

# Dental Management of Sleep Disorders

Second Edition

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## Dedication

This edition is dedicated to those who have offered encouragement and support as well as patience, culminating in this second edition. This is especially true of our spouses who have supported the long hours of dedication required to make this a reality. In addition, the support at Wiley-Blackwell has always been appreciated. A textbook of this nature is also dedicated to those pioneers in sleep medicine who have done research and published learned texts and scientific articles that are the basis for creating each and every chapter in this edition. More importantly, this text is dedicated to those who are willing to spend the time to foster their education in this very dynamic and exciting area, all in an effort to provide optimum patient care.

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## Preface

The importance of sleep, the disciplines of sleep medicine and more specifically dental sleep medicine as well as the management of sleep disorders, has continued to develop over the past 10 years. In like manner, the involvement and contribution of dentistry has also grown. The role of the dentist has and continues to be primarily focused on the recognition and management of sleep-related breathing disorders (SRBDs) primarily associated with the use of oral appliance therapy (OAT). It is recognized that dental practices see a significant number of patients on a regular basis, and this positions them such that screening for a variety of health-related concerns potentially has a significant impact on the lives of the patients they encounter. This now applies to the recognition of a sleep disorder as well, estimated to involve 50–70 million people in the United States. In 2010, the *Journal of the American Dental Association* (JADA) indicated that 65% of patients between the age of 18 and 65 visit the dentist once a year. When considering the SRBD, in particular sleep apnea, it is recognized that roughly 80% of people who are at risk for this are currently undiagnosed, let alone adequately managed.

The role of dentistry has also been recognized and substantiated by the American Dental Association (ADA), with publication of guidelines in 2017 for screening and the use of OAT. The essence here is that every dentist should be familiar with SRBDs and how to screen for them as well as in the use of oral appliances (OAs). The second edition of this textbook is intended to meet and even exceed those objectives. This edition is intended as a basic understanding of sleep, sleep disorders, the role of the dentist, the use of oral appliances, and to also become familiar with other options for the management of the SRBD. Conceptually, this edition is intended for those seeking a basic understanding of sleep as well as the more common sleep disorders. It is applicable to anyone wishing to learn more, from the dental student to those in a postdoctoral program and for the practicing dentist or hygienist. More importantly the intent is for this edition to offer information and guidance that is clinically applicable. This involves the screening process, the clinical evaluation, and the use of OAT.

The second edition is an expanded version of the first edition. The explosion of information and evidence since the first edition was released has been important for this current edition. This edition has been broken down into five sections that will allow the reader to focus on a particular area that may be of particular interest. Additionally, this edition involved contributing authors with expertise in their respective discipline of interest to enhance that specific chapter and provide a higher level of evidence. Throughout the book and in the appendix a variety of documents for screening as well as tracking patient progress have been referenced or created to aid the practitioner with their involvement in this discipline. It is important for the reader and student to

realize that even though the dentist may not be involved in the management of most of the sleep disorders reviewed, it is important to be familiar with many simply to improve patient care and one's quality of life.

A text such as this involves many people. The contributing authors; the staff at Wiley-Blackwell, especially Tanya, Erica, and Krishna; and the many people who contribute to the production of this second edition. Recognition of the many people in research, education, and practice who publish the information used as a basis for the creation of each chapter have also impacted a text such as this one. Hopefully this edition will act as the catalyst for continued education and learning that involves sleep medicine resulting in improved health and quality of life for the patients we serve.

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## Section 1

### Overview of Sleep Medicine

This section provides an overview of sleep medicine specifically as it applies to the practice of dentistry and in particular to anyone interested in becoming involved in this discipline or those already involved with the desire to develop and include this in their practice. In this section, there is a discussion related not only to the science of sleep medicine but also to the recognition that many of the patients who are seen daily may be at risk for a sleep disorder, based on history as well as conditions that the dentist encounters daily, with an emphasis on sleep-related breathing disorders (snoring and sleep apnea). Additionally, the need to understand the impact sleep disorders have on our everyday life is discussed along with the wide variety of sleep disorders that exist and may go undetected.

This discipline is very dynamic. There are areas that are of interest and will continue to develop over time. Areas to monitor in the future are:

- The developing statistics relative to prevalence.
- Understanding the role of neurotransmitters in sleep as research discovers their expanding role and interaction.
- Developing understanding of the gut microbiome related not only to sleep but also to many other health-related consequences.

# 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.

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 SRBD 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 SRBD, 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].