Baseline Sleep Dysfunction Among Matriculating Interns

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Abstract

Background Work hour limitations for graduate medical trainees, motivated by concerns about patient safety, quality of care, and trainee well-being, continue to generate controversy. Little information about sleep habits and the prevalence of sleep disorders among residents is available to inform policy in this area.

Objectives To evaluate the sleep habits of matriculating residents, postgraduate year-1 (PGY-1).

Design An anonymous, voluntary, self-administered survey study was used with 3 validated questionnaires: the Pittsburgh Sleep Quality Index, the Insomnia Severity Index, and the Epworth Sleepiness Scale, which were fielded to PGY-1 residents entering the Accreditation Council for Graduate Medical Education–accredited programs at Massachusetts General Hospital and/or Brigham and Women’s Hospitals in June and July 2009.

Results Of 355 eligible subjects, 310 (87%) participated. Mean sleep time for PGY-1 residents was 7 hours and 34 minutes, and 5.6% of PGY-1 residents had Pittsburgh Sleep Quality Index global scores greater than 5, indicating poor quality sleep. Using multiple linear and ordinal logistic regression models, men had higher Pittsburgh Sleep Quality Index sleep latency scores, whereas women and those with children had higher Epworth Sleepiness Scale daytime sleepiness scores, and 18% of PGY-1 residents had abnormal amounts of daytime sleepiness based on the Epworth Sleepiness Scale. The Insomnia Severity Index identified 4.2% of PGY-1 residents with moderate insomnia.

Conclusions Some PGY-1 residents may begin residency with sleep dysfunctions. Efforts to provide targeted help to selected trainees in managing fatigue during residency should be investigated.

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Introduction

The need for sufficient sleep among physicians-in-training has received considerable attention in recent years and remains the focus of ongoing policy debate.¹ Controversial regulations limiting resident work hours focus on residents’ *opportunity* to sleep, without regard for their actual ability to achieve adequate sleep. As hospitals undertake the enormous costs associated with work hour limits,² a better understanding of resident fatigue is essential.

Quality sleep is an important component of healthy living for the population at large. Sleep disorders are associated with an increased risk of coronary heart disease,³ obesity,^{4,5} diabetes,⁶ motor vehicle accidents,⁷ and depression.⁸ In addition, sleep deprivation among residents has been implicated as a cause for increased medical errors,^{9,10} and in motor vehicle crashes of postcall residents.¹¹

Recent research has suggested that work hour restrictions alone are not sufficient to promote adequate rest.¹⁰ The average number of hours that residents spend sleeping has changed very little since the implementation of work hour limits, even when a significant decrease in work hours is documented, suggesting that duty hours may be just one of several factors that influence a resident’s ability to achieve adequate rest.¹⁰ The degree to which difficulty

sleeping affects resident fatigue is unknown. Although studies have demonstrated considerable individual differences in vulnerability to sleep deprivation,¹² the prevalence of sleep disorders among young physicians compared with nonphysicians, or among subgroups of physicians, has not, to our knowledge, been studied to date.

We sought to address the lack of available data regarding the sleep habits of matriculating residents, or postgraduate year-1 (PGY-1) residents. Specifically we sought to test the following hypotheses: (1) sleep habits of incoming residents are similar to those of the general population, and (2) identifiable subgroups of residents are more likely to have baseline sleep disorders than the remainder of the incoming residents.

Methods

We analyzed survey data collected at 2 large teaching hospitals in Boston, Massachusetts. Eligible subjects included all interns (first-year, PGY-1 residents) entering Accreditation Council for Graduate Medical Education–accredited programs at Massachusetts General Hospital and/or Brigham and Women's Hospital in June to July 2009. The study was approved by the Partners' HealthCare System Institutional Review Board.

Subjects were recruited at the institutional PGY-1 resident orientation sessions. An explanation of the research was provided, and written, informed consent was obtained. Surveys were completed during the orientation session, before the new matriculants had begun their internships and undertaken clinical responsibilities. The survey was voluntary, self-administered, and anonymous and had an estimated completion time of 5 to 7 minutes. Participants were each provided with a \$5 gift card.

Demographic information collected included age, sex, relationship status (dichotomized as single versus partnered), and number of children in household. The questionnaire also incorporated 3 validated surveys: the Pittsburgh Sleep Quality Index (PSQI), the Epworth Sleepiness Scale (ESS), and the Insomnia Severity Index (ISI).

The PSQI is a validated,¹³ 19-item, self-administered questionnaire that retrospectively assesses sleep quality during the previous 1-month interval. It provides 7 subset scores (for subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction), and a global score can be calculated.¹⁴ A global score greater than 5 indicates poor-quality sleep.¹⁵ The cutoff score of 5 was used because it has previously been shown to have a diagnostic sensitivity of 89.6% and a specificity of 86.5%.¹⁴

The ESS is a validated,¹⁶ self-administered questionnaire used to determine the degree of daytime sleepiness.

What was known

Duty hour limits seek to promote patient and resident safety but do not appear to have resulted in added sleep for residents. Little information about the sleep habits and the prevalence of sleep disorders in residents is available to inform policy.

What is new

Validated survey instruments found that 5.6% of responding postgraduate year-1 residents had Pittsburgh Sleep Quality Index global scores greater than 5, indicating poor quality sleep, and 4.2% had moderate insomnia.

Limitations

Evaluation at a single point in time; potential for external factors affecting sleep quality and for underreporting of the percentage of residents with poor-quality sleep.

Bottom line

Identifying, educating, and assisting residents with sleep problems may contribute to enhanced patient safety, resident performance, and resident safety.

The subject is asked to rate on a 4-point scale the chances of dozing in 8 different situations. A score of 10 or more is indicative of excessive daytime sleepiness. The ESS has a sensitivity of 93.5% and specificity of 100% for the diagnosis of narcolepsy¹⁷ and is the most sensitive metric for improvement in sleep apnea patients who undergo therapy.¹⁸

The ISI is a validated,¹⁹ self-administered questionnaire measuring respondents' perception of insomnia. Five questions assess the respondent's perceptions regarding insomnia and its interference with daily life, perceptions of others, and degree of bother. A score of 0 to 8 is categorized as no insomnia, 8 to 14 as subthreshold insomnia (defined as minimal or no perceived sleep difficulties, minimal impairment, little or no distress), 15 to 21 as moderate insomnia, and 22 to 28 as severe insomnia.²⁰ A score of 8 or more has a sensitivity of 95.8% and a specificity of 78.3% to identify insomnia symptoms.²¹

All of these validated tools have been used in numerous clinical and community settings. They were selected because of their use in the assessment of similar populations of young persons, their utility in identifying change over time (in future studies using this work as a baseline), and their relevance to concerns surrounding residency training.

Possible bias in survey completion was assessed by the Wilcoxon rank sum test for continuous and ordinal measures and the Fisher exact test for categorical measures between complete and incomplete surveys. Significance of associations between PSQI categories and demographics were calculated from χ^2 tests. Multiple linear regression and, for analysis of PSQI scores, multiple ordinal logistic regression tests were used to evaluate independent

associations between sleep scale scores and age, sex, relationship status, and presence of children in the household. Associations were declared significant based on 2-tailed tests at $\alpha = 0.05$. For tests of PSQI scores, the larger of the 2 P values from the linear and ordinal logistic-regression models was used to be conservative. Results are reported as mean differences, rather than cumulative odds ratios, for ease of interpretation. All analyses were performed using SAS software (version 9.2, SAS Institute, Cary, NC).

Results

Of 355 eligible subjects, 310 (87%) participated in the study. Twenty-two surveys (7%) were incomplete and were excluded from the analysis. Respondents with incomplete surveys were similar to other respondents in terms of age, sex, partner status, number of children, reported sleep duration, ESS or ISI scores (minimum $P > .2$), and PSQI global score (4.4 versus 3.6; $P = .19$) but were more likely to have a PSQI global score greater than 5 (36% versus 17%, $P = .015$). The analysis sample ($n = 288$) was 54% men, 41% married or partnered, and 7% with one or more children. Eighty-three percent were 30 years or younger. Additional demographics are shown in TABLE 1.

Entering PGY-1 residents reported a mean sleep time of 7 hours and 34 minutes (SD, 64 minutes), with average bed time at 11:38 PM (SD, 57 minutes), and average wake-up time of 7:48 AM (SD, 80 minutes). Mean sleep latency (time to sleep) was 15.5 minutes (SD, 26 minutes).

Responses to individual questions on the PSQI are summarized in TABLE 2. The primary contributors to high PSQI scores were middle-of-the-night awakenings, long sleep latencies, feeling hot, and waking up to use the bathroom. Specifically, 44% reported waking up in the middle of the night or early morning at least once a week, 33% reported waking up to use the bathroom at least once a week, 22% reported inability to fall asleep within 30 minutes at least once a week, and 21% reported feeling hot at least once a week. As shown in TABLE 3, 17.4% of respondents had PSQI global scores greater than 5, indicating suboptimal sleep quality, and 5.6% experienced poor quality sleep (PSQI score, > 8). Subgroup analysis was conducted to identify possible associations between demographic subgroups and sleep disturbances, and no significant associations were identified.

A multiple regression model was created to evaluate the association between sleep scores and demographics. Men had significantly higher sleep latency (PSQI sleep latency) scores than did women (mean score, 0.86 versus 0.64, respectively; difference, 0.22, 95% confidence interval [CI], 0.04 to 0.40; $P = .02$), indicating it took men longer to fall asleep. Respondents with children had higher daytime

TABLE 1	DEMOGRAPHICS OF STUDY POPULATION
Characteristic	Population, No. (%)
Age ($n = 288$), y	
20–27	141 (49.0)
28–30	97 (33.7)
31+	50 (17.4)
Sex	
Women	133 (46.2)
Men	155 (53.8)
Relationship status	
Single	170 (59.0)
Partnered	118 (41.0)
Children	
Children	19 (6.6)
No children (269)	269 (93.4)

dysfunction scores than did those without children (mean scores, 0.95 versus 0.61, respectively; difference, 0.34), but those scores did not reach statistical significance (95% CI, 0.01 to 0.67; $P = .07$). No significant association was noted between age, sex, relationship status, or number of children and PSQI global scores.

Based on the ESS, borderline and abnormal levels of daytime sleepiness (ie, scores ≤ 10) were identified in 18% of respondents (TABLE 4). A multiple regression model testing for effects of demographic factors found that women ($P < .001$), individuals with one or more children ($P = .02$), and respondents without partners ($P = .03$) had significantly higher scores, indicative of increased daytime sleepiness. Age was not a significant, independent predictor of daytime sleepiness.

Evaluation of perceived insomnia severity using the ISI test (TABLE 4) found that only 4.2% of respondents identified themselves as having moderate insomnia, whereas 16.3% had subthreshold scores (ie, scores of 8–14). There was no association among demographic variables and ISI scores in multiple regression analysis.

Discussion

In this study, the mean sleep duration reported by physicians embarking on their residency training (7 hours and 34 minutes) was nearly 1 hour less than the 8.5 hours recommended for young adults,²² and 16% of respondents reported sleeping 2 hours less than that benchmark. This observation is made during a time in which recent medical school graduates generally have fewer obligations and might be expected to

TABLE 2 PITTSBURGH SLEEP QUALITY INDEX (PSQI) MEASUREMENTS OF SLEEP DISTURBANCES

Sleep Characteristics	Bedtime	Sleep Latency	Rise Time	Total Sleep Time
Mean (SD)	11:38 PM (57 min)	15.5 min (26.0 min)	7:48 AM (80 min)	7:57 h (1.06 h)
PSQI Question	Not in past mo, %	Less than 1/y, %	1–2/wk, %	3+/wk, %
How often have you had trouble falling asleep because you...				
Cannot get to sleep within 30 minutes?	43.8	34.7	15.6	5.9
Wake up in middle of night or early morning?	27.4	28.5	26.4	17.7
Wake up to use the bathroom?	35.8	31.3	21.2	11.8
Cannot breathe comfortably	90.3	5.2	3.8	0.7
Cough or snore loudly?	84.4	8.3	3.1	4.2
Feel too cold?	69.4	21.5	8.0	1.0
Feel too hot?	56.3	22.6	20.1	1.0
Have bad dreams?	55.9	34.0	9.0	1.0
Have pain?	91.0	5.9	2.1	1.0
Had other reasons?	91.3	1.7	3.1	3.8
How often have you...				
Taken medicine to aid in sleep?	86.5	6.9	5.2	1.4
Had trouble staying awake while driving, eating, or engaging in social activity?	71.9	22.2	5.2	0.7
Had a problem getting the enthusiasm to get things done?	56.3	34.4	9.4	0.0
	Very good	Fairly good	Fairly bad	Very bad
Rate Overall Sleep	40.3	56.3	3.5	0.0

sleep more than during internship or residency. A poll conducted by the National Sleep Foundation²³ found that people aged 18 to 29 years reported an average of 6.8 hours of sleep per night, and those aged 30 to 49 years reported 6.7 hours per night.²³ Demographic subgroups were found to have higher rates of certain types of sleep dysfunction: men had higher sleep latency scores, and women and individuals with children experienced more daytime dysfunction. These findings are consistent with other studies that identified women as more likely to have insomnia symptoms with daytime consequences.²⁴

There are few studies describing the sleep habits of the age group represented by medical trainees. Studies

evaluating young adults in this age group report poor quality sleep in 13% to 60%.^{8,23,25} Those findings are in contrast to our sample, in which only 5.6% of respondents were identified as having poor quality sleep based on PSQI global score criteria (PSQI > 8). This finding suggests that medical school graduates, as a group, may experience higher quality sleep with less overt dysfunction than do nonphysicians of a similar age. In theory, individuals who choose the medical profession may self-select, resulting in a population of new medical school graduates who sleep well compared with their nonphysician peers.

The ISI identified 4.2% of respondents as having moderate insomnia, and 16% as having subthreshold

TABLE 3 PITTSBURGH SLEEP QUALITY INDEX (PSQI) SCORES BY DEMOGRAPHIC^a (UNADJUSTED ANALYSES)

PSQI Categories	Optimal (0–5), No. (%)	Midrange (6–7), No. (%)	Poor (8+), No. (%)	P
All, n = 288	238 (82.6)	34 (11.8)	16 (5.6)	
Age, y				.41
20–27	113 (80.1)	21 (14.9)	7 (5.0)	
28–30	85 (87.6)	7 (7.2)	5 (5.2)	
31+	40 (80.0)	6 (12.0)	4 (8.0)	
Sex				.71
Male, n = 155	128 (82.6)	17 (11.0)	10 (6.5)	
Female, n = 133	110 (82.7)	17 (12.8)	6 (4.5)	
Relationship status				.53
Partnered, n = 118	101 (85.6)	12 (10.2)	5 (4.2)	
Single, n = 170	137 (80.6)	22 (12.9)	11 (6.5)	
Children				.49
None, n = 269	222 (82.5)	31 (11.5)	16 (5.9)	
One or more, n = 19	16 (4.2)	3 (15.0)	0 (0)	

^a χ^2 test.

insomnia. Although our study cannot assert a diagnosis of *chronic* insomnia among entering postgraduate medical trainees, Breslau⁸ found that more than 45% of young adults who had insomnia at baseline also reported insomnia 3.5 years later, suggesting that many individuals with insomnia at a single point in time go on to develop chronic insomnia. It is possible that residents with insomnia may enter their residency training already impaired and that at least some of those residents may go on to develop chronic sleep disorders. This is an important area for future study because insomnia has been associated with reduced productivity at work,²⁶ increased risk of accidents,²⁷ and reduced quality of life. Insomniacs have been reported to have impaired short-term memory,²⁸ and studies have shown that many chronic insomniacs report impaired next-day function after a sleepless night.^{29,30} Insomnia among those beginning internship is particularly concerning given

the added stressors and sleep disruption they will encounter during clinical training.

The ACGME mandates that all training programs educate faculty and residents to “recognize the signs of fatigue and sleep deprivation” and to “adopt and apply policies to prevent and counteract its potential negative effects on patient care and learning.”^{31(p1)} More than 17% of respondents were identified as having borderline (7.3%) or abnormal (10.4%) sleepiness based on their ESS scores, suggesting that one-sixth of all entering residents experience daytime sleepiness. Subjective assessments of sleepiness, such as the ESS do not correlate well with objective assessments of sleepiness,³² but are, nevertheless, important because individual residents must rely on subjective assessments to determine whether they are able to work safely or are compromised by fatigue. Van Dongen et al³³ demonstrated that individuals who experience sleep

TABLE 4 THE INSOMNIA SEVERITY INDEX (ISI) AND EPWORTH SLEEPINESS SCALE (ESS) SCORES

ISI	No Insomnia, %	Subthreshold, %	Moderate Insomnia, %
	79.5	16.3	4.2
ESS	Normal, %	Borderline, %	Abnormal, %
	82.3	7.3	10.4

deprivation were not aware of the extent of their cognitive impairment. In addition, it is possible that high-achieving persons, such as resident trainees, will underestimate the degree of sleepiness because of concern about the repercussions. Self-reporting of fatigue or sleep deprivation may not be an optimal way to identify impaired residents. Given the individual variation in baseline sleep quality and the documented daytime sleepiness *before* the rigors of graduate medical education, it may be appropriate to target sleep health interventions and fatigue monitoring to those subgroups of trainees who are at high risk of sleep dysfunction. Moreover, it may be helpful to target those residents at highest risk for sleep dysfunction³⁴—or, ideally, those identified as having sleep dysfunction (perhaps by individualized objective performance testing)—for more intensive education regarding recognition and impact of fatigue and perhaps for facilitated access to back-up support. Although that support must be provided for all residents, a tiered approach may be more efficient and effective than the necessarily more superficial one-size-fits-all plans for addressing resident fatigue.

This study is strengthened by a high response rate (87%), reducing the likelihood of sampling error or volunteer bias. Our study population includes graduates of a large number of medical schools, entering multiple different specialties and subspecialties of medicine. Thus, these findings should be generalizable to the larger population of high-functioning physicians entering training in competitive residencies. The use of several validated instruments for detecting sleep disturbance allows direct comparison to other populations and strengthens the significance of our findings.

Certain limitations must be noted. Trainees were evaluated at one point in time, providing only point prevalence of disordered sleep. It is possible that the stress of recent relocation and the anticipation of residency training negatively affected sleep during the prior month, assessed by the questionnaires. Sleep disturbance because of “feeling hot” (21%), may, in part, be due to the weather typical of June and July in New England but was not reported frequently enough to affect the overall results. Finally, individuals who did not complete the survey were found to have higher global PSQI scores than did those who completed the survey, suggesting that the number of entering residents with poor quality sleep may be under-reported in the present study.

Conclusions

Some PGY-1 residents may begin residency with sleep dysfunctions. An understanding of the prevalence of sleep dysfunction and its association with subgroups of residents

will provide the basis for further research on resident fatigue and development of effective methods for addressing it.

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