in minority samples may vanish if confounding factors are adequately controlled for. Second, due to the intermixing of distinct racial groups, self-reported classification of subjects into a particular group will be imperfect. Given the advances in genomics, improved methods for racial classification may shed new light on why some groups are more susceptible to OSA than others [52].

Craniofacial Anatomy

A number soft and hard tissue factors may affect the upper airway's mechanical properties and increase its tendency to collapse during sleep. During wakefulness, static cephalometric analyses employing radiography, computed tomography, and magnetic resonance imaging have revealed a number of skeletal and soft-tissue structural differences between those with and without OSA. Retrognathia, tonsillar hypertrophy, an enlarged tongue or soft palate, an inferiorly positioned hyoid bone, maxillary and mandibular retroposition, and a decreased posterior airway space can reduce upper airway dimensions and increase the incidence of apneas and hypopneas during sleep [53], [54]. Although there are no apparent craniofacial anomalies, slight variations in the size of the upper or lower jaw can heighten the susceptibility to OSA. The findings of a meta-analysis examining craniofacial risk factors indicate that mandibular body length exhibits the most robust correlation with heightened risk [55].

Genetics

Multiple comprehensive investigations have substantiated the involvement of inheritance and familial variables in the development of OSA [56]. Individuals who have first-degree relatives affected by the condition exhibit a higher susceptibility compared to individuals whose first-degree relatives are unaffected by the disorder. The likelihood of developing obstructive sleep apnea due to familial factors is positively correlated with the number of affected relatives [57]. The segregation studies conducted in the Cleveland Family Study indicate that genetic factors account for a significant proportion of the variance in disease severity, regardless of BMI. These genetic factors may contribute up to 35% of the observed variance, and there is a possibility that racial inequalities exist in the manner in which these genetic factors are inherited [58]. Nevertheless, there are views suggesting that the presence of confounding variables, such as obesity, hinders the establishment of conclusive findings regarding the genetic basis of OSA. Consequently, further investigations are required to more accurately determine the extent to which this illness is influenced by genetic factors. In light of the substantial evidence linking these factors to the development of obesity, it is pertinent to consider the genetic drivers of obesity and regional fat distribution. While further clarification is required about the genetic underpinnings of OSA, existing evidence indicates that inquiring about familial background can be a valuable tool in identifying individuals who may have the condition but have not yet been diagnosed [59].

Smoking and Alcohol Consumption

Alcohol and cigarette consumption have been suggested as potential risk factors for OSA as smoking increases the risk of snoring and OSA, according to epidemiological studies. [60] Second-hand smoking has also been linked to chronic snoring. Since former smokers do not exhibit an increased risk for obstructive sleep apnea, airway inflammation and damage caused by cigarette smoke may modify the mechanical and neural properties of the upper airway, thereby increasing its collapsibility during sleep. It has been demonstrated that drinking alcohol prior to bed increases the collapsibility of the upper airways, which can cause obstructive apneas and hypopneas to occur during sleep. Normal or asymptomatic people can get apnea from alcohol [61], [62]. Alcohol might prolong apnea and aggravate hypoxemia. Alcohol causes or increases pharyngeal collapse through unknown processes [60].

Medical History

In addition to affecting daily sleep and cognitive ability, OSA has been linked to cardiovascular diseases such hypertension, coronary artery disease, congestive heart failure, and stroke. Other concomitant illnesses like coronary artery disease may benefit directly and indirectly from early detection and treatment of OSA. Such improvements highlight the importance of considering undiagnosed OSA in the presence of medical conditions like uncontrolled hypertension, coronary artery disease, congestive heart failure, stroke, and diabetes mellitus [60].

4. Conclusion

In the past literature, OSA studies have identified its prevalence, risk factors, symptoms, diagnostic methods, and effective treatments. Due to OSA prevalence in GCC and its multiple noted negative complications, more clinical studies and trials on OSA are recommended in order to better comprehend its effects. To help diagnose and treat OSA early, community and health sector knowledge of this illness is crucial and should be focused on by authorities.

Conflict of Interest

The author declares no conflict of interests. Author read and approved final version of the paper.

References

[1] Neoh, M. J. Y., Carollo, A., Lim, M., Dimitriou, D., & Esposito, G. (2023). A scientometric review of obstructive sleep apnea and obesity. Applied Sciences, 13(2), 753.

[2] Mirrakhimov, A. E., Sooronbaev, T., & Mirrakhimov, E. M. (2013). Prevalence of obstructive sleep apnea in Asian adults: a systematic review of the literature. BMC Pulmonary Medicine, 13, 1-10.

[3] Vazir, A., & Kapelios, C. J. (2023). Sleep-disordered breathing and cardiovascular disease: who and why to test and how to intervene?. Heart. http://dx.doi.org/10.1136/heartjnl-2019-316375

[4] Arnardottir, E. S., Bjornsdottir, E., Olafsdottir, K. A., Benediktsdottir, B., & Gislason, T. (2016). Obstructive sleep apnoea in the general population: highly prevalent but minimal symptoms. European Respiratory Journal, 47(1), 194-202.

[5] BaHammam, A. S., Al-Rajeh, M. S., Al-Ibrahim, F. S., Arafah, M. A., & Sharif, M. M. (2009). Prevalence of symptoms and risk of sleep apnea in middle-aged Saudi women in primary care. Saudi Medical Journal, 30(12), 1572-1576.

[6] BaHammam, A. S., Alrajeh, M. S., Al-Jahdali, H. H., & BinSaeed, A. A. (2008). Prevalence of symptoms and risk of sleep apnea in middle-aged Saudi males in primary care. Saudi Medical Journal, 29(3), 423-426.

[7] Aljawadi, M. H., Khoja, A. T., BaHammam, A. S., Alyahya, N. M., Alkhalifah, M. K., & AlGhmadi, O. K. (2021). Determining the prevalence of symptoms and risk of obstructive sleep apnoea among old Saudis. Journal of Taibah University Medical Sciences, 16(3), 402-412.

[8] Punjabi, N. M. (2008). The epidemiology of adult obstructive sleep apnea. Proceedings of the American Thoracic Society, 5(2), 136-143.

[9] Shaya, F. T., Lin, P. J., Aljawadi, M. H., & Scharf, S. M. (2009). Elevated economic burden in obstructive lung disease patients with concomitant sleep apnea syndrome. Sleep and Breathing, 13, 317-323.

[10] Dempsey, J. A., Veasey, S. C., Morgan, B. J., & O'Donnell, C. P. (2010). Pathophysiology of sleep apnea. Physiological Reviews, 90(1), 47-112.

[11] Somers, V. K., White, D. P., Amin, R., Abraham, W. T., Costa, F., Culebras, A., ... & Young, T. (2008). Sleep apnea and cardiovascular disease: An American heart association/ American college of cardiology foundation scientific statement from the American heart association council for high blood pressure research professional education committee, council on clinical cardiology, stroke council, and council on cardiovascular nursing in collaboration with the national heart, lung, and blood institute national center on sleep disorders research (national institutes of health). Circulation, 118(10), 1080-1111.

[12] Javaheri, S., Barbe, F., Campos-Rodriguez, F., Dempsey, J. A., Khayat, R., Javaheri, S., ... & Somers, V. K. (2017). Sleep apnea: types, mechanisms, and clinical cardiovascular consequences. Journal of the American College of Cardiology, 69(7), 841-858.

[13] Baaisharah, S. S., Bamagoos, A. A., Altaib, H. O., Alamaa, M. N., Aljammali, K. W., Bafakeer, B. S., & Wali, S. O. (2017). Prevalence of depression, anxiety, and stress among obstructive sleep apnea patients in Saudi Arabia. Saudi Journal of Internal Medicine, 7(1), 5-12.

[14] Eastwood, P. R., Malhotra, A., Palmer, L. J., Kezirian, E. J., Horner, R. L., Ip, M. S., ... & Hillman, D. R. (2010). Obstructive sleep apnoea: from pathogenesis to treatment: current controversies and future directions. Respirology, 15(4), 587-595.

[15] Booth, A. J., Djavadkhani, Y., & Marshall, N. S. (2014). A critical review of the treatment options available for obstructive sleep apnoea: an overview of the current literature available on treatment methods for obstructive sleep apnoea and future research directions. Bioscience Horizons, 7, Article, hzu011.

[16] Senaratna, C. V., Perret, J. L., Lodge, C. J., Lowe, A. J., Campbell, B. E., Matheson, M. C., ... & Dharmage, S. C. (2017). Prevalence of obstructive sleep apnea in the general population: a systematic review. Sleep Medicine Reviews, 34, 70-81.

[17] Vats, M. G., Mahboub, B. H., Al Hariri, H., Al Zaabi, A., & Vats, D. (2016). Obesity and sleep-related breathing disorders in Middle East and UAE. Canadian Respiratory Journal, 2016.

[18] Alshehri, K. A., Bashamakh, L. F., Alshamrani, H. M., Alghamdi, I. O., Mahin, B. A., Alharbi, A. A., ... & Alhejaili, F. F. (2019). Pattern and severity of sleep apnea in a Saudi sleep center: the impact of obesity. Journal of Family & Community Medicine, 26(2), 127-132.

[19] Wali, S. O., Abalkhail, B., & Krayem, A. (2017). Prevalence and risk factors of obstructive sleep apnea syndrome in a Saudi Arabian population. Annals of Thoracic Medicine, 12(2), 88-94.

[20] Alruwaili, H., Ahmed, A., Fatani, A., Al-Otaibi, K., Al-Jahdali, S., Ali, Y., ... & Al-Jahdali, H. (2015). Symptoms and risk for obstructive sleep apnea among sample of Saudi Arabian adults. Sleep and Biological Rhythms, 13, 332-341.

[21] Almeneessier, A. S., Alangari, M., Aldubayan, A., Alsharidah, A., Altaki, A., Olaish, A. H., ... & BaHammam, A. S. (2020). Prevalence of symptoms and risk of obstructive sleep apnea in Saudi pregnant women. Annals of Thoracic Medicine, 15(3), 163-70.

[22] Alotair, H., & BaHammam, A. (2008). Gender differences in Saudi patients with obstructive sleep apnea. Sleep and Breathing, 12, 323-329.

[23] Zreaqat, M., Hassan, R., Samsudin, A. R., & Stas, Y. (2020). Prevalence of sleep-disordered breathing and its association with obesity among Saudi schoolchildren. The Journal of Contemporary Dental Practice, 21, 1022-1026.

[24] Alhejaili, F., Hafez, A., Wali, S., Alshumrani, R., Alzehairi, A. M., Balkhyour, M., & Pandi-Perumal, S. R. (2021). Prevalence of obstructive sleep apnea among Saudi pilots. Nature and Science of Sleep, 537-545.

[25] Shehata, S., Mardhamah, N., Alrushaydan, A., Alqahtani, N., Alzahrany, A., & Alfentokh, O. (2019). Population awareness regarding obstructive sleep apnea in Saudi Arabia. International Journal of Medicine in Developing Countries, 239, 45.

[26] Al-Abri, M. A., Al-Adawi, S., Al-Abri, I., Al-Abri, F., Dorvlo, A., Wesonga, R., & Jaju, S. (2018). Daytime sleepiness among young adult Omani car drivers. Sultan Qaboos University Medical Journal, 18(2), e143.

[27] Al-Lawati, F., Al-Mubaihsi, S. M., Jayakrishnan, B., Rizvi, S., & Al-Abri, M. A. (2022). Obstructive sleep apnea in patients with severe asthma: Prevalence and association between severity and asthma control. Annals of Thoracic Medicine, 17(2), 118-123

[28] Al-Abri, M., Al-Hashmi, K., Jaju, D., Al-Rawas, O., Al-Riyami, B., & Hassan, M. (2011). Gender difference in relationship of apnoea/hypopnoea index with body mass index and age in the omani population. Sultan Qaboos University Medical Journal, 11(3), 363-368.

[29] Mahboub, B., Afzal, S., Alhariri, H., Alzaabi, A., Vats, M., & Soans, A. (2013). Prevalence of symptoms and risk of sleep apnea in Dubai, UAE. International Journal of General Medicine, 109-114.

[30] Abdalla, M., Halabi, M., Kowash, M., Hussein, I., Khamis, A., & Salami, A. (2022). Sleep-disordered breathing in children and adolescents seeking paediatric dental care in Dubai, UAE. European Archives of Paediatric Dentistry, 23(3), 485-494.

[31] Ibrahim, A. S., Almohammed, A. A., Allangawi, M. H., Aleem A. Sattar, H. A., Mobayed, H. S., Panneerselvam, B., & Philipose, M. V. (2007). Predictors of obstructive sleep apnea in snorers. Annals of Saudi Medicine, 27(6), 421-426.

[32] Mannarino, M. R., Di Filippo, F., & Pirro, M. (2012). Obstructive sleep apnea syndrome. European Journal of Internal Medicine, 23(7), 586-593.

[33] Al Ansari, A., Al-Saey, H., Al-Sulaiti, M., Ganesan, S., Abdul Sattar, H., Balamurugam, P., & Philipose, M. V. (2007). Body Mass Index (BMI) and Neck Circumference (NC) in Diagnosing Obstructive Sleep Apnea. Qatar Medical Journal, 2007(1), 15.

[34] Al-Qattan, H., Al-Omairah, H., Al-Hashash, K., Al-Mutairi, F., Al-Mutairat, M., Al-Ajmi, M., ... & Ziyab, A. H. (2021). Prevalence, risk factors, and comorbidities of obstructive sleep apnea risk among a working population in Kuwait: a cross-sectional study. Frontiers in Neurology, 12, Article, 620799.

[35] Shaarawy, H., & Affara, N. (2013). Assessment of the prevalence of obstructive sleep apnea in patients with stable uncontrolled asthma, impact of continuous positive airway pressure treatment. Egyptian Journal of Chest Diseases and Tuberculosis, 62(1), 183-187.

[36] Khogali, F. W. E., Hammoudeh, S., & Janahi, I. A. (2021). Obstructive Sleep Apnea and Obesity in Gulf Cooperation Council (GCC) Countries. Fortune Journal of Health Sciences, 4(3), 456-469.

[37] Kapur, V., Strohl, K. P., Redline, S., Iber, C., O'connor, G., & Nieto, J. (2002). Underdiagnosis of sleep apnea syndrome in US communities. Sleep and Breathing, 6(02), 049-054.

[38] Ancoli-Israel, S., Ancoli-Israel, S., Kripke, D. F., Kripke, D. F., Klauber, M. R., Mason, W. J., ... & Kaplan, O. (1991). Sleep-disordered breathing in community-dwelling elderly. Sleep, 14(6), 486-495.

[39] Young, T., Shahar, E., Nieto, F. J., Redline, S., Newman, A. B., Gottlieb, D. J., ... & Sleep Heart Health Study Research Group. (2002). Predictors of sleep-disordered breathing in community-dwelling adults: the Sleep Heart Health Study. Archives of Internal Medicine, 162(8), 893-900.

[40] Durán, J., Esnaola, S., Rubio, R., & Iztueta, Á. (2001). Obstructive sleep apnea-hypopnea and related clinical features in a population-based sample of subjects aged 30 to 70 yr. American Journal of Respiratory and Critical Care Medicine, 163(3), 685-689.

[41] Malhotra, A., Huang, Y., Fogel, R., Lazic, S., Pillar, G., Jakab, M., ... & White, D. P. (2006). Aging influences on pharyngeal anatomy and physiology: the predisposition to pharyngeal collapse. The American Journal of Medicine, 119(1), 72-e9.

[42] Kinugawa, K. (2023). Obstructive sleep apnea and dementia: A role to play?. Revue Neurologique, 179(7), 793-803.

[43] Udwadia, Z. F., Doshi, A. V., Lonkar, S. G., & Singh, C. I. (2004). Prevalence of sleep-disordered breathing and sleep apnea in middle-aged urban Indian men. American Journal of Respiratory and Critical Care Medicine, 169(2), 168-173.

[44] Young, T., Peppard, P. E., & Taheri, S. (2005). Excess weight and sleep-disordered breathing. Journal of Applied Physiology, 99(4), 1592-1599.

[45] Benca, R. M., Krystal, A., Chepke, C., & Doghramji, K. (2023). Recognition and Management of Obstructive Sleep Apnea in Psychiatric Practice. The Journal of Clinical Psychiatry, 84(2), 45191.

[46] Selvadurai, S., Voutsas, G., Katz, S. L., Blinder, H., & Narang, I. (2022). Evaluating symptoms and polysomnographic findings among male and female children with obesity with and without obstructive sleep apnea. Sleep Medicine, 100, 56-63.

[47] Chervin, R. D. (2000). Sleepiness, fatigue, tiredness, and lack of energy in obstructive sleep apnea. Chest, 118(2), 372-379.

[48] Shepertycky, M. R., Banno, K., & Kryger, M. H. (2005). Differences between men and women in the clinical presentation of patients diagnosed with obstructive sleep apnea syndrome. Sleep, 28(3), 309-314.

[49] Banno, K., Manfreda, J., Walld, R., Delaive, K., & Kryger, M. H. (2006). Healthcare utilization in women with obstructive sleep apnea syndrome 2 years after diagnosis and treatment. Sleep, 29(10), 1307-1311.

[50] Alotaibi, S. D., Alotaibi, A. S., Barashi, M. A., Khojah, M. Z., & Rajeh, M. T. (2022). The influence of obstructive sleep apnea on self-perceived dental aesthetics and need for orthodontic treatment among the general population in Makkah, Saudi Arabia. Journal of Orthodontic Science, 11, 52.

[51] Ahmed, A. E., Al-Jahdali, F., AlALwan, A., Abuabat, F., Salih, S. B., Al-Harbi, A., ... & Al-Jahdali, H. (2017). Prevalence of sleep duration among Saudi adults. Saudi Medical Journal, 38(3), 276.

[52] Gottlieb, D. J., & Punjabi, N. M. (2020). Diagnosis and management of obstructive sleep apnea: a review. Jama, 323(14), 1389-1400.

[53] Liu, Y., Zhao, T., Ngan, P., Qin, D., Hua, F., & He, H. (2023). The dental and craniofacial characteristics among children with obstructive sleep apnoea: a systematic review and meta-analysis. European Journal of Orthodontics, cjac074.

[54] Cakirer, B., Hans, M. G., Graham, G., Aylor, J., Tishler, P. V., & Redline, S. (2001). The relationship between craniofacial morphology and obstructive sleep apnea in whites and in African-Americans. American Journal of Respiratory and Critical Care Medicine, 163(4), 947-950.

[55] Al Nufaiei, Z. F., Alluhibi, R. H., Alsabti, M. B., Onaybisi, H. S., Alahmadi, L. M., Jabal, S. A., & Al Zhranei, R. M. (2023). Knowledge and awareness of obstructive sleep apnea among patients' families in Saudi Arabia.

[56] Redline, S., & Tishler, P. V. (2000). The genetics of sleep apnea. Sleep Medicine Reviews, 4(6), 583-602.

[57] Wang, J., Lam, S. P., Huang, B., Liu, Y., Zhang, J., Mandy, W. M., ... & Wing, Y. K. (2023). Familial α-synucleinopathy spectrum features in patients with psychiatric REM sleep behaviour disorder. Journal of Neurology, Neurosurgery & Psychiatry, 94(11), 893-903.

[58] Buxbaum, S. G., Elston, R. C., Tishler, P. V., & Redline, S. (2002). Genetics of the apnea hypopnea index in Caucasians and African Americans: I. Segregation analysis. Genetic Epidemiology: The Official Publication of the International Genetic Epidemiology Society, 22(3), 243-253.

[59] Palmer, L. J., Larkin, E. K., Elston, R. C., Redline, S., Patel, S. R., & Tishler, P. V. (2004). Linkage to Apnea-Hypopnea Index Across the Life-Span: Is this a Viable Strategy?. American Journal of Respiratory and Critical Care Medicine, 170(11), 1260-1261.

[60] Johar, R. A., Bakhamees, F. H., & Altamimi, J. O. (2021). Obstructive sleep apnea: A review article. Saudi Journal of Oral and Dental Research, 6(5), 221-226.

[61] Khoo, S. M., Tan, W. C., Ng, T. P., & Ho, C. H. (2004). Risk factors associated with habitual snoring and sleep-disordered breathing in a multi-ethnic Asian population: a population-based study. Respiratory Medicine, 98(6), 557-566.

[62] Franklin, K. A., Gíslason, T., Omenaas, E., Jögi, R., Jensen, E. J., Lindberg, E., ... & Janson, C. (2004). The influence of active and passive smoking on habitual snoring. American Journal of Respiratory and Critical Care Medicine, 170(7), 799-803.