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Obstructive Sleep Apnoea: epidemiology, quality of life, and management – implications for dentists. A review

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DP Motloba[1], OA Ayo-Yusuf[2], YF Solomons[3], MPS Sethusa[4]

ABSTRACT/SUMMARY

Obstructive Sleep Apnoea (OSA) is a common respiratory disorder due to upper airway blockage resulting in reduced, or absence of, breathing. OSA remains largely underdiagnosed despite evidence that it is an independent risk factor for cardiovascular and neurological morbidity and mortality. The currently increasing levels of obesity, diabetes, smoking and alcohol use call for increased vigilance by doctors and dentists in identifying and managing patients with signs and symptoms of OSA. This review provides an update on the epidemiology of OSA, on its impact on quality of life and on the implications of the condition for dentists.

Keywords: obstructive sleep apnoea, snoring, quality of life, oral appliance

INTRODUCTION

Obstructive sleep apnoea (OSA), a subset of Sleep Disordered Breathing (SDB), affects 2-5% of the population in the western world[1-3] whilst in other parts of the world the condition is probably largely underestimated.[4] OSA is characterised by repeated episodes of apnoea and hypopnoea during sleep due to the collapse of the upper airway. Common manifestations are: loud snoring; gasping sensation; daytime sleepiness, forgetfulness, mood changes, insomnia etcetera.[5] The risk factors for OSA include obesity, cardiovascular diseases, diabetes, hypertension, smoking and alcohol making this condition a significant public health problem, and a cause of morbidity and mortality.[1,6] OSA impacts greatly on the patient's social, psychological, economic, physical and overall quality of, life.[7-9] Management of OSA entails a long-term, multidisciplinary regime, which incorporates the integration of medical, behavioural and surgical alternatives, administered by well-trained physicians, dentists and other health professionals.[5,10,11] The aim of this study was to review the literature in order to understand (i) the epidemiology of

ACRONYMS

AHI: Apnoea-Hypopnea Index
BMI: Body Mass Index
CAD: Coronary artery disease
EDS: Excessive daytime sleepiness
FLP: Functional Limitation Profile
FOSQ: Functional Outcomes of Sleep Questionnaire
HRQoL: Health-related quality of life
HT: Hypertension
MSLT: Multiple Sleep Latency Test
MWT: Maintenance of Wakefulness Tests
NHP: Nottingham Health Profile
OA: Oral appliances
ODI: Oxygen desaturation index
OSA: Obstructive Sleep Apnoea
OSA–18: Franco's Paediatric Obstructive Sleep Apnoea Questionnaire
PAP: Positive Airway Pressure
APAP: autotitrating PAP
CPAP: continuous PAP
BPAP: bilevel PAP
PM: Portable monitors
POMS: Profile of Mood States
PSG : Polysomnography
SDB: Sleep Disordered Breathing
SF36: Medical Outcome Study Short Form
SIP: Sickness Impact Profile

1. **DP Motloba:** *BDS, MPH(Epid), MDent (Comm.Dent), MBL.* Head, Department of Community Dentistry. School of Oral Health Sciences, Sefako Makgatho Health Sciences University.
2. **OA Ayo-Yusuf:** *BDS, DHSM, MSc Odont, MPH, PhD.* Professor and Dean/Director. School of Oral Health Sciences, Sefako Makgatho Health Sciences University.
3. **YF Solomons:** *BDS, MDent (Prosthodontics).* Department of Prosthodontics. School of Oral Health Sciences, Sefako Makgatho Health Sciences University.
4. **MPS Sethusa:** *B (Diag) Rad, BDS, PDD, M Dent (Orthodontics), P G Dip (UWC).* Head of the Department of Orthodontics. School of Oral Health Sciences, Sefako Makgatho Health Sciences University.

Corresponding author

DP Motloba:
Head, Department of Community Dentistry, School of Oral Health Sciences, Sefako Makgatho Health Sciences University.
E-mail: pagollang.motloba@smu.ac.za

OSA and its impact on health related quality of life and (ii) to clarify the role of dentists in the management of OSA.

METHODOLOGY

In conducting this narrative review, we searched Medline (National Library of Medicine, 1966 to 2015) for relevant electronic journals. Only English-language journals were considered for this review. The MeSH headings and keywords used in the search were 'sleep', 'sleep apnoea', 'obstructive sleep apnoea', 'sleep disordered breathing', 'epidemiology',' quality of life', 'oral appliances', 'treatment'. In order to increase retrieval rate, we undertook a hand search of referenced articles. To minimise the possibility of omitting relevant articles, we scanned Sleep and Otolaryngology journals and reviewed treatment guidelines from key academic groups. Articles were excluded from the review if there was a failure to address the epidemiology and treatment of OSA or the health-related quality of life (HRQoL), or did not report the use of validated HRQoL instruments like SF-36, NHP, SIP, and FLP. Included in this paper are original articles and/or reviews.

LITERATURE REVIEW

i. Definition and classification of Obstructive Sleep Apnoea

OSA is defined by the number of apnoeas (cessation of breathing), and/or hypoponeas (reduced airflow) experienced per hour (measured using the Apnoea-Hypopnea Index or AHI).[5] These apnoeas and hypopnoeas can occur up to 400 times during sleep and each may last up to 1-2 minutes followed by gasps for air. OSA occurs as a result of obstruction of the airway by anatomical structures in the mouth and back of the throat.

Diagnosis of OSA includes objective in-laboratory polysomnography (PSG) or portable monitors (PM), and sleep history, clinical examination and subjective evaluation of HRQoL. A positive diagnosis of OSA is made when AHI>5. The severity is catalogued as mild with an AHI over 5 but less than 15, as moderate with an AHI between 15 and 30, and as severe with an AHI over 30 with additional symptoms.[10,12]

ii. Epidemiology of OSA

a. Gender and distribution of obstructive sleep apnoea

OSA is more prevalent in males than in females, the mild form afflicting 3% to 28% of sufferers, whilst the moderate form is diagnosed in 1%-14% of the affected population.[4,13] The risk of progression from mild to severe OSA (AHI≥30) is six-fold in patients who gain 10% in weight.[1,2,7] Males have a 2-8 times greater risk of developing OSA than females. It is postulated that sex hormones explain the OSA-associated phenotypical differences between men and women, such as the amount of neck and abdominal fat.[13,14] The causal relationship between gender and OSA may be confounded by exogenous exposures (i.e. occupational and environmental) and by socio-behavioural risks factors such as smoking and alcohol use. Men seek medical help late, often only when the conditions are worse, and hence tend to report more severe forms of OSA than females. Furthermore, it has been suggested that health practitioners are more inclined to suspect OSA in males than in females, leading to over-diagnosis in men.[15] Male gender as an independent risk factor for OSA is still unclear and requires further research.

(b) Obstructive sleep apnoea in relation to age

OSA related symptoms increase with age. Failure to fall asleep, frequency and duration of night awakenings and snoring are among common complaints in adults 65 years and older.[2,16] The risk of OSA (AHI≥10) for adults over 65 years is 6.6 times the risks facing those between 20 and 44 years. The prevalence of OSA (AHI≥10) in males aged 20 to 44, 45 to 64 and 65 and above years rose from 3.2% to 11.3% and 18.1% respectively.[2,17] Amongst women, the increase in prevalence of OSA (AHI≥15) rose from 0.6% to 2.0% and 7.0% for ages 20 to 44, 45 to 64 and 65 and above respectively.[2,17,18] For both genders the prevalence of OSA plateaued around 60 years of age, after a steady increase from younger ages. It is postulated that an increase in fat deposits in the parapharynx and comorbid conditions predispose the elderly to development of OSA. In the absence of strong evidence from longitudinal studies, it remains unclear whether OSA in the elderly is a distinct condition compared with how it presents in younger adults.[19]

(c) Race, ethnicity and obstructive sleep apnoea

Evidence of a relationship between race, ethnicity and OSA is inconclusive. Ancoli-Israel and Kripke found that African Americans have a risk of suffering OSA 2.5 times higher than do Caucasians, even after controlling for Body Mass Index (BMI: ratio of weight in kgs to the square of the height in meters) and comorbidities.[16] Contrary findings from the Sleep Heart Health Study indicate that the risks are similar across race groups, irrespective of age, gender and BMI.[20] The prevalence of OSA in African Americans could be due to high rates of significant comorbidities (obesity, diabetes, HT), limited access to care, low socio-economic position, and distinct culture practices (diet, behaviour patterns etc.).[21]

iii. Risk factors for OSA

a. Excessive Body Weight and OSA

A cause-effect and effect-cause relationship exists between body weight and obstructive sleep apnoea. A study in the UK found that 60 to 90% of patients with OSA have excessive body weight.[21] Patients with impaired glucose metabolism and high BMI are particularly at risk of severe OSA.[22] Fat deposits reduce the lumen and hence the volume of the respiratory tract leading to hypopnoea and apnoea due to decreased airflow.[23] Evidence of a positive "dose-response" relationship between BMI and OSA is discussed extensively in literature. Wall *et al.*[21] estimate the odds of developing OSA to be 6.62 times higher in individuals with 30+ BMI than normal BMI, and the odds increase drastically to 27.5 times for 40+BMI.[15,23] It has been suggested that those having such high BMI's but without OSA will develop the condition, and those with OSA will develop more severe forms of the OSA, given excessive weight gain.

b. Hypertension (HT)

Hypertension is the most prevalent cardiovascular condition, affecting a third of adults worldwide, and 24.4% in South Africa.[24] The coexistence of OSA and hypertension in the same population groups highlights possible related aetiologies and the public health significance of effecting joint management of the two conditions.[14,20,26,27] According to the Sleep Heart Health Study the odds of developing HT increase with severity of OSA, reaching a plateau at very high levels of the condition.[20] Patients with mild OSA (AHI≥15) are three times more likely to be hypertensive than those who do not have OSA. Almost all patients (83%) with drug resistant hypertension have OSA.[15,21]

Evidence from human and animal studies confirm OSA as a cause of hypertension, the relationship varying with weight and age.[14]

c. Coronary artery disease (CAD)
OSA is an independent risk factor for coronary artery disease among adults, resulting in increased morbidity and mortality.[28] Patients with untreated OSA experience an increased incidence of cardiovascular events over those with controlled OSA. Similarly, the group with concurrent CAD and OSA experienced more pre-mature deaths than those without OSA.[29]

d. Heart failure, Stroke and Arrhythmia
There is an established etiologic causal relation between OSA, hypertension and CAD, which underpins the possible association of OSA and heart failure, stroke and arrhythmia.[27,28,29] The prevalence and serious outcomes of heart failure, stroke and arrhythmias increase relative to the presence and severity of OSA.

e. Craniofacial morphology
Craniofacial features may contribute to pharyngeal obstruction during sleep and increase the risk of OSA and related symptoms. Radiological and soft tissue analyses reveals that

i. collapsible and enlarged pharyngeal walls,
ii. low position of the hyoid bone,
iii. long and large tongue,
iv. long and thicker soft palate,
iv. shorter, narrower, and tapering maxilla,
v. retro-positioned maxilla, and
vi. deficient mandible are craniofacial features associated with OSA.[30,31]

Cakirer and colleagues demonstrated the association between anthropometric measures, namely cranial index and facial index, and OSA.[32] They concluded that brachycephaly was correlated with increased AHI in whites, and that brachycephaly could serve as a phenotypic clinical feature to identify patients at increased risk of OSA.[32] Cephalometric results are nevertheless inconclusive as indicators for OSA, and should be used in addition to other findings.[33]

f. Alcohol and smoking
Alcohol acts as a depressant and when used before sleep disturbs the nocturnal respiratory cycle, and may narrow the airways leading to apnoea. Despite this plausible causal mechanism, there is little evidence from large population based studies that can associate alcohol use with OSA.[34] Divergent findings also make it difficult to establish smoking as an independent risk factor for OSA. For example smokers were found to be three times more at risk of OSA than never-smokers, and never-smokers did not have increased risk of OSA than former smokers.[35,36]

OSA AND HEALTH RELATED QUALITY OF LIFE (HRQOL)

i. Overview of the concept of HRQoL and its assessment

Health related quality of life represents the patient's perception of the effect of illness and its subsequent management or treatment on their daily functioning.[9] HRQoL is measured based on four domains, physical and occupational function, psychological functions, social interaction and somatic sensation.[37] Despite extensive research, there is no consensus on what truly constitutes a comprehensive measure of the quality or life, nor is there consensus on which domains thoroughly explain this concept.

A wide array of instruments (generic and specific) have been used to measure HRQoL and OSA across a variety of study designs The most commonly used generic instruments (Medical Outcome Study Short Form – SF36, Nottingham Health Profile[39]– NHP, Sickness Impact Profile[39]–SIP and Functional Limitation Profile[40] –FLP) assess the physical, social, emotional, mental and general health functioning of an individual, summarising daily functioning and vitality. Specific descriptors evaluated using these tools include alertness or vigilance, activity levels (productivity, mobility or ambulation), self-care, bodily pain and some unusual activities related to physical limitations.[8]

Specific instruments measure HRQoL precisely, by evaluating the impact of OSA on activities in the daily lives of these patients. For example, Franco's Paediatric Obstructive Sleep Apnoea Questionnaire[41] (OSA–18), captures both the children's daytime functioning and the concerns of the caregivers. The Functional Outcomes of Sleep Questionnaire[42] (FOSQ) evaluates the sleep specific attributes like recreation, sexual intimacy and relationships with partners. Cohen's paediatric OSA surgery quality of life questionnaire[43] evaluates the impact of surgery (tracheostomy or sleep apnoea) on quality of life, by focussing on costs (to child and family, material and otherwise), physical, social and emotional dimensions.

The choice of instrument to use in evaluation of HRQoL in OSA patients depends on the purpose and population under investigation

ii. Effects of OSA on the quality of life.

Daytime consequences of OSA have a direct impact on the vitality, social, physical and psychological health of sufferers, and on the quality of their lives. OSA patients commonly suffer from a trilogy of significant dysfunctions categorised as impairment of daytime alertness, of cognition, and of quality of life.[44,45] These three attributes of daytime functioning have a cause-effect and effect-cause relationship with each other and form part of a complex web of causation associated with OSA.

1. Impaired daytime alertness
Excessive daytime sleepiness (EDS) is the cardinal symptom of OSA and is the most commonly reported measure of functional impairment in sleep disordered breathing (SDB). Subjective sleepiness assessment using POMS (Profile of Mood States) show reduced vigour and the EPS (Epworth Sleepiness Scale) shows increased fatigue, demonstrable by subjects dosing off while engaging in daily activities like watching television, working or driving.[46] Patients with OSA recorded lower scores for vigour on POMS than did controls (14 versus 23),[47] whilst, conversely, similarly poor scores were recorded for fatigue on EPS (8 versus 4). The Multiple Sleep Latency Test (MSLT, used in the diagnosis of narcolepsy) objectively indicated that the onset of sleep was slower in patients with OSA than in normal controls (<5 vs. 10).[47]

Similar results are observed from Maintenance of Wakefulness Tests (MWT) in which OSA patients remained

awake or vigilant for an average of 16 minutes compared with 27 minutes for controls.[48,49] Overwhelming evidence from clinical and epidemiological studies confirm that obstructive sleep apnoea leads to an impairment of performance on a scale of 2-3 times worse than the reference norms.[44,50]

2. Cognitive Impairment

Cognitive performance in research assesses the neuropsychological performance which includes the following functional abilities: - attention, memory, recall and learning, executive activities such as planning, organising and problem solving.[44] Data from clinical studies indicate moderate cognitive impairment effects in patients with OSA. Epidemiological studies on the other hand report low association between cognitive impairment and OSA (AHI). Individuals with OSA do display difficulties in performing new tasks, and a reduced efficiency in performing regular duties. It has hence been speculated that cognitive impartment among those with OSA might be a cofactor in motor vehicle accidents and work-related casualties.[44,50] Whilst the literature is limited, restricting conclusions, it may nevertheless be observed that OSA is associated more with sleepiness than with cognitive dysfunction.

3. Quality of Life

The poor quality of life in patients with OSA is a consequence of the impact of excessive daytime sleepiness and cognitive impairment on emotional and mental health, on physical and social functioning and on vitality.[45] Studies using generic and specific measures of HRQoL provide compelling evidence that the quality of life is substantially and differentially reduced depending on the severity of OSA.[7,8]

Areas of life impacted by OSA are broad and include:

i. daytime symptoms like unrefreshed sleep, fatigue, insomnia, lack of concentration, poor memory and attention, and generalised body pain.
ii. night-time experiences such as snoring, wakefulness, restless sleep, choking, dry mouth etc.
iii. effects on daily activities because of the urge to fall asleep, persistent napping during the day, difficulties in staying awake while doing work, reading and driving.
iv. increases in emotional states of impatience, lethargy, anxiety, depression and moods.[44,51]

Overall, OSA impacts on the ability of an individual to create 'social capital', and to meet the basic human need to socialise and build rewarding relations. For OSA patients the quality and frequency of interaction with friends, family and colleagues is comparatively compromised. Due to persistent snoring, OSA patients bother partners during sleep and are reluctant to accept overnight hospitality. They do not go out often and experience serious intimacy and sexual relationship challenges.[52-54] The causal relationship between OSA and HRQoL is undeniable despite the lack of "gold standard" instruments to measure quality of life.

MANAGEMENT OF OSA

A plethora of guidelines provide evidence-based approaches for the evaluation, management and long-term care of patients with OSA. Due to the long-term and serious consequences of OSA, it is recommended that a thorough and proper diagnosis be made to determine the baselines necessary for comprehensive patient management.

i. Evaluation or diagnosis

Definitive diagnosis of OSA is based on clinical signs and symptoms obtained following

i. assessment of sleep-related history,
ii. physical examination and
iii. objective sleep testing, using polysomnography (PSG) or portable monitors (PM).[5]

Other tests like actigraphy and multiple sleep latency tests (MSLT) may be used as part of the diagnosis of OSA. The culmination of the diagnostic process is classification of OSA as mild, moderate or severe depending on the AHI.[2]

ii. Treatment

Treatment of OSA requires a long-term, multidisciplinary approach, ranging from behavioural and medical care to surgical intervention in some cases. Medical treatment of OSA is non-specific and includes treatment of risk factors and related conditions, like hypertension, diabetes etc. Positive Airway Pressure (PAP) is regarded as the treatment of choice for OSA, and is delivered in a variety of ways, continuous (CPAP), bilevel (BPAP) and autotitrating (APAP).[5] CPAP is recognised in achieving improved patient comfort and enhanced adherence, hence it is the commonly recommended mode of PAP. Other forms of PAP may in other circumstances be appropriate due to differences in risk factors and patient preferences.

Behavioural strategies

Dietary control and exercise in weight loss programmes will reduce OSA symptoms in overweight sufferers, the objective being to lower BMI to 25kg/m^2 in these obese patients.[55] This treatment regime is normally combined with other OSA interventions due to low compliance and reduced success rates. Avoiding the use of alcohol and other sedatives before bedtime reduces apnoea-hypopnea.[5] A change in sleep position as a behavioural option seems to improve patency and airway size in OSA patients, resulting in significant relief of associated symptoms.[56] The prone sleeping position relieves OSA symptoms and results in improved AHI and ODI (oxygen desaturation index) scores in affected patients.[57]

Oral appliances (OA)

These devices increase airway patency, improve muscle tone, and reduce collapsibility of the upper airway.[11,58] OA are less efficacious compared with CPAP, and hence are indicated for mild to moderate cases of OSA, or for patients who failed to benefit from both CPAP and behavioural measures. CPAP is more successful in reducing AHI, in alleviating oxygen desaturation, and in improving arousal from sleep.[59] Research shows that OA's do reduce snoring, obstructive breathing, daytime sleeping and other symptoms.[11,60,61] Other studies have reported positive improvement in polysomnographic index scores (AHI), comorbidities, in subjective indicators of OSA and quality of life following the use of OA's.[11,14,60,62] Contra-indications for the use of OA's include reduced dexterity, poor oral hygiene, TMJ problems and other conditions which can be aggravated when using these appliances.[5,11,63]

OA's have been proven as the simplest and best alternative to CPAP when tested in a subgroup of patients with OSA.[63] There is increased compliance, and patients have greater acceptance of these custom-made devices. OA's can be used anywhere without attracting undue attention.

Other advantages of OA's are lower costs, ease of fabrication, and the facility of fitting and placement in the clinic.

Surgery

Surgical treatment in OSA patients is reserved for severe correctible obstructive anatomical anomalies for which CPAP is not effective.[6] As with all interventions, a risks and benefits analysis is undertaken to determine the feasibility of the procedure. Upper airway surgeries include nasal procedures, oral, oropharyngeal, nasopharyngeal, hypopharyngeal and other related operations. These procedures have had better overall outcomes than OA's and CPAP, primarily because of adherence and the compliance of patients.[11,60,62,64] For severe cases of OSA, procedures like maxillomandibular advancement surgery and bariatric operations have been undertaken with relative success. To date there are few randomised trials which include the surgical option.[65]

Role of dentists in the management of OSA

Dentists spend extended periods of time consulting and treating patients in their practices; such interactions provide considerable opportunities for dentists to be part of the multidisciplinary teams in the treatment of OSA.

The role of dentists in this regard include:

i. screening patients at high risk of OSA. This profiling is achieved through the use of appropriate tools like sleep history, recognition of symptoms and signs.
ii. timeous referral of any patient with a history of snoring to trained physicians to confirm the presence or absence of OSA, and to recommend further treatment.
iii. on the request by an appropriately trained physician, the dentists may be requested to provide OA's and behavioural therapy for OSA patients.[5,62]

The treatment provided by dentists is supplementary, hence it is ill-advised to start treatment for snoring or OSA without a prescription from the physician. OSA is associated with high mortality, and is implicated as a cause of other medical conditions.[59,66] This combination increases the risks associated with OSA, requiring diligent and cautious management by a skilled team of professionals.

CONCLUSION

OSA is a societal epidemic with far reaching consequences both medically and psychologically as well as carrying an enormous economic burden. OSA is arguably more prevalent than diabetes, and carries significant medical morbidities. It is one of the most common and under-diagnosed chronic conditions that "erodes health over time."[67] Dentists are uniquely positioned to diagnose OSA and related diseases at an early stage since they see patients on a regular maintenance schedule. They could provide a valuable service to their patients by incorporating sleep apnoea screening and treatment into their practice. It is further critical for dentists to be in partnership with physician colleagues to help address this epidemic health issue. However, protocols and guidelines must be clarified for dentists to ensure credible and scientific approaches which will protect patients and produce best outcomes. Dentists have two options in approaching OSA: namely screening and early detection and collaboration in diagnosis and/or treatment in consultation with physician colleagues. Dental education should enable dentists to offer excellent treatment to their OSA patients by prolonging "more than just the life of a tooth, perhaps a marriage and even a patient's life."[66,67]

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