1

Impact of Sleep Disorders on Society

Conceptual Overview

Sleep disorders can no longer be thought of as simply having a poor night's sleep. At the current time, there are a large number of different sleep disorders that may affect one's quality of life (QOL). In addition, there is a difference between the sleep state and the wake state. Sleep is not simply an altered state of consciousness. In other words, it is not simply a matter of being asleep or being awake. Sleep is a totally separate behavioral and physiologic state that is unique and well documented. Carskadon and Dement define sleep in this way: "Sleep is a reversible behavioral state of perpetual disengagement from and unresponsiveness to the environment" [1]. As such sleep is a combination of rapid eye movement (REM) and non-rapid eye movement (NREM) sleep associated with well defined and variable brain activity [2].

Sleep disruption and the specifically recognized sleep disorder may have a major impact on one's well-being, health status, and even QOL. There may also be other associated public health concerns that are related to accidents, mortality, morbidity, utilization of healthcare, executive function, and routine daily tasks. Therefore, as good sleep may have a positive impact on one's life, the presence of a sleep disorder may have the opposite effect.

The Evolution of Sleep in Modern Times

Sleep was not always as we know it today or have known it for over 100 years. Prior to the industrial revolution, sleep and wakefulness were mostly predicated by the rising and setting of the sun. When the industrial revolution occurred, the 24-hour day was broken down into three 8-hour periods: one for work, one for sleep, and the other one for pleasure and other activities. Prior to this time, sleep was typically broken down into two stages or shifts and was referred to as "segmented sleep" [3]. These were referred to as first and second sleep or alternatively as "dead sleep" and "morning sleep." Between these two was a period referred to as "the watching," which was a period of wakefulness that would last for an hour or even longer in some situations. Furthermore, the eight-hour uninterrupted period of sleep became more common because of the use of supplemental light that resulted in bedtimes that became later and as such the period between the two stages eventually disappeared.

As sleep became more like we know it today, as is explained in a book by Benjamin Reiss [4], the industrial age changed many things. Where people would sleep in a communal manner, they now would have separate bedrooms. More importantly, sleep disorders that we recognize today most likely were being recognized and became more prevalent.

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Another example was Henry David Thoreau's *Walden*. This was produced when he decided to abandon the sleep pattern of the day and return to one from the past. This led to a time of creativity that had not previously been experienced.

As time progressed, other changes in society were taking place that ultimately would impact our circadian clock and our sleep. One such change was in 1910 when standardized time zones were established, mainly because of the need for railroads to synchronize schedules. Today many changes related to modernization and technology are all in some way impacting our sleep.

Epidemiology and Prevalence of Sleep Disorders

The origin and onset of a specific sleep disorder is often multifactorial. Epidemiology as it applies here is the study of a particular sleep disorder and how it impacts the overall health of the patient. By definition, epidemiology is the study of the occurrence of a particular disorder and how it impacts the health as well as the diseases of different and varying populations [5]. It is basically the foundation for public health. A text specific to the study of epidemiology has defined the four major concerns associated with this [6].

1) Occurrence
2) Geographic distribution
3) Population patterns of disease
4) Search for determinants of the observed patterns

Specifically, clinical epidemiology applies to how the occurrence of a particular condition, in this case a sleep disorder, is related to the occurrence as well as the distribution of a disease and how this impacts other risk factors. The ultimate goal is the improvement in people's health. Currently, the most common sleep disorders based on epidemiologic studies are [7]:

- Insomnia
- Sleep apnea
- Restless leg syndrome (RLS)

The ultimate outcome of these early epidemiologic studies of sleep resulted in the first published classification of sleep disorders that over time has been modified and revised. At the current time, the International Classification of Sleep Disorders, third edition, (ICSD-3) is the evidence-based standard for the diagnosis of sleep disorders [8].

The general onset of sleep disorders as well as their progression is to some degree dependent on age, the presentation of being at risk for health-related consequences, and even trauma. In many instances, these disorders may appear as a health issue as well as some type of emotional or psychological condition. In many instances, it is the presentation of the health problem that is first recognized or diagnosed that may have its origin as a sleep disorder. As an example sleep apnea patients may seek treatment and use more healthcare resources for the diagnosis of the cardiovascular disease (CVD) and more specifically hypertension prior to the diagnosis of the underlying cause, that being the sleep apnea [9].

The prevalence of sleep disorders based on epidemiologic studies is most often cited as occurring in each of the specific one's as opposed to a general statistic overall. Hence, the actual distribution of a specific sleep disorder is variable dependent on the study that is presented. As an example, it is best to consider the three most common sleep disorders as previously cited.

Prevalence of Sleep Apnea

An example of the most often cited study on the prevalence of sleep apnea is from a 1993 study that was published in the *New England Journal of Medicine* [10]. In this study of 602 people, it was

determined that 24% of men and 9% of women are at risk for sleep-related breathing disorders (SRBDs). When this same group also had daytime hypersomnolence, the prevalence of sleep apnea was determined to be 4% of men and 2% of women. A more current study in 2013 found that there was an increase in prevalence of SRDB that ranged from 14 to 55% based on age, sex, and severity of the apnea hypopnea index (AHI) [11]. This study looked at age groups by their sex and found that in men the prevalence was 10% (age 30–49) and was 17% (age 40–70). In women, the prevalence was 3 and 9%, respectively for the same age groups. The prevalence in this case was based on an AHI of 15 or greater. When an AHI of 5 or more was considered, in ages 30–70, along with daytime sleepiness, the prevalence was determined to be 14% in men and 5% in women.

Since 2013, there have been other studies that have determined the prevalence of SRDB. The facts from two other studies that are significant merit consideration.

1) A study commissioned by the American Academy of Sleep Medicine (AASM) determined that approximately 80% or 23.5 million people who are at risk for sleep apnea in the United States are undiagnosed [12]. Estimation of the prevalence of obstructive sleep apnea (OSA) is at 12% or 29.4 million adults in the United States. Based on this, it was determined that this is having a major impact on the healthcare system. The estimated annual cost per individual in 2015 who is undiagnosed is $6366 as compared to the healthcare costs for someone who is diagnosed and being treated was $2105.
2) It has been determined that worldwide the prevalence of sleep apnea now approaches nearly one billion (936 million) people [13], based on a review of the data available from 16 countries and considering people age 30–69. When considering those who have more moderate to severe sleep apnea the prevalence is 425 million. The impact was most significant in China and then the United States followed by Brazil and India.

Prevalence of Insomnia

For insomnia the prevalence may vary based on the study but in general it appears to be around 33% of the population [2]. The majority of the insomnia complaints focuses on the inability to maintain sleep. Percentages will vary based on the defined criteria that may exist as a result of the specific study parameters. There are two frequently cited studies regarding the prevalence of insomnia. The first indicates that 29.9% of people report insomnia symptoms and 9.5% satisfy the criteria for a diagnosis [14]. Second, it was found that 34.5% of the population had at least one of three symptoms that were present three nights per week and 9.8% were found to have symptoms along with daytime complaints [15]. It is important to understand that insomnia is the most frequent complaint in a primary care practice.

Prevalence of Restless Leg Syndrome (RLS)

The prevalence of RLS, or Willis–Ekbom disease as it is currently termed, is estimated to be between 2.5 and 10% of the general population [16]. Many of the studies have limitations due to misdiagnosis and because patients may not seek medical care. With improved criteria for making a diagnosis the recognition of RLS may actually result in an increased prevalence. A study in 2012 reviewed a variety of previously published studies [17]. In general, the outcome is that the prevalence is between 3.9 and 15% but may vary depending on the structure of the study. Other reported findings are that RLS appears to be more prevalent in females, less common in Asia, and can be worse with age and some health issues.

Increasing Awareness of Narcolepsy

Narcolepsy is another sleep disorder that has been studied epidemiologically. At the present time, its prevalence is between 25 and 50 people per 100 000 [18]. Currently, it is stated that narcolepsy

has a similar prevalence to multiple sclerosis. A more current publication indicates that the prevalence is 1 for every 2000 people and it is estimated that about 50% may be undiagnosed [19]. Over the upcoming years more research will be done, and as more data is gathered the actual prevalence of Narcolepsy will be better defined and hence the recognition as well as management strategies should improve.

Risk Factors

There are a multitude of risk factors that may impact the onset as well as the progression of a specific sleep disorder. The risk factors may be different for each specific sleep disorder and overlapping risk factors may be present that apply to a number of different sleep disorders and are becoming increasingly common. In general, the demands of modern-day life have impacted the quality of one's sleep as well as the required amounts that are deemed appropriate. In addition, the disruption of an individual's sleep can impact other family members, roommates, or one's bed partner. As an example, a study published in the *Mayo Clinic Proceedings* as it relates to sleep related breathing disorders (SRBD) clearly demonstrated that the snoring of one person significantly impacted the sleep of the bed partner to the point that the effected person had symptoms that were worse than those of the snorer [20].

The more common risk factors associated with the three most common sleep disorders as previously discussed are discussed elaborately in other chapters (Table 1.1).

The prevalence of sleep problems related to comorbid illness is well recognized. The more health-related problems that exist the greater the chances that a sleep disorder as well as sleep complaints may be related. This is especially true when one considers people who are older; however, the comorbidities were found to be more significant than age [21]. The number of morbidities reported in another study, referred to as multi-morbidities, correlated mostly to reports of sleep duration, short as well as long sleep, and to sleep quality [22]. Alteration in sleep duration as well as sleep quality may be associated with a number of chronic health issues as well. This study demonstrates that the presence of multi-morbidities in conjunction with sleep quality and duration poses concern from a public health point of view (Table 1.2).

Health Consequences and Related Costs

The impact of sleep disorders on one's health can present in a variety of ways. It is now well recognized that a wide variety of health issues potentially may arise as a result of sleep disorders. In addition, at times an illness or health problem can conversely impact one's sleep. For the sake of clarity, the one's of greatest importance and the most frequently encountered will be reviewed here.

The increased risk for CVD and elevated blood pressure associated with SRDB are well documented. The largest and the most cited study, the Sleep Heart Health Study, took place between 1995 and 1998 as a multicenter cohort study with over 6000 people age 40 and above as participants [23]. The results of this study found that sleep apnea along with other SRBDs are risk factors for CVD which is inclusive of myocardial infarction and stroke. A variety of mechanisms are proposed indicating that sleep apnea and CVD are related with elevated blood pressure as the more common finding.

Alteration in metabolic and endocrine function is also associated with an SRDB, the most prevalent of which is type 2 diabetes. It has been found that snoring alone increases the risk for type 2 diabetes independent of any other risk factors [24].

Table 1.1 Common risk factors.

Sleep-related breathing disorders
Increased incidence with age
Frequent and loud snoring
Mouth breathing – difficulty in nose breathing
Gasping for air during sleep
Associated with larger neck and waist size
Increases with weight gain
Males have greater risk than females
Airway obstruction – especially large tonsils and adenoids
Hypothyroidism
Coexisting cardiovascular disease or hypertension
Allergy or asthma
Family history
Insomnia
Increases with age
Associated with anxiety and/or depression
Associated with pain, headaches, arthritis, temporomandibular Joint (TMJ) symptoms
Dissatisfied with one's quality of sleep
Females have greater risk than males
Substance abuse
Perceives health as worse or bad
Level of schooling
Restless limb syndrome (RLS)
Increases with age
Worsens over time – follows a chronic course
Females greater than males
Use of antidepressants
Associated with low iron levels
Peripheral neuropathy
Pregnancy
End-stage renal disease
May coexist with sleep bruxism

Table 1.2 Prevalence of sleep problems with comorbid illness (age 55–84).

Prevalence of sleep problems by %	Number of comorbidities
36%	None
52%	1–3
69%	4 or more

Source: Adapted from Foley et al. [21].

Other health issues that impact sleep also need to be recognized. Classically among these are painful conditions, increased stress, and psychological issues such as anxiety and depression. These most often lead to insomnia and a decrease in sleep time, sleep quality, and in many instances an associated increased time in bed.

As has been demonstrated, sleep disorders may potentially increase the risk for a multitude of health problems. It is not an absolute that a given sleep disorder will lead to any one specific health problem. The important issue is to recognize that these health problems may have an underlying sleep disorder as a contributing factor in the development or progression of a health issue (Table 1.3).

Because of the increased risk for the development of health problems with sleep disorders, there may be an associated increase in healthcare costs as well. It is well documented that the presence of a sleep disorder may drive up the cost of healthcare in general. It has been estimated that untreated sleep apnea may add $3.4 billion in medical costs [25]. At this time, it is unclear what the actual savings in medical costs are with the management of sleep apnea. In a study of 31 patients diagnosed with CVD and who had sleep apnea, when they adequately managed the apnea there was a reduction in the need for hospitalization related to the cardiovascular illness [26]. In addition, it is recognized that an association with the severity of the sleep disorder may be related to increased healthcare expenditures.

The costs of healthcare are increased by the lack of attention to the specific sleep disorder. A 1998 study demonstrates that 10 years prior to the actual diagnosis of sleep apnea the patients that were eventually diagnosed with sleep apnea when compared to the matched controls incurred nearly double the costs for healthcare and were hospitalized more [27, 28]. This demonstrates that in many instances the sleep disorder precedes the onset of the specific health issue or consequence. If the sleep disorder is not discovered, then the attention to the related health issue takes precedence. This may then lead to an increase in expenditures for various testing, imaging, physician visits, hospitalizations, and medication or prescription usage.

Along with the health issues that may arise there is also an impact on one's QOL. Studies that look at QOL measures clearly demonstrate that patients with a sleep disorder feel that their QOL is poorer than those without apnea [29, 30]. In addition, the QOL of the bed partner is also impacted. When the SRBD is improved, both the patient and the bed partner may experience an improvement in their QOL [31].

The Dental Perspective

More than ever, the dentist is compelled to provide more than just dentally related services and as such is becoming involved with not only the oral health of the patient but also with their

Table 1.3 Common health issues associated with sleep disorders.

Painful conditions	Headaches
Arthritis	Fibromyalgia
Anxiety or depression	Hyperthyroidism/hypothyroidism
Pregnancy	Gastroesophageal reflux disease (GERD) or acid reflux
Medication usage	Cardiovascular disease
Hypertension	Diabetes
Obesity	Periodontal disease

overall health. A commentary in the *Journal of the American Dental Association* (JADA) called for an increase in the education of the dentist in biological and medical sciences [32]. In this chapter, a direct reference to medical topics that may be related to the dentist that appeared in JADA from 2004 to 2006 included such topics as diabetes, heart disease, CVDs, and sleep apnea. In another commentary by Dr. Michael Glick in JADA describes the potential for the dentist to inform patients about risk factors for CVD is possible [33], as well as many other health and medically related disorders.

Regardless of the role the dentist assumes, the initial action needs to start with the recognition of those who may be at risk for or have a health problem that may have an underlying sleep disorder as a contributing factor. Having an awareness of these relationships has the potential to be beneficial to the overall health of people and to improve their QOL.

Conclusion

The dentist now has an increasing role in the recognition of a patient who may be at risk for a sleep disorder, especially those that are most commonly encountered. This has been supported and emphasized by the American Dental Association (ADA) in a number of ways but specifically related to the recognition and management of SRBD [34, 35]. In 2019, the ADA published a guide for the dentist regarding screening for diabetes by assessing blood glucose and A1c [36]. This is an additional means by which the dentist is able to contribute to the overall health of the patient, similar to screening for hypertension. Once the condition is recognized the appropriate referral for more definitive management is indicated. Epidemiologic data supports the increasing awareness of the relationship of sleep disorders and other health issues. Clinical management and decision-making now emphasize sound evidence-based documentation that relies on epidemiologic studies to assist in determining the coexistence of a sleep disorder that in turn are impacting the health of the public and the patients we serve.

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