Factors Associated with Intern Fatigue

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BACKGROUND: Prior data suggest that fatigue adversely affects patient safety and resident well-being. ACGME duty hour limitations were intended, in part, to reduce resident fatigue, but the factors that affect intern fatigue are unknown.

OBJECTIVE: To identify factors associated with intern fatigue following implementation of duty hour limitations.

DESIGN: Cross-sectional confidential survey of validated questions related to fatigue, sleep, and stress, as well as author-developed teamwork questions.

SUBJECTS: Interns in cognitive specialties at the University of California, San Francisco.

MEASUREMENTS: Univariate statistics characterized the distribution of responses. Pearson correlations elucidated bivariate relationships between fatigue and other variables. Multivariate linear regression models identified factors independently associated with fatigue, sleep, and stress.

RESULTS: Of 111 eligible interns, 66 responded (59%). In a regression analysis including gender, hours worked in the previous week, sleep quality, perceived stress, and teamwork, only poorer quality of sleep and greater perceived stress were significantly associated with fatigue ($p < 0.001$ and $p = 0.02$, respectively). To identify factors that may affect sleep, specifically duty hours and stress, a secondary model was constructed. Only greater perceived stress was significantly associated with diminished sleep quality ($p = 0.04$), and only poorer teamwork was significantly associated with perceived stress ($p < 0.001$). Working > 80 h was not significantly associated with perceived stress, quality of sleep, or fatigue.

CONCLUSIONS: Simply decreasing the number of duty hours may be insufficient to reduce intern fatigue. Residency programs may need to incorporate programmatic changes to reduce stress, improve sleep quality, and foster teamwork in order to decrease intern fatigue and its deleterious consequences.

KEY WORDS: medical education; fatigue; duty hours.

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INTRODUCTION

In July 2003, the Accreditation Council for Graduate Medical Education (ACGME) mandated a reduction in the number of hours residents could work in a single week, the “duty hour limitations.” Published studies had linked operator fatigue with diminished patient safety, educational performance, and resident well-being,¹ and the declared aim of the mandate was to reduce fatigue and its pernicious consequences.^{2–6} The action was taken in the wake of several well-publicized instances of medical errors; legislative action had been threatened.

Increased resident work hours are associated with sleep deprivation.^{7,8} For some, sleepiness is a near daily occurrence.⁹ Resident sleep deprivation has been associated with diminished well-being and objectively measured worsened educational performance.¹⁰ Studies note diminished workplace performance, particularly for tasks that are dependent on a high level of vigilance or newly learned procedural skills.¹¹ Sleep deprivation also leads to fatigue, which impairs mood as well as cognitive and performance skills.^{12,13} Resident fatigue is associated with diminished personal safety, increasing risk for percutaneous injuries at work,³ and automobile accidents.⁴ Indirect evidence has also linked fatigue to impaired medical decision-making and decreased patient safety.⁷

Although duty hour reduction is associated with decreased in-hospital mortality and potential improvements of patient care,^{10,14–16} data suggest that these mandates may not have solved the problem of sleep deprivation¹⁷ or fatigue¹⁸ for medical trainees. Studies to date have not identified the workplace factors associated with fatigue.

To understand the factors associated with fatigue, we surveyed interns in cognitive specialties at the University of California, San Francisco (UCSF). We hypothesized that workplace factors unrelated to the raw number of hours worked might be more strongly associated with intern fatigue than the number of hours worked.

METHODS

Overview

We surveyed interns about factors hypothesized to be associated with fatigue, including work hours, perceived stress, quality of sleep, and perceptions of teamwork functioning. We performed multiple regression to explore relationships among these variables.

Sites and Subjects

The study was performed at UCSF in February 2004. By that time, all 19 of UCSF’s ACGME-accredited residency programs

had been in compliance with duty hour reduction mandates as of July 2003.

UCSF interns (first-year residents) rotate through several hospitals, including San Francisco General Hospital, the San Francisco Veterans Affairs Medical Center, UCSF Medical Center, and California Pacific Medical Center, as well as smaller, community-based clinics.

The eligible study population was interns ($n=111$) from the cognitive specialties of Internal Medicine, Family and Community Medicine, Pediatrics, and Psychiatry.¹⁹ Cognitive specialties are those in which the physician principally examines, treats, and counsels patients, with less emphasis on performing procedures.¹⁹

The four selected residency programs evidenced similar patient care practices, work flow, duty hour reduction system changes, and training goals (Table 1); we posited that study subjects' experiences of fatigue might likewise be similar. The professional responsibilities of the procedure-focused specialties (such as the surgical specialties) differ significantly from our cohort, so the former were excluded. Preliminary interns (including Neurology, Anesthesiology, Dermatology, Ophthalmology, and Radiology) were excluded because it could not be determined whether they would ultimately enter cognitive or procedural specialty residency programs.

Questionnaire Development

We convened a group of experts in the fields of education, psychometrics, health services research, and well-being, who determined the five domains for this survey-based project and helped to select validated scales, as follow:

Fatigue. Fatigue was measured using the Chalder Fatigue Scale. This 11-item scale assesses physical and mental symptoms of fatigue experienced during the previous week. Each symptom is rated on a scale from 1 (never) to 5 (very often). The scale is scored from 11–55; a higher score indicates a higher degree of fatigue.²⁰ In this sample, the internal consistency of the scale was excellent (Cronbach's $\alpha=0.95$).

Work Hours. Work hours were measured by a single question: "During the last week, how many hours did you work?" The possible responses were <40, 40–60, 61–80, 81–100, 101–120, and >120. No interns reported working <40 h per week or >100, and only three reported working 40–60 h per week. Because the number of interns working 40–60 h per week was too small for separate analysis, responses were dichotomized to ≤ 80 h vs. >80 h.

Sleep Quality. Sleep quality was measured using the six-item Medical Outcomes Study (MOS) Sleep Scale. Items query the quality and quantity of sleep, difficulty falling and staying asleep, and difficulty staying awake during the day during the prior 4 weeks. Questions are scored on a scale of 1 (all of the time) to 6 (none of the time). Scores were rescaled to range from 0 to 100;²¹ a higher score indicates poorer quality of sleep. In this sample, the internal consistency of the scale was good (Cronbach's $\alpha=0.73$).

Stress. Stress was measured using the four-item Cohen Perceived Stress Scale, which was designed to measure the degree to which situations in one's life are appraised as stressful during the prior month. Each item is scored on a scale of 1 (never) to 5 (very often). On the score range of 4–20, a higher score indicates a higher level of perceived stress.²² In this sample, the internal consistency of the scale was acceptable (Cronbach's $\alpha=0.68$).

Teamwork. Teamwork questions were developed by the authors using a focus group of internal medicine interns from the previous class and sought to measure perceptions of teamwork functioning. Any topic that was raised by more than one focus group participant, and those that were raised by one participant and by an author, were translated into open-ended questions, which were piloted with a group of senior residents across disciplines. Results were tabulated, and the most frequent responses were categorized into a response format. We administered a 17-item scale measuring attributes of positive teamwork during the prior month. These attributes included camaraderie at work, appreciation at work, belonging (how often a respondent felt like a part of a team), and institutional support (Appendix A). Scores were scaled from 1 (never) to 5 (all of the time). Scores could range from 9–45, with higher scores indicating perception of more positive teamwork functioning. The internal consistency of the scale was high (Cronbach's $\alpha=0.89$).

Additional Survey Items. Several additional questions regarding hours worked and demographics were extrapolated from published work.^{23,24} The resulting survey was reviewed by the initial group of experts and revised after piloting by educational experts and residents not associated with UCSF.

Survey Administration

Upon Institutional Review Board approval, throughout February 2004 we distributed the confidential survey to all interns at

Table 1. UCSF Cognitive Specialty Intern Training Programs - Academic Year 2003–2004

Residency program	Total intern population in program	Respondents in program: n (%)*	Longest work shift required (hours)	Frequency of the longest shift (per call month)	Number of call months
Internal medicine	56	33 (58.9)	30	Every 3rd–6th night	9
Family and community medicine	13	2 (15.4)	30	Every 4th–6th night	8
Pediatrics	28	24 (85.7)	30	Every 4th–6th night	9
Psychiatry	14	7 (50)	30	Every 4th–7th night	7

*% = Respondents/total intern population in program

UCSF by campus mail, postal mail, and at conferences. Data were collected through May 2004. This time period was selected in order to permit interns to acclimatize to the work environment and to collect perceptions reflecting interns' steady-state work rather than those reflecting beginning of the year start-up stress. Interns received a \$3 incentive with the survey, regardless of completion. Monthly reminders were sent via e-mail and announced at conferences, yielding a total of 4 months of data collection. Respondents provided the last four digits of their social security number for tracking purposes only; codes were removed prior to analysis. Data were entered by a data entry company and double-keyed for accuracy. Participation was voluntary, and consent was implied with the return of the survey. There were no conflicts of interest regarding survey administration. Specifically, none of the authors played a leadership role in the residency programs such that interns would feel pressured to complete the survey instrument or alter their answers.

Statistical Analysis

Univariate statistics characterized the distribution of responses. Means and frequency distributions were computed for all variables. Cronbach's alpha was calculated to determine the internal consistency of the various summary measures. Spearman correlations elucidated bivariate relationships between fatigue and other variables.

We used a multivariate linear regression model to identify factors independently associated with fatigue. In the first model, the dependent variable was the Chalder fatigue score. Independent variables were gender, hours worked, quality of sleep, perceived stress, and teamwork scores. In a second model, we included variables representing the interaction of sleep quality and perceived stress and the interaction of duty hours and perceived stress.

Variables were selected based on our a priori hypothesis regarding factors related to intern fatigue, and all variables were retained. Multivariate models were not adjusted for the training program in order to analyze the cohort as a group; the subjects' program similarities obviated the need for such adjustment. Additionally, given the small sample size, separate modeling was unlikely to lead to meaningful results. All analyses were performed using SAS version 8.12 (SAS Institute Inc, Cary, NC).

RESULTS

Sixty-six (59%) interns in cognitive specialties completed the survey. Of the cohort, 53 (82%) had worked ≤ 80 h in the previous week, and 12 (18%) had worked >80 h (Table 2).

Respondents had a mean (SD) fatigue score of 31.1 (9.0) out of a maximum score of 55. Symptoms rated as occurring most frequently included feeling the need to rest more (mean 3.41/5.0, SD 1.11), and feeling sleepy or drowsy during work (mean 3.18/5.0, SD 0.84). Of the six items measuring sleep quality, the most frequently selected items included not getting the amount of sleep needed (mean 2.61/6.0, SD 1.19) and not getting enough sleep to feel rested in the morning (mean 2.67/6.0, SD 1.06), with an overall mean (SD) of 59.2 (15.3). The mean (SD) perceived stress score was 9.1 (2.5) out of a maximum score of 20. The overall mean (SD) of the teamwork scale was 30.3 (5.4) out of 45 (Appendix A).

Table 2. Characteristics of Cognitive Specialty Interns

Characteristic	Respondents: N (%) n=66	Nonrespondents: N (%) n=41*
Female	46 (69.7)	23 (56.1)
Age group		
20–25 years	14 (13.5)	5 (12.2)
26–28 years	57 (54.8)	20 (48.8)
29–30 years	13 (12.5)	7 (17.1)
≥ 31 years	20 (19.2)	9 (21.9)
Married or living with partner	33 (31.7)	10 (24.4)
Program		
Family practice	2 (3.0)	10 (24.4)
Internal medicine	33 (50.0)	22 (53.6)
Pediatrics	24 (36.4)	2 (4.9)
Psychiatry	7 (10.6)	7 (17.1)
Hours worked in previous week		
≤ 80	53 (81.5)	
>80	12 (18.5)	

*Data not available for four nonrespondents

Regression analysis revealed that reported decreased quality of sleep and greater perceived stress were the only factors significantly associated with higher levels of fatigue (sleep quality: $\beta = -0.33$, $p < 0.001$, stress: $\beta = 0.83$, $p = 0.02$). An increase of approximately 1 point (0.83) in perceived stress is associated with a 1-point increase in fatigue. Likewise, a decrease in sleep quality score of a third of a point (-0.33) is associated with a 1-point increase in fatigue. The changes in the independent variables are quite small, suggesting that the fatigue score is very sensitive to variations in perceived stress and sleep quality scores. Gender, hours worked in the previous week, and teamwork were not significantly associated with fatigue. Overall, this model accounted for 58% of the variance in the Chalder Fatigue score (Table 3). In the second model, which included interaction terms, neither interaction was significantly associated with fatigue (sleep $\times$ stress: $\beta = 0.0003$, $p = 0.99$; duty hours $\times$ stress: $\beta = 0.53$, $p = 0.46$), and the model R² changed only minimally to 0.59.

Because work hours were not significantly associated with fatigue, additional regression analyses were conducted to determine if the effect of work hours was indirect; i.e., if work hours affected sleep quality or perceived stress (Fig. 1). In the first of these, sleep quality score was the dependent variable, and independent variables were gender, hours worked, perceived stress, and teamwork. Of these variables, only perceived stress was significantly associated with sleep quality, with greater stress associated with poorer sleep quality ($\beta = -1.66$, $p = 0.04$). Poorer sleep quality was reported by interns who had worked >80 h in the previous week, although the association was not significant ($\beta = -8.56$, $p = 0.08$) (Table 4).

In the second analysis, perceived stress was the dependent variable, and independent variables were gender, hours worked, quality of sleep score, and teamwork. Both lower levels of teamwork ($\beta = 0.17$, $p = 0.002$) and poorer sleep quality ($\beta = -0.04$, $p = 0.04$) were associated with greater perceived stress (Table 4).

There is clearly a relationship between sleep quality and perceived stress ($r = -0.36$, $p < 0.0001$). The regression analyses provide evidence of the strength of this relationship, even after controlling for the additional variables in the regression models.

Table 3. Predictors of Fatigue, Sleep Quality, and Perceived Stress among Cognitive Specialty Interns

Variable	Fatigue		Sleep quality		Perceived stress	
	Parameter estimate (β)	p value	Parameter estimate (β)	p value	Parameter estimate (β)	p value
Female gender	2.87	0.09	-3.58	0.36	0.75	0.23
Working >80 h in previous week	2.74	0.19	-8.56	0.08	0.89	0.24
Perceived stress	0.83	0.02	-1.66	0.04		
Teamwork	-0.09	0.57	0.39	0.30	-0.20	<0.001
Sleep quality	-0.33	<0.001				

Notes: $n=66$. Higher fatigue scores represent greater fatigue. Higher perceived stress scores represent greater stress. Lower sleep quality scores represent worse sleep.

Mean fatigue score was 31.1 (SD 9.0), mean perceived stress was 9.1 (SD 2.5), and mean sleep quality was 59.2 (15.3). Greater perceived stress and lower sleep quality were significantly associated with greater fatigue. An increase of approximately 1 point (0.83) in perceived stress is associated with a 1-point increase in fatigue. Likewise, a decrease in sleep quality score of a third of a point (-0.33) is associated with a 1-point increase in fatigue. The changes in the independent variables are quite small, suggesting that the fatigue score is very sensitive to variations in perceived stress and sleep quality scores.

DISCUSSION

In this cross-sectional study of interns in cognitive specialties at an academic health center, working >80 h a week did not have a statistically significant association with interns' perceived stress levels, quality of sleep, or fatigue. In fact, lower perceived teamwork functioning was associated with increased stress, and a higher level of stress was associated with decreased quality of sleep (Fig. 1). Higher stress and low quality of sleep, in turn, were associated with increased fatigue.

Our cohort reported fairly high frequencies of fatigue-related behaviors, e.g., feeling drowsy or the need to rest, and poor sleep quality behaviors, e.g., getting insufficient sleep. Respondents also reported moderate overall stress levels. Despite this, teamwork-enhancing attributes such as feeling part of a team and feeling a sense of camaraderie with coworkers was reported frequently. The developmental sample ($n=3,053$) for the MOS sleep scale had a mean score of 28.3, SD of 18.2. While our mean score is much higher (59.2), indicating more sleep problems, our standard deviation (15.3) is similar to that of the much larger developmental sample. Normative data for the Chalder Fatigue Scale and Cohen Perceived Stress Scale are not available.²¹

Figure 1. Summary of relationships found among perceived stress, sleep, and fatigue. Figure illustrates results of multiple regression analyses. Note: Figure 1 shows the hypothesized relationships. It is possible, however, that the causal pathway may be reversed or that the relationships noted may be bi-directional.

Our findings suggest that solely reducing the raw number of hours worked by residents does not achieve the core goal of the duty hour reduction mandates – to reduce resident fatigue and its negative consequences. To reduce fatigue, programs should consider strategies that enhance the quality of trainees' sleep and sense of teamwork, and decrease perceived stress.

Future interventions should be evidence-based and might include scheduling maintenance naps for on-call interns²⁵ and improving quality of sleep by restructuring schedules to minimize sleep-wake cycle disturbances.^{7,26} Examining the effects of a change to a shift-work system is warranted. Increasing autonomy and support²⁷ and decreasing workload might also decrease stress levels.^{20,28,29}

Our finding linking poor quality teamwork to stress and, in turn, to fatigue may provide further evidence of poor teamwork's contribution to errors.³⁰ Curricula teaching formal teamwork structure and process,³¹ high fidelity simulation-based team training,³² and training incorporating didactic instruction with interactive participation³³ have been shown to improve communication and enhance safety. The efficacy of these training interventions are likely generalizable to residents and might reduce levels of stress and fatigue.

We recognize several limitations of the study. Our sample size is moderate, with a 56% response rate, but our sample represents residents across cognitive specialties, permitting wider generalizability of our findings. We attempted to diminish the extent of recall bias by anchoring our questions with short time frames. Our study was performed at a single, large academic center. Although this may limit generalizability, many of our duty hour reduction strategies are similar to those reported elsewhere.^{34–36} Because data were collected over 4 months, responses could reflect a seasonal effect. However, we believe that collecting data from February through May optimized the chance of detecting our outcome measure. We also acknowledge that fatigue itself could have affected the accuracy of survey responses.

Seventy percent of respondents were female ($n=46$), compared with 56% of nonrespondents ($n=23$), likely indicating a response bias. Non-responding residents and preliminary interns may have shared certain characteristics, such as increased fatigue, and their exclusion could lead to bias. Our moderate sample size and the relatively small proportion of interns who reported working >80 h may have precluded us from finding a relationship between duty hours and fatigue. Additionally, there may be a

continuous relationship between work hours and stress, diminished quality of sleep, and fatigue. However, because our measurement of work hours was categorical, and because responses were limited almost exclusively to two of the categories, we were not able to conduct an analysis to address that potential relationship. Last, we recognize the problem of causal inference and emphasize that our results simply identify associations.

CONCLUSION

After implementation of duty hour limitations, trainees still experience high levels of fatigue. To achieve improvements in the presumed effects of fatigue, training programs should address residents' quality of sleep, perceived stress, and team-work functioning.

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APPENDIX A: DEVELOPMENT OF TEAMWORK SCALE

Table 4.

Table 4. 28. How often during the past month did you have the following experiences?

	Never	A few times	Fairly often	Very often	All the time
You felt you were part of a team*	1□	2□	3□	4□	5□
You felt you had no control over your work tasks	1□	2□	3□	4□	5□
You were intimidated by someone at work	1□	2□	3□	4□	5□
You were inspired by someone at work	1□	2□	3□	4□	5□
You were yelled at by a nurse or ancillary staff	1□	2□	3□	4□	5□
You felt a sense of camaraderie with your co-workers or felt you were part of a team*	1□	2□	3□	4□	5□
You felt effective in your job*	1□	2□	3□	4□	5□
You felt you were making a difference in a patient's life	1□	2□	3□	4□	5□
You felt you were making a contribution to the institution (UCSF)*	1□	2□	3□	4□	5□
You felt your co-workers appreciated your contributions*	1□	2□	3□	4□	5□
You felt that your attending appreciate your efforts*	1□	2□	3□	4□	5□
You had a good laugh with a colleague*	1□	2□	3□	4□	5□
You felt you had a "home" at UCSF*	1□	2□	3□	4□	5□
You were left unsupervised for a procedure with which you were inexperienced	1□	2□	3□	4□	5□
You were chastised by a supervisor in a public place (attending or resident)	1□	2□	3□	4□	5□
Asked a question by a supervisor in public that made you feel embarrassed or uncomfortable	1□	2□	3□	4□	5□
Asked a question by a supervisor in public that made you feel challenged and confident*	1□	2□	3□	4□	5□

*Factor analysis was done on these 17 items and 9 of the items loaded onto the first factor (eigenvalue 5.26 with 31% of the variance accounted for). Three other factors were identified, but the eigenvalue dropped steeply for those factors. In a factor analysis including all 17 of the items, the 9 items that loaded on the first factor were termed the teamwork scale for the purpose of analysis (factor loadings 0.49–0.84). In a follow-up factor analysis including only the nine teamwork scale items, all items loaded on the single factor, with item loadings ranging from 0.63–0.85. Cronbach's alpha for the teamwork scale was 0.89, indicating excellent internal consistency. As all nine identified through the factor analysis were deemed to be highly relevant to teamwork by the reviewers, all of these items (in bold and with asterisks above) were retained in the teamwork scale.