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Sleep Disordered Breathing and Disrupted Sleep: General Insights, Screening, and Interventions

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Abstract

The CDC has recently identified sleep as a pillar of health, wellness, and disease prevention, noting its relationship to numerous biophysical markers, cardiovascular disease, and mental well-being. The economic and societal impact of sleep-related issues underscores the importance of effective screening and intervention strategies where the lack of sleep is related to impaired mental and physical health, cognitive function, and productivity. By promoting healthier sleep habits with a goal of 7-8 hours per night for adults, and providing targeted support, healthcare providers can assist patients in significantly improving overall health and well-being for individuals and communities alike. Early detection of sleep disruption is essential with appropriate screening, interventions, and referral. This paper aims to provide an evidence-based general overview of the adult population for screening and interventions for disrupted sleep with a focus on sleep-disordered breathing/ obstructive sleep apnea through the lens of the healthcare provider.

Introduction

Sleep health is a multidimensional concept encompassing the various aspects of sleep that have been shown to contribute to health and well-being outcomes[1]. The Center for Disease Control now recognizes sleep as a pillar of health and wellness[2], yet often sleep is insufficient, disturbed or interrupted and thus not restorative. Fifty-70 million adults in the United States (US) have chronic sleep issues with 62% reporting difficulty sleeping several times per week. Yet it is estimated that up to 90% of these issues are not diagnosed or treated[3]. Furthermore, it is recognized that sleep is also affected by social determinants of health, adding another layer of complexity to patient care[4].

Recent evidence has emerged highlighting the ramifications of sleep deprivation on both mental and physical health. Consequences are individual where chronic loss may lead to silent morbidities. Examples from systematic reviews reveal that disrupted sleep is associated with cardiovascular disease[5,6] and metabolic consequences including diabetes and obesity[7]. In addition, inadequate sleep may compromise a wide variety of higher cortical functions that include, but are not limited to; cognitive ability, mood, physical activity performance[8,9], depression and anxiety[10,11]. Furthermore, impaired attention, memory, and decision-making due to sleep deprivation compromise alertness[12] where driving competency has been shown to lead to traffic collisions and fatalities[13]. Decreased worker productivity and sick days cost the US economy approximately 411 billion dollars annually[14]. Sleep disruptions/disorders are numerous

and are categorized by the International Classification of Sleep Disorders: insomnia, sleep disordered breathing (SDB), central disorders of hypersomnolence, parasomnias, and sleep-related movement disorders[15].

While insomnia is the most common sleep disorder treated most effectively with cognitive behavioral therapy[16], SDB is also very prevalent and under recognized and will be the focus of this paper highlighting scientifically supported screening and interventions that have overlap and application for other sleep disorders including insufficient sleep from behavioral and lifestyle practices.

Sleep Disordered Breathing

Sleep disordered breathing is a general term to describe upper airway dysfunction and breathing abnormalities during sleep which results in: obstructive sleep apnea (OSA), upper airway resistance syndrome (UARS), excessive snoring, and mouth breathing. In general, SDB is the result of excessive upper airway narrowing during sleep. With OSA, there is complete or partial cessation of airflow with persistent respiratory effort associated with oxygen desaturation and respiratory effort related arousals [17,18].

Risk Factors

Numerous physiological factors can put individuals at risk for sleep disordered breathing. For example, older individuals are at increased risk of obstructive sleep apnea due to a decrease in muscle tone that is accompanied by an increased likelihood of airway collapse during sleep[19]. Men are also generally at higher risk for OSA; however, this issue may increase for women around menopause secondary to hormone changes[20]. Obesity has a direct, linear correlation with OSA[21] where the incidence of OSA increases six times with a 10% weight gain, resulting in a 30% increase in the apnea-hypopnea index[22]. This may be explained by an association of a neck circumference greater than 17 inches in men, and 16 inches in women with a higher risk of OSA[18] due to physical airway obstruction from excessive adiposity. In addition, smoking is a significant behavioral risk factor for sleep obstruction secondary to inflammation and fluid retention in the airway[23]. Lastly, alcohol and sedative use relax the muscles in the airway, which also increases the likelihood of obstruction[24].

Nasal Breathing vs Mouth Breathing

Habitual mouth breathing can also be concerning as it decreases breathing efficiency and has been associated with negative health consequences. Mouth breathing promotes dry airways with increased oropharyngeal tissue vibration, increasing the propensity to snore[25]. After age 40, adults are six times more likely to alternate between nasal and oral breathing up to 50% of the time during sleep[26]. Conversely, nasal breathing promotes significant physiological benefits when air is warmed, humidified, and filtered contributing to respiratory tract conditioning. This may be best explained by nitric oxide (NO) being produced in the paranasal sinuses, generating essential vasodilatory and bronchodilatory effects beneficial for respiratory function. Research indicates that NO may play a role in mitigating respiratory tract infections by inactivating viral particles and limiting viral replication within epithelial cells[27]. Mouth breathers have lower levels of NO in the respiratory tract than nasal breathers, which could affect the ability to combat viral pathogens[27].

Orofacial Structure

Since the late 1700s and into the 1800s, advances in food processing have brought about a softer diet requiring less chewing. This and the decline in breastfeeding with the advent of infant formula have led to a progressive change in oral facial structure, size, and development[28]. The consequence has been less growth of the mandibular structures and a narrowed oropharyngeal pathway. There are specific craniofacial features often termed “long face syndrome,” characterized by an elongated face, a short, narrow chin, and a posteriorly positioned mandible, which may predispose patients to breathing obstruction[29]. Oral dysfunctions that can cause airway impairment include a small oral cavity with overlapping teeth, an underdeveloped mandible, dental overbite (overjet), malocclusion, a narrow hard palate, and soft palate abnormalities[30]. Other soft tissue structures that can cause airway obstruction include macroglossia (an enlarged tongue), an enlarged uvula, tonsils and/or adenoids, and nasal issues such as deviated septum, polyps, turbinate hypertrophy, and nasal valve incompetence. Similarly, allergen sensitivity is also on the rise, causing a propensity to nasal blockages, which perpetuates mouth breathing[31]. Assessment and management of these impediments may require referral to specialist care.

Subjective Symptoms/Reports

Patients with SDB/OSA may report daytime symptoms of nonrestorative sleep, morning headache, dry/sore throat, fatigue, excessive sleepiness or drowsiness, cognitive challenges, and/or sexual dysfunction[32]. Patients may or may not be cognizant of their sleep habits, which a sleeping partner can often verify. Reported signs and symptoms at night include, but are not limited to; witnessed apneas, frequent loud snoring, restlessness, mouth breathing, and nocturia[33]. Witnessed apneas and disruptive snoring taken together as factors have a 94% specificity for OSA[18].

Screening and Diagnostic Testing

Screening for signs of sleep impairments and determining appropriate referral are essential skills for health care providers. This includes a history of sleep duration and quality, nocturnal wakening, and daytime

symptoms. A sleep partner can often verify witnessed apneas, frequent loud snoring, restlessness, mouth breathing and nocturia[33]. Sleep screening tools can assist the practitioner in identifying those who may need a referral. Two of the most common used to screen for OSA[34] are following:

STOP-BANG Questionnaire

This is the most used self-reported instrument to screen for OSA with 8 questions and reported high sensitivity[31]. Scores of less than 3 out of 8 can help rule out OSA: scores of 5 to 8 can help rule it in[18]. The higher the score, the greater the probability of moderate to severe OSA[32].

The Epworth Sleepiness Scale (ESS)

The 8-question ESS is widely used to determine the propensity to doze/drowsiness in the assessment of daytime sleepiness[32]. This operational definition of sleepiness and the ESS is used by sleep clinicians and provides an accurate measure across patients[33]. A score of 9 or higher indicates daytime sleepiness, with 10-15 suggesting further medical attention. A score of 16 or higher indicates the prompt need for medical intervention.

Polysomnogram (PSG)

To identify sleep apnea and severity a sleep study may be administered as an in lab polysomnogram (PSG) or home sleep apnea test (HSAT). It is most accurately administered with a PSG as an overnight observed study, and entails recording physiologic variables including an electrooculogram, chin electromyogram, electrocardiogram, respiratory effort, airflow, oxygenation, ventilation, and snoring[18]. Sleep studies have the capability of detecting central sleep apnea (CSA), which is caused by impaired central nervous system function (i.e. brain stem lesions, opioid use) or altered respiratory motor control (i.e. neuromuscular disorders, multiple system atrophy). Apneas can present as obstructive, central or mixed. The apnea hypopnea index (AHI) is the most commonly used measure of the severity of sleep apnea, which represents the ratio of the total number of apneas and hypopneas per hour of sleep (PSG) or recording time (HSAT)[35]. The hypoxic burden which includes depth and duration of apneic and hypopneic events, is increasingly recognized as an important marker in predicting cardiovascular disease related mortality. In addition, numerous sleep monitoring devices are available to the consumer, ranging from smartphone apps paired with watches and rings, which are being used with increasing frequency. Some have been found accurate in detecting sleep and wakefulness, but not sleep staging, where additional research is warranted and developing[36]. These devices are based on algorithms and many are compared to the PSG. For example, the OURA ring is among them and shows a strong correlation with polysomnography[37]. Patients should be cautioned against becoming preoccupied with these devices to avoid the risk of orthosomnia[38].

Conservative Interventions

The field of sleep medicine has grown tremendously over the past decade in which interventions to support sleep should be tailored to individuals sleep disorders and behaviors. Following, are highlights of scientifically supported interventions that may be considered.

Aerobic Exercise has demonstrated the positive impact of physical activity on sleep quality and reducing secondary symptoms from sleep disorders[39-41]. A recent review suggests a consistent regimen incorporating moderate intensity may be the most effective[42]. It has been suggested as a first-line non-pharmacological intervention[43].

Continuous positive airway pressure (CPAP) is the first line of treatment for OSA especially when moderate to severe. The patient dons a mask or nasal pillows attached via a cannula to the device at sleep time, which delivers continuous air pressure throughout the respiratory cycle. The pressure within the airway rises above atmospheric pressure preventing airway collapse. There are varied modes of treatment and types of masks depending on the patient's individual needs. CPAP technology has improved and is an effective intervention for different populations. Recent studies have demonstrated 3-month adherence rates around 80%, but overall compliance rates vary between 51.3-80.6% and are influenced by age and gender and decrease over time [44].

Oral appliances (OA) may be considered an alternative to CPAP for treating mild to moderate OSA, are indicated for snoring, and are better tolerated than CPAP[45]. The mandibular advancement device (MAD) is the most commonly used and is designed to protrude the mandible to increase retropalatal and retrolingual airway patency while sleeping[46]. While oral appliances are available commercially, a qualified dentist with advanced training in dental sleep medicine should complete assessment, fitting, and subsequent adjustments. Oral appliances have become increasingly popular since the early 2000's. While the clinical efficacy is lower than CPAP, a compliance rate of up to 89% has been reported[47].

Myofunctional therapy is a system of isotonic and isometric exercises that focuses on the lip, tongue, soft palate, and lateral pharyngeal wall which was developed in the early 1900s[48,49]. In conjunction with proper tongue position, this therapy is believed to improve mandibular growth, increase nasal breathing, and enhance facial appearance[39]. A meta-analysis showed a reduction in AHI of 50% and greater in adults and children, along with a 72% reduction in snoring[50].

Breathing practices promoting nasal breathing may be considered an intervention for SDB. During sleep, nasal breathing has been shown to improve respiratory measures in OSA patients and has been reported to modulate SDB[51]. To promote nasal breathing and an open airway space, the mouth should be positioned with the lips together, the teeth slightly apart and the tongue lightly positioned against the palate[52].

Mouth taping has been suggested to promote nasal breathing[53]. This involves placing a piece of tape (elastic tape is commonly used clinically that can be removed easily) across the lips and can be worn at night[54]. It has shown potential in decreasing sleep disorders in mouth breathers, reducing snoring and improving AHI scores[55]. The user should be aware of potential aspiration risk and continual use of a relaxed, slight opening of the jaw with the tongue lightly positioned on the soft palate.

Pharmacological interventions are commonly used for difficulty initiating and maintaining sleep, but can have moderate to severe side effects. This includes increasing hypoxia in patients with SDB, causing central sleep apnea, worsening restless legs or parasomnias, and/or disrupting normal sleep patterns. The healthcare provider should pay attention to common medications that may disrupt sleep including, but not limited to steroids, antidepressants, beta-blockers, decongestants, diuretics, and smoking cessation-related drugs[57]. Some commonly prescribed sleeping aids are benzodiazepine and melatonin receptor agonists, sedating antidepressants, antihistamines, and antipsychotics. Dual orexin receptor agonists (DORAS) may be a safer option for older patients[58]. Commonly consumed alcohol, caffeine and nicotine can also negatively impact sleep quality[59].

Practitioner referral

Sleep disorders, especially insomnia and sleep disordered breathing are highly prevalent and affect health and quality of life. Direct to consumer monitoring and treatment options are increasing, but it is important for health care providers to screen for and address sleep disorders.

With appropriate screening, the provider may recommend further evaluation with a sleep medicine health care practitioner, ear, nose, and throat specialist, oral facial surgeon, pulmonologist, and/or dental practice specializing in sleep medicine. The provider may suggest polysomnography to accurately determine the best course of treatment. Recommendations and referral could significantly impact the patient's quality of life.

Conclusion

The prevalence of OSA and other sleep disorders is extensive. The economic and societal impact of sleep-related issues underscores the importance of effective screening and intervention strategies where the lack of sleep is related to decreased mental and physical health, impaired cognitive function, memory, decreased productivity and increased incidence of occupational accidents. Currently, it is all too often that a conversation about sleep between the patient and the healthcare provider is inadequate or nonexistent. It is incumbent upon all healthcare providers to screen for inadequate and disrupted sleep, and provide general sleep recommendations Detection and accurate diagnosis with interventions and when indicated, referral, are fundamental in improving the quality of life and well-being for individuals and communities alike.

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Conflict of Interest

The authors do not declare a conflict of interest.

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Table 1 outlines general sleep recommendations are important considerations for all sleep disorders:

Sleep Promotion Recommendations
• Maintain a healthy body mass index
• Incorporate regular, moderate intensity physical activity
• Sleep in a sidelying position keeping the spine in a neutral position promoting an open airway
• Treat allergies/nasal congestion to promote nasal breathing
• Consider nasal strips and dilators to help expand small nasal passages
• Promote mouth taping
• Establish a regular wind down routine prior to bed
• Avoid stressful activities, bright lights and screentime 30-60 minutes before bedtime
• Keep a regular bedtime/waketime sleep schedule
• Primarily use the bedroom for sleeping
• Sleep in a quiet, dark and cool environment (temperature 60-67°F)
• Limit naptime to no longer than 20 minutes and avoiding late afternoon napping
• Limit caffeine, alcohol and nicotine use at least 5 hours prior to bedtime
• Leave the bedroom if not sleeping for >20 minutes to a dimly lit space and return when sleepy

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