Sleep quality, sleep habits, and chronotypes of medical interns at the beginning of their training

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ABSTRACT

Introduction: *Despite the implementation of resident work hour regulations, studies have not consistently shown beneficial changes in residents' sleep quality or duration. We hypothesized that inter-individual sleep-related differences may exist prior to training and the pre-existing sleep health and habits may impact training.*

Objective: *To determine interns' baseline sleep quality, sleep hygiene, chronotypes, and their correlates at the beginning of their residency training program.*

Methods: *A cross-sectional study using an anonymous "Resident Sleep Survey" included baseline demographic information and questionnaires, including the Epworth Sleepiness Scale (ESS), the Pittsburgh's Sleep Quality Index (PSQI), the Morningness-Eveningness Questionnaire (MEQ), and the Sleep Hygiene Index (SHI).*

Results: *One hundred and twenty-nine subjects participated the study; 45.7 % (n=59) were male and 18.6 % (n=24) were married. Twenty percent of interns had an ESS >10. The PSQI revealed that 28% of interns had poor sleep hygiene. The mean sleep efficiency was 91.2 ±7.4% estimated from the PSQI. Non-married interns had a lower prevalence of morning chronotypes (22.3% vs. 45.8%, p=0.02). Morning chronotype interns had a lower ESS score (6.1 ±3.1 vs. 7.6 ±3.6, p=0.03) and a lower SHI (29 ±7.0 vs. 34.3 ±7.1, p=0.003).*

Conclusion: *About a quarter of interns had poor sleep quality and excessive daytime sleepiness prior to their training. Non-morning chronotype interns appeared to have more daytime sleepiness and poorer sleep quality. Since pre-existing sleep problems may adversely affect learning, we suggest that strategies to improve sleep hygiene and quality in this specific population should be emphasized early in their training.*

Keywords: Sleep quality, chronotype, Epworth Sleepiness Scale, Pittsburgh Sleep Quality Index, Morningness-Eveningness Questionnaire, Sleep Hygiene Index

INTRODUCTION

Sleepiness and sleep deprivation are common problems among medical residents. Self-report studies have shown a high prevalence (20-84%) of sleepiness among medical residents based on the Epworth Sleepiness Scale (ESS) score.[1,2] Prior publications also indicate that sleep loss increases daytime sleepiness and reduces work performance.[1,3]

Extended resident work hours are associated with undesired consequences, including serious diagnostic errors in the intensive care unit (ICU),[4] near-miss car crashes,[5] and accidental needle sticks.[6] In

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2011, the Accreditation Council for Graduate Medical Education (ACGME) legislated new resident work hour regulations for maximum work hours per week and extended duty periods for post graduate year 1 residents (PGY1) of 80 and 16 hours, respectively. After this change, a survey of Family Medicine residents showed that resident work hour regulations improved their satisfaction, as well as educational and personal benefits (e.g., catch up with sleep, work related to medical records, scholarly activities, and family responsibilities, etc.).[7] To date, studies have not consistently shown any significant change in the actual residents' sleep duration[8,9] or rates of medical error.[9] Although the data suggest that the regulation of work hours does not guarantee adequate sleep, other relevant factors could include underlying the circadian chronotype, genetic traits, sleep behavior, sleep hygiene, social factors, and environmental factors. Sleep studies report vast variations in individuals' vulnerability to sleep loss or extension.[10]

We hypothesized that variations may exist in sleep-related variables among interns prior to residency. The goal of this study was to investigate the baseline chronotype, sleep hygiene, and sleep quality and quantity of interns at the beginning of their training within Tulane University residency programs. Chronotype refers to behavioral manifestation of circadian rhythm. The three chronotypes include morning-type, evening-type, and intermediate-type. Early identification of interns with preexisting predispositions to sleep-related disorders could inform an effective intervention to improve their sleep and subsequently their educational experience and delivery of patient care.

Methods

Study design

This is a cross-sectional survey of incoming PGY-1 residents at Tulane University School of Medicine in New Orleans, LA, from 2012 to 2014. We recruited new PGY-1 level trainees of any age, race, and gender. All participants completed the Resident Sleep Survey included in their orientation packets. The investigator and co-investigators collected the surveys at the end of each orientation. The Tulane University IRB approved this study.

Questionnaires

The Resident Sleep Survey included each participant's baseline demographic information (i.e., age, race, sex, and marital status) and sleep-related questionnaires, including the Epworth Sleepiness Scale (ESS), the Pittsburgh Sleep Quality Index (PSQI), the Morningness-Eveningness Questionnaire (MEQ), and the Sleep Hygiene Index (SHI).

The ESS is an 8 item standardized, validated questionnaire to assess the likelihood of one's falling asleep during certain activities. The ESS considers different situations and activities of daily living. An ESS score >10 (range 0-24) indicates increased daytime sleepiness.[11]

The PSQI is a measurement of an individual's subjective sleep quality and patterns during the previous month. It comprises seven domains, including subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency (SE), sleep disturbances, the use of sleeping medication, and daytime dysfunction. A global PSQI score of 5 or greater indicates poor sleep quality. Sleep efficiency was calculated by using items one to four from the PSQI score, and a score > 90 percent indicates good sleep efficiency.[12-14]

The Morningness-Eveningness Questionnaire (MEQ) is a validated 19 item questionnaire. The MEQ determines an individual's chronotype or circadian phase preference, as morning-type, evening-type, or intermediate-type.[15-17] The Sleep Hygiene Index (SHI) is a 13 item tool designed to assess behaviors reflecting an individual's sleep hygiene. The total score ranges from 0 to 52, with a higher score representing poorer sleep hygiene.[18-20]

Statistical analysis

Data from all participants who provided baseline demographic data and at least one component of the Residency Sleep Survey were used for statistical analysis. The sleep efficiency (SE %) was calculated

from the individual PSQI data. The MEQ and SHI were used to assess the interns' chronotypes and sleep-related behaviors, respectively. All categorical data are presented as the frequency and percentage; the Chi-square test was used to determine the statistical significance of categorical data with odds ratio (OR) and the 95% confidence interval (CI). All continuous data are presented as the mean ± standard deviation, and Student's t-test was used to determine statistical significance. Statistical analysis was performed using SPSS version 20.0, and P-values < 0.05 were considered statistically significant.

Results

One hundred and twenty-nine interns participated and completed at least one component of the sleep survey. The majority of interns completed the ESS, PSQI, MEQ, and SHI with completion rates of 100%, 96.8%, 97.6%, and 70%, respectively. The entire study cohort included 59 men (45.7%), 93 White subjects (72.1%), and 24 married subjects (18.6 %) (Table 1). Two hundred and ninety interns started Tulane residency programs during the study period; 44.5% of the interns completed at least one questionnaire. Seventy-eight subjects completed all questionnaires (Tables 1-4).

Table 1. Demographics of the study population

Characteristic	Population[+] (n=129)	Population[$] (n=78)
Gender, n (%)		
Male	59 (45.7%)	36 (46.2%)
Female	69 (53.5%)	42 (53.8%)
Race, n (%)		
White	93 (72.1%)	58 (74.4%)
Black	15 (11.6%)	10 (12.8%)
Hispanic	3 (2.3%)	0 (0%)
Asian	17 (13.2%)	10 (12.8%)
Others	1 (0.8%)	0 (0%)
Relationship, n (%)		
Single	92 (71.3%)	57 (73.1%)
Married	24 (18.6%)	20 (25.6%)
Divorce	2 (1.6%)	1 (1.3%)

[+]Data calculated from trainees who completed at least one questionnaire.
[$]Data calculated from trainees who completed all 4 questionnaires.

Twenty-six subjects (20.2%) scored as sleepy (ESS > 10); 36 subjects (28%) had poor sleep quality (PSQI > 5). Twenty-eight interns (22.4%) had sleep efficiencies < 90%. Based on the MEQ, 27.9% of interns had morning, 54.3% had intermediate, and 15.5% had evening chronotypes (Table 2).

Unmarried interns were less likely to have a morning chronotype compared to married colleagues (22.3% vs. 45.8%, p = 0.026) (Table 3). We did not find statistical significant differences in the ESS, the frequency of daytime sleepiness (ESS>10), PSQI, or the SHI between marital groups (Table 3).

PGY 1 residents with a morning chronotype had a lower prevalence of daytime sleepiness (8.3% vs. 24.4%, p = 0.04) and lower ESS scores (6.1 ± 3.1 vs. 7.6 ± 3.6, p=0.03) than non-morning chronotypes (Table 4). They also had better sleep hygiene (SHI; 29 ± 6.9 vs. 34.3 ± 7.1, p=0.003) and a trend toward better sleep efficiency (93.3 ± 5.2 vs. 90.6 ± 7.8, p=0.08) (Table 4). However, we did not find significant differences in sleep quality among these chronotypes.

We found no differences in ESS, PSQI, SHI, and SE scores between sexes or races in our study.

Discussion

Overall, this study demonstrated preexisting underlying sleep problems in some PGY1 residents prior the training. According to our anonymous Residency Sleep Survey, 20% of Tulane University medical interns had excessive daytime sleepiness (ESS > 10), and 28% had poor sleep quality (PSQI > 5) at the beginning of their training. Our results reported fewer trainees with poor sleep quality than in a study from Oregon Health and Science University, which reported that half of medical students (50.9%, n=148) met the PSQI cutoff of poor sleep quality.[21] This finding supported our hypothesis that inter-individual sleep-related variables among interns exist prior to their training. Indeed, about one third of them had poor sleep at beginning of their training. This poor

Table 2. Results of sleep surveys

Sleep Survey	Results[+] (n=129)	Results[$] (n=78)
Epworth Sleepiness Score, n=129	*7.3 ± 3.5	*7.5 ± 3.6
≤ 10	103 (79.8%)	60 (76.9%)
>10	26 (20.2%)	18 (23.1%)
Pittsburg Sleep Quality Index, n=125	*4.4 ± 2.4	*4.5 ± 2.8
≤ 5	89 (69%)	55 (70.5%)
> 5	36 (27.9%)	23 (29.5%)
Sleep Hygiene Index, n-90	*32.9 ± 7.4	*32.8 ± 6.9
[#]Sleep Efficiency %, n=125	*91.2% ± 7.4	*92.9% ± 6.1
Sleep Efficiency more than 90%	97 (77.6%)	71 (91.0%)
Morningness-Eveningness Questionnaire, n=126		
Morning chronotype	36 (27.9%)	20 (25.6%)
Intermediate chronotype	70 (54.3%)	45 (57.7%)
Evening chronotype	20 (15.5%)	13 (16.7%)

*Results reported as the mean ± SD or the number and percent.
[#]Calculated from first 4 items of the PSQI.
[+]Data calculated from trainees who completed at least one questionnaire.
[$]Data calculated from trainees who completed all 4 questionnaires.

sleep quality may persist or worsen as their training progresses despite the ACGME resident work hour regulations.

Characterizations of trainees' chronotypes based on MEQ showed that the majority (70%) had a non-morning chronotype, which was also associated with poorer sleep hygiene index, more daytime sleepiness, and a trend toward poorer sleep quality. Although no published study of chronotypes in medical students has been done in the USA to compare with our study, one Brazilian study showed that 27.6% (n=61) of medical students had a morning chronotype, which is comparable to our findings.[22] The Brazilian study also reported that the evening chronotype was associated with poorer sleep quality (based on PSQI score), but not with excessive daytime sleepiness.[22] Recent evidence supports associations between the evening chronotype and negative consequences on sleep quality and habits. Evening chronotype individuals have longer sleep duration,[23] less time in bed during the weekdays but more during the weekends,[23] irregular sleep-wake cycles,[23,24] and a higher prevalence of insomnia.[25] In addition to its effects on sleep, the evening chronotype is associated with a higher consumption of caffeinated drinks,[24] sleeping pills,[24] alcohol,[26,27] and stimulants.[26,27] Furthermore, anxiety,[28] depression,[28] dysfunctional attitudes toward work,[29] poor academic performance,[29] and poor quality of life[30] have been associated with the evening chronotype.

Since PGY1 residents with non-morning chronotype have poorer sleep hygiene and more daytime sleepiness, this circadian preference may predispose them to develop worse sleep quality and habits as training progresses. However, a prospective study is needed to evaluate the causal relationship between interns' baseline chronotypes and its consequences after a period of residency training. Confounding factors that may affect chronotype, such as the use of alcohol and stimulants, need to be considered. If this hypothesis holds true, chronotherapy at the beginning of residency training could potentially improve the sleep-wake cycle and the sleep quality.

Compared to non-married trainees, married individuals had more morning chronotypes in our study.

Table 3. Sleep survey components: Comparison of marital status

Sleep Survey	Married[+] (n=24)	Non-married[+*] (n=94)	p-value, OR (95%CI)
Epworth Sleepiness Score (Mean ±SD) Epworth Sleepiness Score > 10	6.2 ± 3.5 3 (12.5%)	7.6 ± 3.5 21 (22.3%)	0.09 0.22, 0.49 (0.14-1.82)
Pittsburg Sleep Quality Index (Mean ±SD) Pittsburg Sleep Quality Index > 5	4.17 ± 2.3 5(20.8%)	4.53 ± 2.5 29 (30.8%)	0.57 0.21, 0.56 (0.19-1.66)
Sleep Hygiene Index (Mean ±SD)	31.3 ± 4.7	33.4 ± 7.3	0.25
Sleep Efficiency	94.4 ± 3.6	91.19 ± 7.4	0.054
Morningness-Eveningness Questionnaire Morning chronotype	11 (45.8%)	21 (22.3%)	0.026
Sleep Survey	**Married[$] (n=20)**	**Non-married[$*] (n=58)**	**p-value, OR (95%CI)**
Epworth Sleepiness Score (Mean ±SD) Epworth Sleepiness Score > 10	6.4 ± 3.8 3 (15.0%)	7.9 ± 3.5 15 (25.9%)	0.11 0.32, 0.51 (0.13-1.97)
Pittsburg Sleep Quality Index (Mean ±SD) Pittsburg Sleep Quality Index > 5	4.4 ± 2.4 4 (20%)	4.6 ± 2.5 19 (32.8%)	0.73 0.34, 0.51 (0.15-1.75)
Sleep Hygiene Index (Mean ±SD)	30.9 ± 4.5	33.4 ± 7.4	0.17
Sleep Efficiency	94.9 ± 3.8	92.3 ± 6.7	0.09
Morningness-Eveningness Questionnaire Morning chronotype	10 (50%)	10 (17.2%)	0.006

OR-odds ratio, CI-confidence interval, numbers represent either the mean ±SD or the number and percentage.
*Non-married category includes single and divorced residents.
[+]Data calculated from trainees who completed at least one questionnaire.
[$]Data calculated from trainees who completed all 4 questionnaires.

However, there was no significant difference in ESS, PSQI, SE, and SHI. Several studies have explored the relationship between marital status and sleep. A longitudinal, observational study of marital status and sleep quality in midlife women revealed that being married was associated with better sleep outcomes. The author suggested that women with a stable marital history had better sleep quality based on their PSQI.[31] Neuro-hormonal factors may a role. More specifically, oxytocin, a substance involved in intimacy and pair bonding, has sedating properties and a close relationship with sleep.[32,33]

The physiological and psychological mechanisms linking sleep and relationship intimacy needs to be studied to improve our understanding of this fundamental process. Since a non-morning chronotype was more common among non-married interns (based on our findings), this particular chronotype maybe a contributing or synergistic factor for poor sleep among those who were not married. However, its role as a confounding factor cannot be excluded. A longitudinal study is needed to evaluate the interaction between marital status and chronotype and status and sleep quality.

Since this study had a cross-sectional design, we cannot prove a causal association between individual chronotype and marital status in PGY 1 residents and important sleep variables. Also since this is a

Table 4. Comparative sleep surveys between morning and non-morning chronotypes

Sleep Survey	Morning[+] (n=36)	Non-morning[+] (n=90)	p-value, OR (95%CI)
Epworth Sleepiness Score Epworth Sleepiness Score > 10	6.1 ± 3.1 3 (8.3%)	7.6 ± 3.6 22 (24.4%)	0.03 0.04, 0.28 (0.8-1.01)
Pittsburg Sleep Quality Index Pittsburg Sleep Quality Index > 5	3.8 ± 2.5 7 (19.4%)	4.7 ± 2.4 29 (32.2%)	0.07 0.13, 0.49 (0.19-1.25)
Sleep Hygiene Index	29 ± 7.0	34.3 ± 7.1	0.003
Sleep Efficiency, %	93.1 ± 5.2	90.6 ± 7.8	0.08
Sleep Survey	**Morning[$] (n=20)**	**Non-morning[$] (n=58)**	**p-value, OR (95%CI)**
Epworth Sleepiness Score Epworth Sleepiness Score > 10	6.5 ± 3.7 3 (15%)	7.9 ± 3.5 15 (25.9%)	0.13 0.33, 0.51(0.13-1.97)
Pittsburg Sleep Quality Index Pittsburg Sleep Quality Index > 5	4.2 ± 2.9 5 (25%)	4.6 ± 2.3 18 (31.3%)	0.45 0.61, 0.74 (0.23-2.35)
Sleep Hygiene Index	28.7 ± 5.1	34.2 ± 6.9	0.001
Sleep Efficiency (%)	95.1 ± 3.4	92.2 ± 6.7	0.07

OR- odds ratio, CI-confidence interval, results represent either the mean ± SD or the number and percent.
[+]Data calculated from trainees who completed at least one questionnaire.
[$]Data calculated from trainees who completed all 4 questionnaires.

single institutional study of an urban life-style medical school, generalization of the findings may not be warranted. In addition, the voluntary nature of the survey might introduce volunteer bias along with incomplete data.

Conclusion

These results indicate that about 25% of interns had poor sleep quality and excessive daytime sleepiness prior to their training. Non-morning chronotype interns appeared to have more daytime sleepiness and poorer sleep quality. In consideration of the potential consequences of sleep problems on residents' performances and health issues, we suggest that strategies to improve sleep hygiene and quality among this specific population should be emphasized early in their training. Especially, training programs should target trainees with poor sleep quality or a non-morning chronotype.

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