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Sleeping through the Ages: An Examination of Sleep in Older Adults

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Abstract

It is widely recognized that sleep disorders (SD) are highly prevalent, despite being under diagnosed and under treated in practice. SDs occurs at all ages, although presentation and subsequent consequences for an individual's health varies throughout the lifespan. Currently, evaluation of SDs are inadequate across all age ranges, and for both sexes, as they are compromised by under reporting and relying on self-report, rather than professional sleep studies (i.e., nocturnal polysomnography (NPS) and multiple sleep latency tests (MSLT)). Moreover, there is a paucity of data specific to the elderly; many older individuals report dissatisfaction with quality of sleep. Indeed, literature has shown that geriatric populations spend less time in slow-wave sleep and rapid eye movement (REM) sleep and have more difficulties maintaining sleep. Their dissatisfaction may occur from changes in sleep architecture associated with the aging process; however, it has been suggested that it largely stems from comorbid illness, social problems, hormonal effects, altered circadian rhythms, or side effects of medications that are common in the elderly. Further, geriatric sleep is related to depression, impaired health and functioning, and weaker/ less synchronized circadian rhythms. In response, we utilized a 111-item questionnaire in conjunction with NPS, MSLT, the Epworth Sleepiness Scale (ESS) and medical chart reviews of individuals referred for SD evaluation to compare sleep in geriatrics with adults. Analysis revealed numerous differences between adult and geriatric groups, with the elderly experiencing more SDs, longer sleep latencies, and fewer sleep complaints. Based on the outcomes of this investigation, we posit further consideration to SDs across the age groups to achieve the best health care and quality of life for all.

Keywords: Geriatric, Sleep disorders, Sleep architecture, Quality of life, Circadian rhythms

Abbreviations:

SD: Sleep Disorder, NPS: Nocturnal Polysomnography, MSLT: Multiple Sleep Latency, ESS: Epworth Sleepiness Scale, REM: Rapid Eye Movement

Introduction

Sleep disorders (SDs) affect approximately one-third of the world's population and impact a multitude of physiological and psychological functions [1-3]. The presence of SDs occurs at all ages, though the presentation and subsequent consequences for an individual's health change in accordance with the natural aging process [4]. At any age, chronic sleep disturbances compromise response times, performance, and short-term memory. These disturbances can have serious consequences for the elderly in particular; geriatric sleep problems are associated with increased risk of falls, increased depressive/anxious feelings, impaired cognitive functioning and overall poorer quality of life [5].

It is commonplace for older individuals to complain that their sleep is not as good as it once was, as an estimated 50% of adults aged 65 and older experience sleep disturbances [6,7]. Indeed, aging is associated with numerous changes in average sleep; it becomes increasingly shallow and fragmented, less time spent in slow–wave and rapid eye movement (REM) sleep, and may result in difficulties maintaining sleep [4,5,8]. However, these changes in sleep architecture do not account for all sleep complaints reported by elderly adults. The majority of sleep complaints seen with increased age are more attributed to myriad medical and psychiatric illnesses, and the lifestyle challenges that present with these illnesses, rather than the aging process itself [5,8-11]. It is also plausible that the relationship shared by sleep disturbances and health status could be bi-directional; wherein chronic disease contributes to poor sleep and, poor sleep adversely affects the course of chronic disease [10].

SDs not attributed to illness or abnormal sleep architecture may also result from lack of stimulation, poor diet, or medications that lead to early onset of sleep [5]. It is not uncommon for the elderly to intake numerous medications, both prescription and over-the-counter, typically with one or more contributing to disrupted sleep [5,12]. Stimulating or alerting drugs that are often taken by older individuals affect and delay sleep onset at bedtime, and while sedative-type drugs can be useful for the relief of temporary insomnia, long-term use may result in habituation, loss of efficacy, drug-induced insomnia, and can gradually begin to imitate the dementia-like symptoms seen in individuals with Alzheimer's disease [4].

Though the aging process can affect one's ability to sleep, sex differences confound an already complex understanding of SDs in the elderly [10]. It has been postulated that sex differences explain the largest proportion of variance in measures of sleep architecture [13]. The factors that are most strongly related to sex differences in geriatric sleep disturbances are the use of medication, sleep apnea, and marital status [14].

It has been observed that women typically have longer sleep duration and higher sleep efficiency, yet are more likely to report sleep-related complaints, and to experience psychological effects such as depression and anxiety than their male counterparts [14]. These trends may be a reflection of gender based psychological and sociocultural factors, in addition to genetic and biologic factors [15].

In addition to psychological and sociocultural factors, hormonal effects may account for many of the sex differences in elderly sleep [14]. Coinciding with a decrease in estrogen and progesterone levels during menopause, postmenopausal women are more likely to suffer from sleep disturbances. Similarly, decreases in testosterone associated with male aging coincide with decreased sleep efficiency in men [13].

Our team constructed a 111-item questionnaire to help develop an understanding of how SDs in the elderly differ from those found in adults in conjunction with how they differ between the sexes through the process of data-driven, observational research utilizing both basic and applied designs. This study design's goal was to focus on sleep patterns revealed by naturally occurring phenomena (e.g. lifestyle, gender, age) to maximize knowledge advancement and applicability of sleep disorder treatment.

Materials and Methods

Currently, evaluations of SDs are inadequate across the ages and sexes, as they are compromised by under reporting and relying on self-reported data rather than professional sleep studies (i.e. nocturnal polysomnography (NPS) and multiple sleep latency tests (MSLT)). Moreover, there is a paucity of data specific to older adults. In response, we partnered with the sleep center at a regional medical center, and constructed a 111-item questionnaire to use in conjunction with NPS, MSLT, the Epworth Sleepiness Scale (ESS), and medical chart reviews of patients referred for evaluation of SDs. In this partnership, every individual referred for NPS at the regional medical hospital's sleep disorder center by his/her general care physician was given the opportunity to enroll in our study, regardless of proposed sleep disorder. Through this inclusive enrollment, our analysis is not limited to any particular SD; instead, patterns are revealed showing the disparities in which individuals are routinely referred to sleep centers, and which individuals do not receive treatment. Those who chose to participate in the study completed informed consent upon arrival at the sleep center for NPS.

Participants were asked, prior to their sleep study, to complete an extensive questionnaire. The 111-item questionnaire, developed over the course of 19 years by our team, collects a variety of behavioral, physiological, psychological, and medical data from each participant. Rather than being sleep-specific, this comprehensive approach allows for objective analysis of sleep effects and overall QoL, without bias to merely sleep disorder symptomatology. During the sleep study, baseline data regarding sleep patterns were collected utilizing NPS and MSLT. Following the study, our team collected impressions and diagnoses were given by trained sleep technicians. After collection of the baseline data, participants were then contacted six months post-sleep study for follow up questioning. These follow up questions collected data that is similar to the baseline questionnaire, geared towards comparing sleep pre-study to sleep experienced after diagnosis. . Following descriptive analysis comparing geriatric and adult sleep, we examined sex differences to further characterize geriatric sleep. The study population consisted of 568 adults (304 male and 264 female) and 151 geriatric participants (92 male and 59 female). Our investigation of sex differences looked at how sleep architecture, marital status, sleep diagnoses, and sleep associates varied between men and women (Tables 6-10). All participants in the study were independent adults not living in care facilities.

Results

We compared SDs and their associates by categorizing participants in two broad age groups: adult (ages 19-65, M=46.2) and geriatric (ages 66-90, M=71.6) to illuminate a characterization of the geriatric population. Chi-square analysis and t-tests revealed differences in the associated sleep disturbance symptoms reported between the adult and geriatric groups. BMI was significantly higher in the adult group (M=35.2) than the geriatric group (M=31.7, $p<0.001$). NPS revealed expected sleep architecture differences specific to the geriatric group spending significantly more time in N1 and less in N3 and REM (Table 1).

	Adult	Geriatric
N1***	12.6%	18.4%
N2	61.8%	60.3%
N3*	5.2%	3.6%
REM***	15.0%	11.58%
p*<0.05, p**<0.01, p***<0.001		

Table 1: NPS sleep architecture across sleep disorders.

Although the geriatric group had a higher prevalence of SD and physiological diagnoses (Tables 2 and 3), they experienced longer sleep latencies, spent significantly less time asleep, and reported fewer sleep related complaints than the adult group (Table 4).

	Adult	Geriatric
Nocturnal hypoxemia**	12.0%	21.5%
Periodic limb movement disorder**	6.1%	14.1%
Poor sleep efficiency***	26.8%	45.6%
Restless leg syndrome*	1.1%	3.4%
Hypersomnolence*	12.8%	6.0%
p*<0.05, p**<0.01, p***<0.001		

Table 2: Sleep diagnoses.

	Adult	**Geriatric**
Allergies*	63.7%	54.1%
Chronic Lung Disease***	12.2%	32.9%
Diabetes*	15.3%	22.4%
Headaches***	70.9%	41.7%
Heart Attack***	6.4%	16.4%
Heart Failure***	7.1%	20.7%
High Blood Pressure Treatment***	36.8%	66.7%

Nasal/Sinus Problems*	43.5%	33.8%
Stroke***	4.8%	13.0%
Thyroid Disease***	16.5%	28.4%
Anxiety***	56.8%	41.2%
Depression**	58.8%	45.6%
Irritability***	76.8%	53.3%
Stress***	83.8%	64.6%
p*<0.05, p**<0.01, p***<0.001		

Table 3: Physiological/Psychiatric symptoms across sleep disorders.

	Adult	Geriatric
NPS Sleep Duration (min)***	340.2	299.4
Wake rested***	14.9%	39.9%
NPS Sleep Latency (min)***	20.5	27.7
Concerned with well-being**	59.8%	41.0%
Bizarre dreams***	51.9%	34.1%
Choking sensation***	39.6%	23.2%
Feels paralyzed**	16.4%	6.5%
Grinds teeth***	29.7%	9.1%
Nightmares*	49.6%	36.1%
Restroom more than 3x/night***	41.5%	64.4%
Reported sleep latency*	27.6%	22.0%
p*<0.05, p**<0.01, p***<0.001		

Table 4: Sleep associated variants across sleep disorders.

The geriatric group reported fewer bizarre dreams, nightmares, and waking with choking sensations. Moreover, they reported waking rested more frequently than the adult group. Daytime detriments were also less frequent in the geriatric group in areas such as difficulty concentrating, sleep disturbances interfering with social life, and memory/ attention to detail (Table 5). Additionally, they experienced fewer headaches, less anxiety, depression, irritability and stress (Table 3).

	Adult	Geriatric
Difficulty concentrating***	66.8%	38.1%
ESS-passenger in car**	56.8%	45.3%
ESS-rest in afternoon**	87.4%	72.0%
Go to bed same time every night*	72.1%	87.7%
Like to sleep late***	65.8%	21.1%
Oxygen aid while sleeping***	7.5%	18.5%
Sleep interference with social life***	61.2%	30.4%
Take naps***	44.7%	64.1%
Wake at same time every day*	66.4	86.4%
Accident due to sleepiness***	22.5%	7.5%
Memory/attention to detail***	71.1%	56.6%
p*<0.05, p**<0.01, p***<0.001		

Table 5: Day time symptoms across sleep disorders.

When comparing sex differences in the geriatric group, we found that males spent more time in REM, experienced sleep problems longer before being diagnosed, and experienced more snoring, while females experienced longer sleep latency (Tables 6 and 7). Additionally, more elderly men were married and more geriatric women report living alone (Table 8).

	Male	Female
N1	19.6%	15.5%
N2	58.1%	60.8%
N3	2.7%	4.6%
REM*	12.8%	10.8%
p*<0.05, p**<0.01, p***<0.001		

Table 6: Sex differences: NPS sleep architecture across sleep disorders.

	Male	**Female**
NPS sleep latency (min)**	21.6	37
Sleep problem length (years)*	11.7	6.6
Snore**	86.2%	66.7%
Stop breathing***	77.4%	44.2%
Arm/leg jerk	51.8%	34.0%
ESS total***	11.7	9.2
Fall asleep while driving**	25.0%	10%
Sleep walking**	0%	4.3%
Enjoy sleep*	43.3%	55.7%
p*<0.05, p**<0.01, p***<0.001		

Table 7: Sex differences: Sleep associates across sleep disorders.

	Male	**Female**
Single	3.8%	7.1%
Married	80.8%	38.6%
Divorced	3.8%	24.3%
Widowed	7.7%	10.8%

p*<0.05, p**<0.01, p***<0.001

Table 8: Sex differences: Marital status*** across sleep disorders.

Despite significant differences in physiological comorbidities such as heart attack, body pain, high blood pressure, and thyroid disease; sleep diagnoses did not significantly differ between sexes (Tables 9 and 10). In our population, women more frequently reported body pain, high blood pressure, anxiety, and had concerns for their mental health. Conversely, men reported a higher incidence of breathing cessation, heart attack, and heart failure. We found this trend across age groups.

	Male	Female
OSA	88.5%	81.4%
Periodic leg movement	14.4%	15.7%
Poor sleep efficiency	51.9%	51.4%
Abnormal sleep architecture	75.0%	77.1%
Hypersomnolence	7.7%	2.9%
Nocturnal hypoventilation	1.0%	2.9%
Primary snoring	10.6%	7.1%
Restless leg syndrome	3.8%	2.9%
Normal sleep	5.8%	4.3%
Nocturnal hypoxemia	19.2%	28.6%
p*<0.05, p**<0.01, p***<0.001		

Table 9: Sex differences: Sleep diagnoses across sleep disorders.

	Male	Female
Allergies*	47.6%	64.8%
Anxiety*	33.7%	51.9%
Asthma**	7.7%	18.6%
Body Pain**	31.3%	81.8%
Heart Attack*	23.1%	6.9%
Heart burn/acid reflux*	32.6%	50.0%
Heart Failure*	25.6%	12.1%
High Blood Pressure**	57.6%	81.0%
Medication for mental health concerns**	26.0%	45.7%
Thyroid Disease***	11.8%	55.2%
p*<0.05, p**<0.01, p***<0.001		

Table 10: Sex differences: Physiological symptoms across sleep disorders.

Discussion

These findings indicate that comparison of SDs and their characterizations in the adult and geriatric groups result in similarities and differences between groups. The adult group had a significantly higher BMI than the geriatric group. Though it is widely accepted that increased BMI is associated with sleep disruptions, the difference in BMI skewed towards the adult group while the geriatric group reported the expected higher prevalence of chronic diseases. This suggests that circadian, social, and behavioral changes associated with aging may outweigh BMI as a predictor for sleep disturbances.

The most profound differences between adult and geriatric sleep exist in self-reported sleep adequacy. NPS revealed expected sleep architecture differences specific to the geriatric population spending significantly more time in N1 and less in N3 and REM. Yet, while the geriatric population experienced longer sleep latencies, spent significantly less time asleep, and had a higher prevalence of sleep disorder diagnoses and chronic disease, they reported fewer sleep-related symptomatology (including psychiatric symptoms). Moreover, the geriatric group reported waking rested more frequently than the adult group. As sleep quality is related to both psychological and physiological factors, future research would likely benefit from a thorough examination of which is more important for perceived sleep satisfaction. Further examining sex differences in elderly adults revealed some differences in perspective. Despite having similar sleep disorder diagnoses, these women reported fewer sleep complaints. Indeed, unlike men, women were more likely to accept sleep problems as a normal part of life. In this research, more geriatric men were married, whereas geriatric women were more likely to be single, divorced, or widowed. Women in the geriatric group were more likely to be diagnosed with physiological health problems and were more likely to be taking medication related to mental health.

These results could be a product of under reporting by the geriatric population or perhaps habituation to the challenges associated with sleep disturbances. It is plausible that the under reporting of geriatric sleep disturbances may be in part attributed to an 'ordering' of health issues. Wherein, perceived higher risk conditions/ chronic diseases such as heart disease, diabetes, or arthritis take precedence in the health concerns of elderly adults while their sleep issues fall to the wayside. It is also the case that our samples of adults versus geriatrics differed dramatically in size (i.e. 151 geriatric cases versus 568 adult cases) which suggests that significantly fewer older adults were referred for sleep studies. We ponder whether this is because sleep complaints by older adults are marginalized, disregarded, or regarded as simply part of the aging process. Given that we assessed all who presented for sleep study to a regional medical center; our sample may representative of referring patters specific to our particular region of the United States. This study is also limited by the fact that we did not seek or select participants according to sleep diagnosis and match the number of participants per diagnosis, we cannot address specific differences between specific sleep disorder diagnoses and the mechanisms therein. Instead, we simply report the outcomes from those referred to the regional medical center. Further, our investigation involved the physical health of participants. All participants were individuals living independently; not in a long-term care facility. Inclusions of elderly people living in dependent care may reveal different characteristics than found in the present study. We suggest that sleep disturbances across all age groups be given ample consideration to provide the best health care and quality of life for all.

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