



RESEARCH ARTICLE

Gender Differences in Sleep Duration and Socio-Demographic Factors: Insights from BRFSS

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ABSTRACT

Background: Insufficient sleep or rest is a risk factors for cognitive impairment, reduced quality of life, mood disorders and impaired ability to fight infection.

Objectives: To examine and compare socio-demographic correlates of short sleep duration and insufficient rest among men and women, using a large, nationally-representative sample.

Methods: A cross-sectional examination was conducted using 2012 Behavioral Risk Factor Surveillance System data (a nationwide telephone-administered survey). Multivariable linear and logistic regressions, incorporating survey weights, were used to estimate the sex-specific association of socio-demographic characteristics with sleep duration and frequency of feeling unrested.

Results: Among men (N=2,897), longer sleep duration was associated with higher education (p=0.0002) and snoring (p=0.02); among women (N=2,908), having children was inversely associated with sleep duration (p=0.002), while being unemployed (p=0.009) and having a higher household income (p=0.03) were associated with longer duration. Among women aged ≤45 years, the only variable associated with insufficient sleep duration was having children in the household, with each child increasing the odds by nearly 50% (95% CI=1.14, 1.87), an association absent among men (95% CI=0.62-1.43)

Conclusions: Factors associated with insufficient sleep and feeling unrested differed by sex, with children adversely affecting women's sleep duration, particularly among those 45 years of age or younger.

Keywords: gender differences, motherhood, prevalence, risk factors, sleep, socioeconomic status, well-being.

Introduction

Sleep problems significantly affect optimal health and functioning of individuals thereby imposing a burden on the population's health in a society. The National Sleep Foundation reported in 1998 that only 35% of American adults slept for eight hours on average per night, and this estimate was reduced to 26% by 2005^{1,2}. A gradual decrease in the mean duration of sleep from 7 hours 40 minutes to 7 hours 18 minutes has occurred in the United States (US) population between 1985 and 2012^{3,4}. Recent studies have noted that about one-third of the US population have self-reported short sleep duration⁵⁻⁷. Additionally, sleep problems have been associated with chronic conditions, including hypertension, obesity, diabetes, and psychiatric disorders like depression⁸⁻¹⁴. The updated results from sleep foundations showed a further reduction in sleep duration, and less than one-third (30%) of Americans sleep less than six hours per night¹⁵.

Several studies have reported an inverse relationship between body mass index (BMI) and sleep quality^{10,11,16-18}. In a 13-year prospective study by Hasler et al.¹⁶, a negative association was reported between sleep duration and BMI in young adults after adjusting for several potentially confounding factors. Other factors that have been shown to affect the quality of sleep adversely include lower socioeconomic status, female gender, race, reproductive status, and lifestyle factors such as no physical activity, smoking, and alcohol intake¹⁹⁻²⁴. However, most of these associations are still controversial. Recent studies have also linked sleep issues with increased mortality.

Sleep disorders pose a significant public health concern in the United States and exhibit a higher prevalence of short sleep duration among high-income nations²⁵. A significant proportion of US adults experienced prolonged sleep deprivation and frequent sleep disturbances, highlighting the need for further investigation into strategies to enhance overall sleep health in the US²⁶. Many studies have investigated demographic and lifestyle factors associated with sleep challenges,

however, it is important to recognize that these associations might be sex-specific, especially among adults in their childbearing years. Men and women often have different social norms, expectations, and family dynamics, and it is important to approach sleep challenges with a holistic perspective. Therefore, this study examined socio-demographic correlates of short sleep duration and insufficient rest segregated by gender, using a large, nationally representative sample.

Methods

STUDY PARTICIPANTS

This observational study was based on publicly available data from the Behavioral Risk Factor Surveillance System (BRFSS) for the year 2012²⁷, the most recent year for which all of the variables of interest were available. BRFSS survey is internationally the largest continuous health survey system, aiming to provide information to promote healthy behaviors and the use of preventative services. The BRFSS randomly samples adults in the United States and conducts cross-sectional, telephone-administered interviews of more than 400,000 participants annually. In 2011, the survey methodology was changed to incorporate more households with cellular telephone respondents. Updated data collection methods were implemented in the year 2012 for both landline and cellphone respondents²⁸.

To be eligible to participate in the BRFSS, selected individuals must be aged 18 years or older, reside in the US, not be institutionalized, and provide verbal consent to participate in the interview. Participants answer questions regarding various topics, including sleep time, demographic characteristics, diet, and exercise habits. The institutional review board of the authors' institution determined this study met the requirements for exempt status. Therefore, no prior IRB approval was required to conduct the study.

DATA COLLECTION AND MEASURES

Data from the BRFSS sleep module provided the foundation for the current analyses. The

Participants were asked, “During the past 30 days, for about how many days have you felt you did not get enough rest or sleep?” and “On average, how many hours of sleep do you get in a 24-hour period? Think about the time you actually spend sleeping or napping, not just the amount of sleep you think you should get”. Participant responses were recorded as whole numbers representing the number of days or hours respectively. For the present analyses, the main outcome variable was sleep duration, which was used as a continuous variable and was also categorized based on guidelines from the National Sleep Foundation, with 7-9 hours per day considered ‘optimal’ and fewer than 6 hours considered insufficient and labeled as ‘too little’²⁹. Also, the feeling of unrest was considered the number of days when the respondent could not sleep enough in the past 30 days, which was taken as a continuous variable. The independent variables included the socio-demographic characteristics i.e., age (continuous), race (white, black, or other), educational attainment (less than high school, high school graduate, or college graduate), body mass index (BMI), marital status (married/cohabitating or

single/widowed/divorced/separated), exercise (any or none), employment status (paid employment or no paid employment), household income (less than \$35,000 annually or \$35,000+ annually), the number of children residing in the household (continuous) and participant snoring (yes or no).

DATA CLEANING AND MANAGEMENT

Some variables were recoded to make the data suitable for analysis. The initial data set included a total of 475,687 observations. The data was cleaned, and the dataset for men was separated, which, after removing missing data, included 2,897 observations. Similarly, after removing the missing data for all the variables, the dataset for women included 2,908 observations. Furthermore, we removed the people who had excessive sleep, that was > 9 hours or had acceptable sleep of 6 hours. The outcome variable for sleep included those who had either too little sleep or optimal sleep (Figure 1).

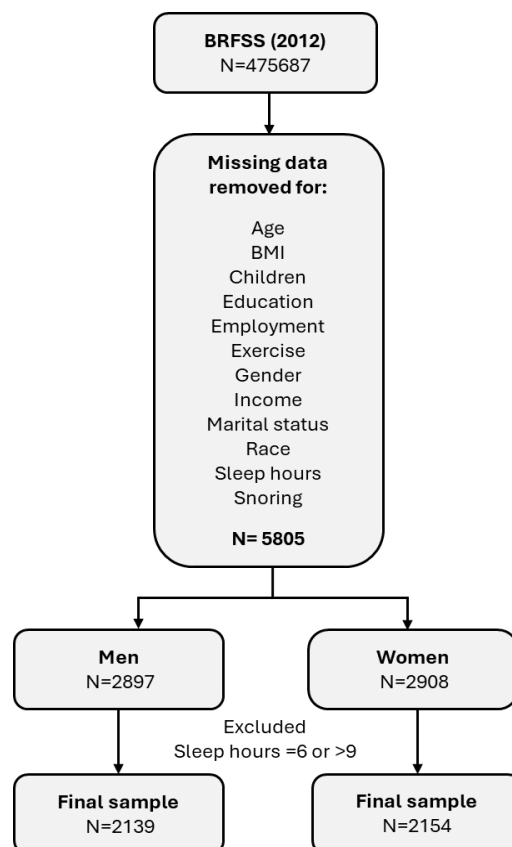


Figure 1: Inclusion and exclusion of final study sample

DATA ANALYSES

All participants with complete data for the variables of interest were included in the analysis (N = 5,805). Statistical software SAS® version 9.4 was used to conduct linear and logistic regression analyses, incorporating survey weighting procedures. Analyses were conducted using segregated data for men and women to evaluate potentially unique correlates of poor or insufficient sleep in each group. Initial analyses included adults of all ages with available data. To better focus on adults in their childbearing years, additional analysis was restricted to participants aged 45 or under and stratified by sex. Each model included all covariates to identify the independent association of each covariate with insufficient sleep. An area greater than or equal to 0.70 under the receiver operating characteristic curve was required to indicate adequate discriminatory performance of each model. We reported the odds ratio and 95% intervals for the predictors of too little vs. optimum sleep time. We reported the β -coefficient and standard error (SE) for the linear regression model using sleep duration as a continuous variable. The α -level was set at 0.05 and considered statistically significant for all the tests applied.

Results

A total of 5,805 adults were analyzed, including 2,897 men and 2,908 women. Among these participants, 317 men and 380 women were aged 45 years or younger and had little or optimum sleep. Overall, men reported an average of 7.05 ± 0.06 (SE) hours of sleep each day, while women reported 7.02 ± 0.05 hours ($p = 0.67$). Men felt not rested an average of 7.66 ± 0.32 days per month, which was less frequent than among women (10.18 ± 0.35 days; $p < 0.0001$). Among participants aged 45 years or younger, sleep time did not differ between men and women (men = 6.99 ± 0.17 hours; women = 6.74 ± 0.12 hours, $p = 0.23$), while women reported more frequent days feeling not rested (men = 9.70 ± 0.77 ; women = 12.05 ± 0.79 ; $p=0.04$).

The initial logistic regression analysis examined the odds of too little vs. optimum sleep duration;

factors included in the model were age, race, education, marital status, BMI, exercise, children present in the household, employment status, income, and partner snoring. Insufficient sleep duration was associated with higher education and being employed. While women's odds of insufficient sleep were increased for black women compared to white women and for women with children in the household (Table 1). When the analysis was restricted to participants aged 45 years and younger, the odds of insufficient sleep among men were higher for those with less than a high school education and were not associated with any other variable. Among women 45 years and younger, the odds of insufficient sleep were higher for women with children in the household, with a 46% increased likelihood of insufficient sleep for each child (Table 1); no other characteristics were associated (Figure 2).

Table 1: Demographic Characteristics of participants with Insufficient Sleep

Too little vs. Optimum sleep time ^a					
Independent variables		OR _{adj} (95% CI)			
		All participants		≤ 45 years	
		Men N=2,139	Women N=2,154	Men N=317	Women N=380
Age per year		0.96 (0.95-0.98)	0.99 (0.97-1.00)	0.99 (0.94-1.05)	0.99 (0.93-1.05)
Race	Black vs. White	0.88 (0.29-2.62)	4.32 (1.6-11.66)	10.03 (0.68-148.4)	1.24 (0.16-9.79)
	Other vs. White	1.11 (0.69-1.81)	1.11 (0.68-1.84)	0.53 (0.19-1.49)	0.77 (0.26-2.21)
Education	< HS vs. College	3.25 (1.58-6.70)	1.19 (0.60-2.38)	10.00 (1.87-53.42)	0.85 (0.21-3.45)
	HS grad vs. College	1.79 (0.96-3.18)	1.35 (0.80-2.27)	2.39 (0.62-9.25)	1.56 (0.53-4.59)
Married (vs. Unmarried)		1.08 (0.65-1.78)	0.97 (0.64-1.46)	1.32 (0.48-3.59)	1.21 (0.45-3.29)
Body Mass Index (per point)		1.02 (0.97-1.06)	1.01 (0.99-1.04)	0.97 (0.88-1.06)	1.03 (0.97-1.09)
Exercise (any vs. none)		1.31 (0.82-2.10)	1.45 (0.94-2.25)	1.75 (0.58-5.22)	1.99 (0.75-5.32)
Children in house (per child)		1.16 (0.90-1.50)	1.25 (1.04-1.51)	0.94 (0.62-1.43)	1.46 (1.14-1.87)
Employment (yes vs. no)		2.40 (1.39-4.15)	1.27 (0.85-1.90)	2.38 (0.98-5.78)	0.79 (0.34-1.83)
Household income (<\$35k USD vs. ≥ \$35k annually)		0.69 (0.42-1.15)	0.49 (0.30-0.80)	0.42 (0.15-1.23)	0.45 (0.16-1.25)
Snore (yes vs. no)		0.83 (0.52-1.31)	0.99 (0.69-1.43)	0.31 (0.11-0.87)	0.76 (0.34-1.73)

Logistic regression model; all co-variables included in each model

^a Too little: Sleep duration <6 hours, Optimum sleep time: Sleep duration 7- 9 hours

Abbreviations: OR Odds ratio; CI Confidence Interval; HS high school

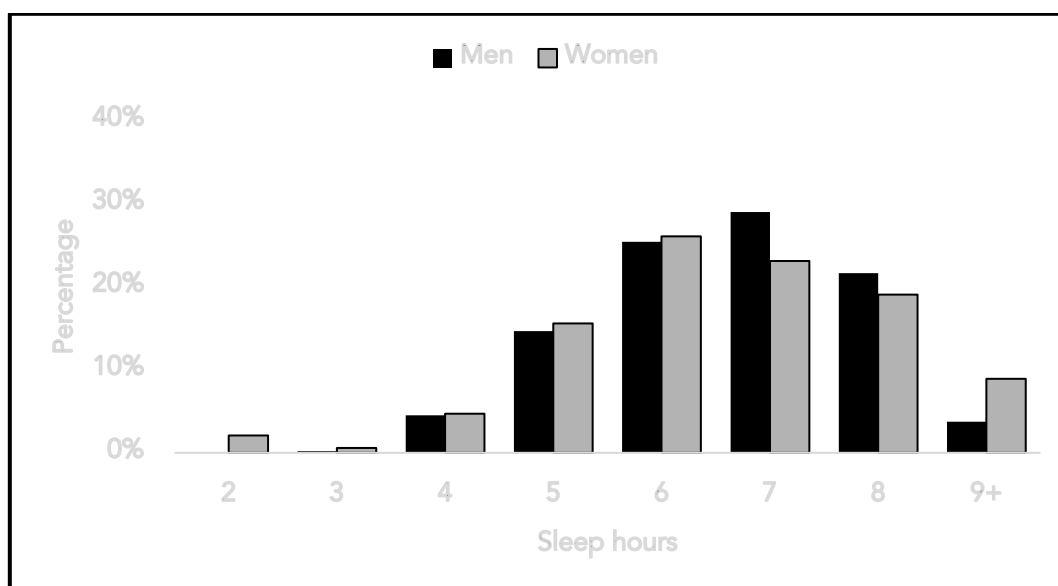


Figure 2: Sleep Duration stratified by gender among individuals 45 years or younger with children in the household

Linear regression analysis examining the number of hours of sleep as a continuous variable modeling the association of age, race, education, marital status, BMI, exercise, children present in the household, employment status, income, and snoring. An inverse association was observed between sleep duration and low education, and a positive association between sleep duration and snoring among men of all ages was identified (Table 2). Women of all ages slept longer if they were employed or had higher household incomes, while those with children in the household had shorter sleep duration. Among men 45 years or

younger, shorter sleep duration was associated with black vs. white race ($\beta = -1.30 \pm 0.60, p = 0.03$) and being married ($\beta = -0.87 \pm 0.29, p = 0.003$), while longer sleep duration was associated with higher BMI ($\beta = 0.04 \pm 0.02, p = 0.045$) and snoring ($\beta = 0.64 \pm 0.31, p = 0.04$) (Table 2). These factors were not associated with sleep duration among women in the same age range. Instead, women who were employed slept longer ($\beta = 0.62 \pm 0.23, p = 0.006$), while those with children in the household had shorter sleep duration ($\beta = -0.21 \pm 0.08, p = 0.005$).

Table 2: Demographic Correlates of Sleep Duration

Independent variables		Sleep Duration			
		All participants Coefficients (SE) ^a		≤ 45 years Coefficients (SE) ^a	
		Men N=2,897	Women N=2,908	Men N=495	Women N=566
Age per year		0.008 (0.006)	0.002 (0.005)	-0.03 (0.03)	-0.02 (0.02)
Race	Black vs. white	0.11 (0.30)	-0.61 (0.54)	-1.30 (0.60)*	-0.45 (0.42)
	Other vs. White	0.19 (0.14)	-0.06 (0.14)	0.73 (0.31)*	-0.04 (0.28)
Education	< HS vs. College	-0.64 (0.17)*	-0.02 (0.20)	-0.52 (0.49)	0.28 (0.45)
	HS grad vs. College	-0.20 (0.12)	-0.03 (0.12)	-0.52 (0.28)	-0.34 (0.29)
Married (vs. Unmarried)		-0.17 (0.13)	-0.04 (0.11)	-0.87 (0.29)*	-0.16 (0.32)
Body Mass Index (per point)		-0.003 (0.01)	-0.004 (0.009)	0.04 (0.02)*	-0.02 (0.02)
Exercise (any vs. none)		0.07 (0.15)	-0.06 (0.14)	0.22 (0.43)	-0.44 (0.32)
Children in house (per child)		-0.15 (0.08)	-0.17 (0.05)*	-0.009 (0.11)	-0.21 (0.08)*
Employment (yes vs. no)		-0.06 (0.14)	0.28 (0.11)*	-0.43 (0.39)	0.62 (0.23)*
Household income (<\$35k vs. ≥ \$35k annually)		-0.13 (0.12)	0.27 (0.13)*	0.10 (0.29)	0.28 (0.29)
Snore (yes vs. no)		0.29 (0.13)*	0.05 (0.10)	0.64 (0.31)*	0.21 (0.20)

Abbreviation: HS: High School, SE: Standard Error

^aEstimated Regression coefficient from linear regression model; all co-variates included in each model

* $p \leq 0.05$

The frequency of feeling not rested was modeled and found to be independently associated with

most demographic characteristics among men, including age 45 or younger, white race, lower

education, higher BMI, exercising, having children in the household, and being employed (Table 3). Among women, those who were 45 years old or younger, those who were not black, exercised, and had children in the household reported an increased frequency of not feeling rested. Participants aged 45 years and younger reported more frequent feelings of not feeling rested when

they were white, married, or employed (for men) or had higher BMI, children in the household, or did not snore (for women) (Table 3). Children in the household were associated with the frequency of not feeling rested among younger women ($\beta = 1.76 \pm 0.54$, $p = 0.001$) but not among younger men ($\beta = 1.06 \pm 0.64$ (SE), $p = 0.10$).

Table 3: Demographic Correlates of Feeling Unrested

Independent variables		Feeling Unrested			
		All participants Coefficients (SE) ^a		≤ 45 years Coefficients (SE) ^a	
		Men N=2,859	Women N=2,908	Men N=487	Women N=565
Age per year		-0.14 (0.03)*	-0.10 (0.03)*	-0.07 (0.10)	-0.12 (0.11)
Race	Black vs. White	-5.12 (0.78)*	-3.27 (0.95)*	-7.16 (1.75)*	-3.23 (1.81)
	Other vs. white	3.74 (1.23)*	6.38 (2.15)*	1.95 (3.35)	2.83 (2.80)
Education	< HS vs. college	2.09 (1.02)*	0.37 (1.35)	-1.58 (2.89)	-2.46 (2.97)
	HS grad vs. college	0.82 (0.72)	0.31 (0.82)	-1.23 (1.78)	-0.45 (1.94)
Married (vs. Unmarried)		0.58 (0.72)	-0.22 (0.79)	3.24 (1.60)*	-0.13 (1.69)
Body Mass Index (per point)		0.18 (0.06)*	0.11 (0.06)	0.07 (0.13)	0.26 (0.11)
Exercise (any vs. none)		3.32 (0.79)*	3.31 (0.86)*	2.60 (1.91)	3.12 (1.84)
Children in house (per child)		1.26 (0.46)*	0.96 (0.43)*	1.06 (0.64)	1.77 (0.54)
Employment (yes vs. no)		2.42 (0.78)*	0.70 (0.75)	4.61 (1.59)*	-0.29 (1.54)
Household income (<\$35k vs. ≥ \$35k annually)		-0.96 (0.80)	-1.07 (0.84)	-1.93 (1.84)	1.36 (1.93)
Snore (yes vs. no)		-0.77 (0.61)	-1.11 (0.68)	-1.19 (1.34)	-2.93 (1.46)

Abbreviation: HS, High School; SE, Standard Error

^aLinear regression; all co-variables included in each model

* $p \leq 0.05$

Discussion

Correlates of insufficient sleep differed among men and women in this sample, but no difference was observed in the average duration of sleep between men and women (7.05 hours/day for men; 7.02 hours/day for women). Women reported not feeling rested more frequently than men (10.18 ± 0.35

days/month cf. 7.66 ± 0.32 days/month, respectively; $p < 0.0001$), consistent with other studies' findings^{22,24,30}. This difference could be due to the hormonal changes that occur in women through young adulthood into menopause³¹. since hormones can contribute to anxiolytic, anesthetic, and sleep-enhancing effects on the body^{31,32}.

In the present study, men who were employed, men with higher education levels, black women, and women with children present in the household had higher odds of insufficient sleep. The association between inadequate sleep and education level persisted when our analysis was restricted to men 45 years or younger; unlike men, a 46% increase in odds in those with children in the household was observed in women. A systematic review reported a similar finding, reporting that sleep in children and parents is interconnected across various sleep parameters³³. Daily fluctuation in the child's sleep was also associated with the mother's sleep and vice versa³³. The current survey did not address personal relationships or dynamics related explicitly to sleep; therefore, the reasons driving disparities associated with the effect of children in the household were beyond the scope of this study. Contrary to other evidence that sleep problems are the main symptoms observed in people who snore, men who snored had lower odds of reporting insufficient sleep³⁴. This difference may be attributable to information being self-reported in the present study. A study shows that simple snoring is not associated with sleep structure or subjective sleepiness³⁵. In contrast, no correlation was identified between women who snored and insufficient sleep.

Sleep duration recommendations vary based on age; Bonnet and Arand reviewed several studies and concluded that a minimum daily sleep time of 8.5 hours was required for optimum functioning³⁶. In contrast, Horne³⁷ concluded that over time, there would be no accumulated sleep-lag for individuals who get 5-6 hours of sleep each day. Utilizing a systematic review, a multi-disciplinary expert panel comprising of representatives from health professional organizations in the US concluded that 7-9 hours of sleep per day is adequate for young and middle-aged adults, while 7-8 hours is adequate for older adults^{7,29}. Researchers have identified two major stages of sleep, non-REM and REM, each linked to different restorative processes^{1,38,39}. A person's quality and duration of sleep influence the transition between these sleep stages, alertness, and optimal functioning later in

the day. Data available in BRFSS do not assess sleep stages or quality and this aspect should be explored in future research on parental sleep.

The present findings provide evidence that sleep duration for men and women was differentially related to socio-demographic characteristics, with the most notable difference being having children in the household. Throughout childhood, children have been associated with disrupted parental sleep. Many aspects of parenting have been associated with sleep challenges and may contribute to this observation. A study of parents of infants reported mothers wake up 2.9 (± 1.5) times per night compared to fathers 2.1 (± 1.2) times ($t = 2.1$, $p = 0.05$, $d = 0.6$); where moms woke up for infant-related tasks 62.5% of the time compared to 25.5% for fathers ($\chi^2 = 30.1$, $p < 0.0001$, Cramer's $V = 0.4$)⁴⁰. Mothers reported being awake for 108.8 (± 59.5) minutes on average; their time awake consisted of 18.5% general infant care, 49.9% feeding, 12% changing, 1% feeding assistance, 2.3% pacifier, and 5.1% consoling their infant. All of these duties other than consoling (5.8%) were performed less by fathers who spent 42.7 (± 40.8) minutes up per wake period. The task of breastfeeding is also important to consider for parents of infants. The same study found that women reported they got up during the night for feedings while men typically did not. Another study reported breast feeding was associated with less parental sleep disruption for parents compared to formula feeding. Parents of babies who were exclusively fed breast milk slept longer than parents who used formula at least some of the time (mothers: exclusively breastfed = 7.2 ± 1.3 , at least some formula = 6.4 ± 1.3 hours [$t = 2.68$, $p = 0.008$]) with mothers sleeping an average of 47 minutes more and fathers 38 minutes more⁴¹. Having shared responsibility for nighttime feedings was also associated with longer sleep duration compared to couples with the mother handling nighttime feedings on their own; this finding held for both mothers and fathers (mothers: sleep duration shared task = 6.2 ± 1.7 vs sole task = 7.1 ± 1.2 hours per night; fathers: sleep duration shared task = 6.0 ± 1.4 vs. mother's task = 7.0 ± 1.2

hours). Sleep disruption associated with parenting is not limited to infancy. Another study of healthy 1-5 year olds used actigraphy to measure sleep patterns and reported children to be awake for 12 (± 10) minutes per night-time wake period⁴². During these night wakings, couples rarely considered themselves to be co-parents who were equally responsible; fathers often had fewer night-time responsibilities and ultimately preserved their sleep while women's' sleep was often interrupted to tend to the needs of the family⁴³. Sleep challenges could also be amplified for families of children with medical concerns as parents may need to tend to their child more during the night and also face additional stress and anxiety related to their child's medical issues⁴⁴.

The main limitations of this study were the cross-sectional design, prohibiting investigation of temporal associations, and the self-reported nature of the data, which increased the chance of misclassification and recall bias.⁴⁵ Also, information on family dynamics and objective quality of sleep were not part of the survey. Parenting practices and systems in each family differ, and these structures may influence the effect children in the household have on the quality of sleep of the parents.

Conclusions

This study raises awareness of the importance of sleep challenges in the US population, specifically for women. Although sleep needs are individual, the need for overall awareness of stress reduction methods and optimal sleep duration potentially minimizes feelings of not being rested. The results of this study should serve as an initial evaluation of these associations; however, it is important to consider each individual's situation and support the management of stressors in each person to achieve optimal sleep and health.

Conflict of Interest Statement:

All authors declare no conflict of interest.

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