Focus on Prehospital Providers

Sleep Quality and Fatigue Among Prehospital Providers

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Abstract

Background. Fatigue is common among medical professionals and has been linked to poor performance and medical error. **Objective.** To characterize sleep quality and its association with severe fatigue in emergency medical services (EMS) providers. **Methods.** We studied a convenience sample of EMS providers who completed three surveys: the Pittsburgh Sleep Quality Index (PSQI), the Chalder Fatigue Questionnaire (CFQ), and a demographic survey. We used established measures to examine survey psychometrics and performed t-tests, analysis of variance (ANOVA), and chi-square tests to identify differences in PSQI and CFQ scores. **Results.** One hundred nineteen surveys were completed. The eight-hour shift was most commonly reported (35.4%). A majority of subjects were overweight (41.9%) or obese (42.7%), and 59.6% had been diagnosed with one or more health conditions (e.g., diabetes). Results from psychometric tests were positive. The mean (± standard deviation) PSQI score was 9.2 (± 3.7). A CFQ score ≥4, indicating severe mental and physical fatigue, was present in 44.5% of the subjects. The mean PSQI score was higher among those reporting severe fatigue (11.3 ± 3.2) than among those not reporting fatigue (7.5 ± 3.0, $p < 0.0001$). **Conclusions.** The results from this study suggest that the sleep quality and fatigue status of EMS workers are at unhealthy levels. The health and safety of the EMS worker and patient population should be considered in light of these results. **Key words:** emergency medical services; sleep; fatigue

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Introduction

Emergency medical services (EMS) providers work a variety of shifts to provide continous 24-hour service to their communities. The nature of EMS shift work includes overnight duty, rotating schedules, early awakening, and interrupted nocturnal sleep. These patterns disrupt circadian rhythms and result in *dyssynchronosis*, where the individual is out of phase with the environment.[1] The most severe consequence of dyssynchronosis is the decrease in the quantity and quality of sleep. Endogenous factors, such as comorbid conditions in shift workers, can exacerbate this misalignment. Overnight shift workers are especially susceptible because they are attempting to sleep during the day, out of phase with their intrinsic circadian sleep–wake rhythm. Attempts to recover from lost nighttime sleep with daytime sleep is difficult because of this circadian misalignment, and results in shorter overall sleep duration.[2]

Sleep deprivation produces impairments in central nervous system (CNS) activities from the most basic functions, such as appetite and temperature regulation, to higher functions, such as memory and vigilance. Sleepiness has been linked to increases in unintentional incidents such as motor vehicle collisons and occupational injuries.[3–5] Chronic disruptions of circadian rhythms and sleep may be associated with a variety of health risks, including sleep disorders, gastrointestinal disturbances, and

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cardiovascular disease.[6] There is also an adverse effect on the mood and psychological well-being. Shift workers have higher rates of heavy drinking, job stress, and emotional problems compared with workers who have fixed work schedules.[7] Shift workers also tend to have to rely on sleep-inducing agents. A survey of emergency medicine residents revealed that 46% used some kind of sleep agent, including alcohol, benzodiazepines, and muscle relaxants, to fall asleep.[8]

Less sleep resulting from extended shift work has been linked to increased rates of medical error and attentional failures in medical residents.[9] In a study of 393 nurses, medical errors were three times more common among nurses working more than 12.5 hours per shift than nurses working fewer hours per shift.[10] In a separate study of 502 critical care nurses, medical errors occurred twice as often among nurses working longer than 12.5 hours per shift than nurses working fewer hours per shift.[11] Dula et al. found that emergency medicine residents had a substantial decline in cognitive performance on a standardized intelligence test after working a series of night shifts.[12]

The current peer-reviewed literature on EMS provider sleep and fatigue is limited, and the perspective from which sleep and fatigue have been defined and studied varies. The basic understanding of sleep quality and fatigue in EMS providers is limited to small studies that may not be generalizable to the larger EMS population considering the variety of shift lengths and operational paradigms.[13–15] A large cross-sectional study is needed to describe these issues in the EMS worker. Therefore, we conducted a pilot study of sleep and fatigue in EMS workers using two previously validated and widely used sleep quality and fatigue instruments.

Methods

Ethical Review

This study was determined to be exempt by the University of Pittsburgh Institutional Review Board.

Study Design and Population

This was a cross-sectional survey of a convenience sample of EMS professionals attending a regional conference in west-central Pennsylvania. This annual conference is attended by emergency medical technicians (EMTs), paramedics, medical directors, EMS administrators, and other prehospital personnel in Western Pennsylvania and adjacent states. Currently practicing EMTs and paramedics were eligible to participate. Estimated attendance at the 2008 annual meeting was 1,300.

Study Protocol

Over a two-day period, study staff approached conference attendees as they passed by a booth located in the conference exhibit hall. Subjects were screened for eligibility and were offered a $5 gift card to complete an anonymous survey. All completed surveys were placed in an opaque box for secure transport to the principal investigator's institution. Data collection was halted when the supply of incentive cards was exhausted.

Instruments

Our survey included 15 demographic and health quality items, 19 items from the Pittsburgh Sleep Quality Index (PSQI),[16] and 11 items from the Chalder Fatigue Questionnaire (CFQ).[17]

The PSQI is a 19-item survey designed to comprehensively measure the complex phenomenon of sleep across seven constructs: Subjective Sleep Quality, Sleep Latency (the time from lying down for sleep to the start of actual sleep), Sleep Duration, Habitual Sleep Efficiency (the proportion of actual sleep to time spent in bed), Sleep Disturbances, Use of Sleeping Medications, and Daytime Dysfunction.[16] The PSQI is an easy-to-use scale of sleep quality, evidenced by its use in over 900 studies. The PSQI survey instructions reference the preceding 30 days and sleep habits while not at work and elicit multiple-choice and fill-in-the-blank responses. Construct-specific scores are calculated and weighted on a 0–3 scale and then aggregated into a global PSQI score that ranges from 0 to 21. A global score >5 suggests poor sleep quality. Prior psychometric testing of the PSQI shows that the PSQI demonstrates good internal consistency and differentiation (validity) between good and poor sleepers.[16] The PSQI produces a global score that is easily interpreted and perceived as useful in the clinical setting to identify a range of sleep problems.[16]

The CFQ was developed in 1993 to measure two constructs, physical fatigue and mental fatigue. The CFQ has been tested in clinical and nonclinical settings and has been incorporated in over 60 published studies since 1993.[17] A comparative analysis of different fatigue scales determined that the CFQ adequately measures varying levels of fatigue and is appropriate for use in the general population.[18] The CFQ elicits four-point Likert scale ratings (always, sometimes, rarely, or never) across 11 simple and unambiguous items. Responses are scored as 0, 0, 1, or 1 and summed to reach a total score ranging from 0 to 11. Scores ≥4 indicate the presence of severe mental and physical fatigue. The CFQ instructions reference perceptions of fatigue while at work. Results from psychometric tests of the CFQ provide evidence of a two-construct measure of fatigue; the scale has been shown to be reliable (internally consistent) and the questionnaire displays acceptable instrument validity.[17] The CFQ has been shown to distinguish between those with symptoms of chronic fatigue syndrome and those without such symptoms. We modified the CFQ items to reference the EMS work setting (i.e., base version: "Do you have problems with tiredness?"; EMS version: "Do you have problems with tiredness during your EMS shifts?")

Statistical Analysis

We used established measures of reliability and validity to evaluate the psychometric properties and thus the utility of our survey as appropriate measures of sleep quality and fatigue in the EMS workforce. First, we used Cronbach coefficient alpha and component score–total coefficients (Pearson product–moment correlation coefficients) to examine the homogeneity of the PSQI and the CFQ, also referred to as the internal consistency/reliability. High reliability scores would indicate that the pattern of responses obtained was consistent across respondents and across the items used to measure a specific construct.[19] Second, we evaluated instrument validity of the CFQ with confirmatory factor analysis (CFA) and three measures of instrument validity (model fit): the chi-square/degrees of freedom ratio (CSDFr), Bentler's comparative fit index (CFI), and the Bentler and Bonett (1980) non-normed fit index (NNFI). For the PSQI it was not possible to evaluate these instrument validity measures because of the required manipulation of raw item responses into scores and use of the same item across multiple domains. Cronbach alpha scores of 0.7 or greater indicate satisfactory reliability.[19,20] A CSDFr less than 2.0 and CFI and NNFI greater than 0.9 are considered acceptable indexes of instrument validity (model fit).[19]

We compared global PSQI scores across respondent characteristics using analysis of variance (ANOVA) and t-tests. We used chi-square to identify differences in the proportion of respondents with severe fatigue across respondent characteristics. All statistical procedures were completed using SAS version 9.1 (SAS Institute Inc., Cary, NC). Statistical significance was based on p-values <0.05.

RESULTS

We collected 119 completed surveys. Subjects were 54.0% female, and the largest age group was 40 to 49 years (39.3%; Table 1). The most common level of certification was EMT-Basic (62.6%), and the most often reported level of EMS experience was 0 to 10 years (41.9%). Most subjects worked full-time (45.8%), with

Table 1: Study sample demographics

	Freq	%
Gender		
Male	54	46.0%
Female	64	54.0%
Age		
17–29yrs	23	19.7%
30–39yrs	31	26.5%
40–49yrs	46	39.3%
50+yrs	17	14.5%
Certification		
EMT-Basic	72	62.6%
EMT-Paramedic	43	37.4%
Years of EMS experience		
0–10yrs	49	41.9%
11–20yrs	38	32.5%
21+yrs	30	25.6%
Employment status		
Full-time	54	45.8%
Part-time	33	28.0%
Volunteer-only	31	26.2%
EMS shifts per month		
0–3 shifts/mo	21	19.4%
4–8 shifts/mo	22	20.4%
9–15 shifts/mo	22	20.4%
16–25 shifts/mo	29	26.9%
26+ shifts/mo	14	12.9%
Type of shift most commonly worked		
24-hour shifts	17	15.0%
12-hour shifts	32	28.3%
8-hour shifts	40	35.4%
<8 hour shifts	24	21.2%
Work at more than 1 EMS agency		
Yes	39	34.2%
No	75	65.8%
General health ranking		
Excellent	14	12.3%
Good	80	70.2%
Fair	19	16.7%
Poor	1	0.9%
Body Mass Index (based on ht & wt)		
Underwt or normal-wt (BMI < 25)	18	15.4%
Overwt or obese (BMI D25)	99	84.6%
Smoking status		
Smoke	17	14.7%
Do not smoke	99	85.3%
Alcohol consumption		
1–3 drinks per week	41	39.4%
4–10 drinks per week	23	22.1%
11+ drinks per week	5	4.8%
Don't drink alcohol	35	33.7%
Ever told by doctor that you have:		
Diabetes	15	12.6%
High blood pressure	27	22.7%
Heart problems	4	3.4%
Sleep apnea	15	12.6%
Lung/breathing problems	9	7.6%
Arthritis	12	10.1%
Weight problems	27	22.7%
Migraine headaches	16	13.5%
Depression	11	9.2%
Proportion with >1 of these conditions	71	59.6%
Total surveys in analysis	119	100%

Table notes: Across several demographic variables the frequencies do not add up to 119. This can be attributed to respondents failure to answer that particular demographic question.

nearly half of the subjects reporting working four to 15 EMS shifts per month (40.8%). The eight-hour shift was the most common shift length reported (35.4%), and a moderate proportion of subjects reported employment at multiple EMS agencies (34.2%). The majority of subjects were overweight or obese (84.6%) based on body mass index (BMI). In spite of this, most reported being in good health (70.2%), not smoking (85.3%), and consuming only a moderate amount of alcohol (61.5%). Approximately one-fifth of subjects reported being told by a doctor that they had high blood pressure (22.7%) and one-fifth reported being told that they have weight problems (22.7%).

The overall reliability for the PSQI was $\alpha = 0.72$, indicating acceptable internal consistency. Component score–total Pearson correlation coefficients ranged from 0.54 ($p < 0.0001$) for the Use of Sleeping Medications construct to a high of 0.79 ($p < 0.0001$) for the Subjective Sleep Quality construct. The mean component score–total correlation (0.62) was comparable with averages published previously.[16]

Internal consistency as measured by Cronbach coefficient alpha was acceptable for both physical fatigue and mental fatigue constructs of the CFQ ($\alpha =$ 0.86 and 0.64, respectively). Component score–total Pearson correlation coefficients for the physical fatigue and mental fatigue constructs were 0.96 ($p < 0.0001$) and 0.80 ($p < 0.0001$), respectively. Evaluation of the two-construct structure using CFA revealed acceptable model fit and validity: CSDFr = 1.76, CFI = 0.95, and NNFI = 0.92.

The mean ($\pm$ standard deviation) global PSQI score across all subjects was 9.2 ($\pm$3.7) (Fig. 1). The mean PSQI was 6.5 points higher than previously documented in healthy adults and only 1.9 points lower than mean sleep quality in subjects diagnosed with depression (Fig. 1).[16] The PSQI scores showed a trend toward variation across many sample demographic variables (e.g., $p < 0.10$) but did not reach statistical significance.

Nearly half of the subjects (44.5%) reported experiencing severe fatigue while at work (Fig. 2). The proportion of subjects with severe fatigue increased with years of experience ($p < 0.0001$), but the proportions with severe fatigue were not different across other respondent demographics (e.g., age, $p = 0.51$). The PSQI and CFQ scores were correlated ($r = 0.54$, $p < 0.001$). Among subjects reporting severe fatigue while at work, the mean sleep quality score was significantly higher (worse, 11.3 + −3.2) than the mean sleep quality score among the nonfatigued subjects (7.5 + −3.0, $p < 0.0001$) (Fig. 3).

DISCUSSION

Multiple factors have brought increased attention to sleep and fatigue among shift workers, including

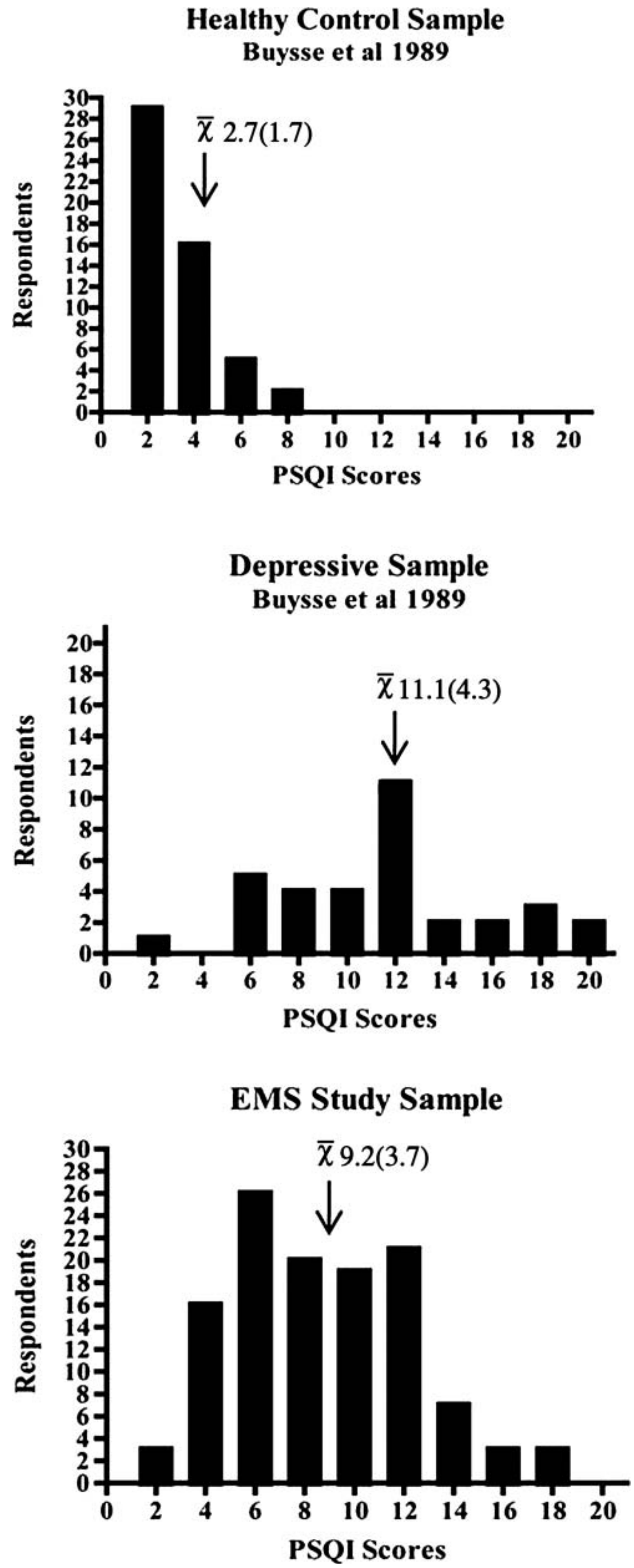

FIGURE 1. Mean global Pittsburgh Sleep Quality Index (PSQI) score in patients treated for clinical depression, in previously studied healthy control subjects, and in the emergency medical services (EMS) study sample. "Buysse et al 1989" refers to Buysse DJ, Reynolds CF 3rd, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatr Res. 1989;28:193–213.

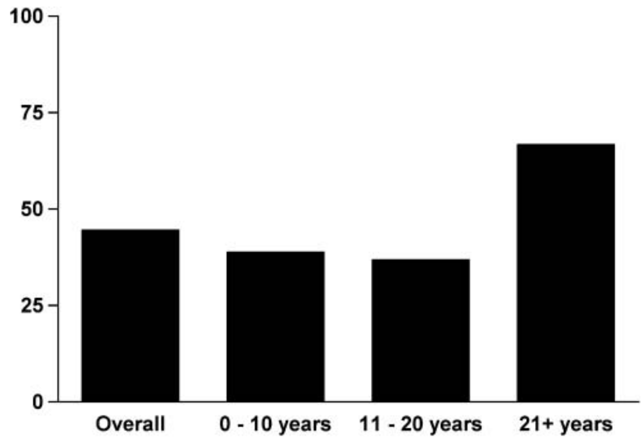

FIGURE 2. Proportion of subjects reporting severe fatigue stratified by years of experience. The overall proportion of subjects reporting severe fatigue (Chalder Fatigue Questionnaire [CFQ] $\geq$4) was 44.5%.

those practicing prehospital emergency medicine. Among these, the most visible include the recent Institute of Medicine (IOM) report on resident duty work hours, the Commission on Accreditation of Medical Transport Systems (CAMTS) proposal to limit medical crew hours, and the National Transportation Safety Board (NTSB) hearings on air medical crashes[21]. In spite of this interest, the current research on these aspects of prehospital provider health and well-being is sparse, making it difficult to formulate guidelines or regulations.

One strength of this study of EMS provider sleep quality and fatigue is the use of two previously validated sleep and fatigue instruments. Psychometric tests performed on these data confirm the utility of the PSQI and the CFQ as satisfactory measures of sleep quality and fatigue in the EMS workforce. The most striking observation in our study sample was the self-reported severity of poor sleep quality. Specifically, the mean PSQI score was appreciably higher than the average sleep quality score in healthy adults and close to the sleep quality scores seen in persons with diagnosed depression (Fig. 1). In comparison with the

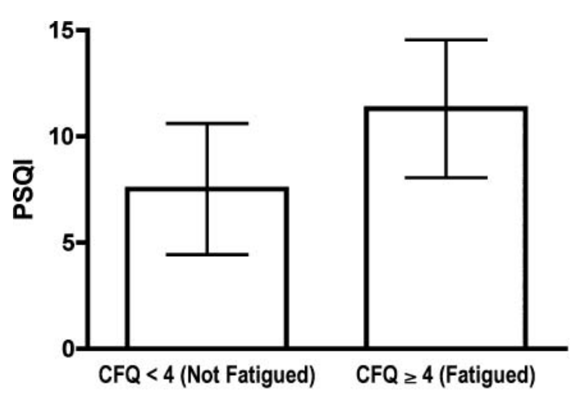

FIGURE 3. Pittsburgh Sleep Quality Index (PSQI) score stratified by the Chalder Fatigue Questionnaire (CFQ) score.

sleep quality reported in studies of patients receiving chemotherapy treatment and outpatient psychiatric services, the sleep quality in our EMS sample was markedly worse.[22,23]

The preliminary nature of this study makes it difficult to identify all the potentially related personal factors. Subjects in the present study were typically overweight or obese, in line with findings in a previous study of EMS providers.[24] It is well known that obesity is a risk factor for sleep apnea and sleep hypoventilation, which may contribute to daytime fatigue.[25] Similarly, obstructive sleep apnea and other sleep disorders have been previously reported in police officers.[26] In our sample, we identified a nonsignificant difference in the proportion with severe fatique and mean sleep quality scores across five categories of BMI ($p > 0.05$). Nevertheless, identification of specific sleep disorders in prehospital providers may partially account for our observations and provide an opportunity to intervene in an area other than shift length and scheduling.

Subjects with more years of service reported more fatigue, although the same relationship was not observed with increasing age even though these variables were highly correlated ($p < 0.0001$). Given the relatively small number of subjects available for this analysis, it was necessary to place these variables into categories. Studies with a larger and more geographically diverse sample of EMS providers are needed to fully understand the magnitude of the potential physical (e.g., BMI) and demographic (e.g., age and years of service) factors and their relationship to sleep quality in the EMS setting.

Measurements of severe fatigue identified a sizable proportion of providers with significant levels of fatigue while at work. The relationship between fatigue and medical error has been identified in the in-hospital setting.[27,28] Given the lack of fatigue-related research in EMS and exploration of its association with patient or provider factors, important questions related to the impact of fatigue in the prehospital setting remain unanswered. Also inadequately addressed in the literature are questions related to transferability of previous instruments such as the CFQ and the definitions of fatigue and how they apply to the EMS setting. Both qualitative approaches such as focus groups and quantitative approaches would facilitate answering questions about instrument validity and definitional validity.

Although there are few studies specific to EMS, information about the potential scope of the problem can be inferred from other sources. Federal law limits work hours for many sectors of the transportation industry, including commerical pilots (eight hours of flight time per 24 hours), shipboard personnel on tankers (15 hours per 24 hours), and long-haul truck drivers (14 hours per shift, with a maximum of 11 hours driving).[29–31]

Although there are no uniform guidelines or regulations for prehospital providers, it is likely that EMS providers are similar to resident physicians in terms of long work hours. The Accreditation Council for Graduate Medical Education limits the work hours of resident physicians nationally. In the emergency department, these physicians are limited to shifts that do not exceed 12 hours. In other patient care settings, resident physicians are currently allowed to work 24 hours, with an additional six hours of transition time per shift, and they should have 10 hours off between shifts. A recent report from the IOM indicated that 24 hours of patient care may be dangerous for the patient and the resident and recommended further limitations, including reducing the shift to 16 hours of patient care or up to 30 hours of patient care if there is a five-hour period of protected sleep time.[32]

Shift length is likely related to fatigue, with longer EMS shifts potentially impairing certain aspects of job performance.[33] Individuals who stay awake for 19 or 24 hours show impairment on a simple reaction time test similar to research subjects with blood alcohol concentrations of 0.05% and 0.10%, respectively.[34] Although the eight-hour shift was most commonly reported in this cohort, a significant proportion of subjects reported 24-hour shifts. Additionally, the 24-hour-shift format is common in the fire service and fire-based EMS system, which is underrepresented in Western Pennsylvania.[35] Finally, the reported "two-hat syndrome," where public safety providers may work in multiple roles or multiple agencies, places them in jeopardy of working consecutive shifts requiring them to stay awake for long periods of time.[36] Considered in aggregate, these situations may place many EMS providers in jeopardy of harming either themselves or patients, especially in cases of drowsy driving.

LIMITATIONS AND FUTURE RESEARCH

Sleep quality and fatigue among providers not attending this conference and among conference attendees choosing not to participate are not well represented by this study design. A large proportion of subjects (39.3%) in this study were between the ages of 40 and 49 years, which, based on previous EMS workforce research, are representative of the older and slightly less prevalent EMS worker.[37] Future studies with larger and more representative EMS samples are needed to determine whether the sleep quality and fatigue results in this study are representative of the larger EMS workforce. All incentives had been dispersed well before the end of the conference. Our study was designed to characterize sleep quality and fatigue in a sample of EMS providers. Our study was not designed to characterize these factors for all EMS clinicians, nor was it powered to examine factors responsible for variations in respondent characteristics. The generalizability of our results is therefore limited by the convenience nature of our sample from one regional conference in west-central Pennsylvania and the limited proportion of meeting attendees completing the survey.

CONCLUSIONS

In this convenience sample of EMS providers, we have identified poor sleep quality and a high proportion of providers with severe mental and physical fatigue while at work. These data provide information to design and power additional studies to more fully describe and identify respondent, social, and environmental factors that may be responsible for poor sleep quality and fatigue in EMS providers.

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