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Original research article

Sleep quality of paramedics in the Czech Republic

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Abstract
Introduction: Sleep disorders are common among shift workers and those who work under stressful and unpredictable conditions. Sleep quality and its promotion in paramedics are understudied.
Objective: The study aimed to investigate the quality of sleep in emergency medical service workers, to compare certain relationships between variables (gender, age, length of experience), and to assess whether a cut-off score of 10 is appropriate for the discriminatory ability of the selected instrument in the Czech clinical setting.
Design: A cross-sectional study.
Methods: Data were obtained using the Pittsburgh Sleep Quality Index (PSQI). The sample comprised 191 paramedics. Data were analyzed using selected statistical methods.
Results: The mean PSQI total score was 7.45 (SD 3.60). The lowest scoring component was sleep duration (1.45; SD 1.01). There was no relationship between sleep quality and gender. With respect to age, two components, sleep disturbances and daytime dysfunction, were found to be significant ($p < 0.05$). Regarding the length of experience, daytime dysfunction was identified as a significant component. The PSQI total parameter with a cut-off of 10 (PSQI total ≤10 good sleep; PSQI total >10 poor sleep) was confirmed to be suitable for discriminating the subjectively perceived sleep quality in paramedics.
Conclusion: The study demonstrates that sleep quality is compromised in paramedics. Impaired sleep quality has the greatest impact on daytime dysfunction in paramedics. The PSQI, with a cut-off score of 10, is an appropriate instrument for assessing their sleep disturbances.

Keywords: Paramedic; Pittsburgh Sleep Quality Index; Sleep quality

Introduction

Due to the nature and specifics of their work, health professionals perform their work activities in a shift system (Gonczaryk et al., 2023). The type of work and the work environment in emergency medical services (EMS) are unique. The volume of work is unpredictable, involving high-stress situations, long shifts, and high-risk activities that are time-sensitive and critical to the life or death of patients (Patterson et al., 2023). The nature of shift work in EMS is characterized by night shifts, shift changes, early rising, and intermittent night-time sleep. These patterns disrupt circadian rhythms and lead to circadian desynchronization. A serious consequence of circadian desynchronization is the disruption of natural biological rhythm, which adversely affects the quality of sleep (Patterson et al., 2010). Sleep loss and sleep fragmentation are commonly observed in individuals working shifts. Fatigue and sleep disturbances have been reported in EMS workers in Europe and other continents (Patterson et al., 2023).

The work environment and its conditions, shift work, and its very nature predispose paramedics to a variety of negative health complications, such as risk of cardiovascular disease, infections, cancer, mental disorders, and sleep disturbances (Gonczaryk et al., 2023). Sleep deprivation causes impairment of the central nervous system, from its most basic functions, such as appetite and temperature regulation, to its higher functions, such as memory and alertness (Nowak and Łukomska, 2021). Drowsiness is associated with an increase in unintentional incidents such as motor vehicle collisions and workplace accidents (Patterson et al., 2010). This is supported by an analysis of nearly one million shifts from 14 EMS agencies, which found that the risk of occupational injury or illness was related to shift length (Weaver et al., 2015). Mood and psychological well-being are also adversely affected. Recent studies have shown that sleep deprivation impacts emotional

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empathy, with paramedics and police officers among the most affected (Guadagni et al., 2018). Working night shifts has been proven to interfere with 24-hour blood pressure (Patterson et al., 2021). Shift workers are more prone to excessive drinking, job stress, and emotional problems than those who do not work nights (Barger et al., 2018). Sleep aid use among emergency medicine residents may be common. A survey of emergency medicine residents revealed that 46% used substances (including alcohol, benzodiazepines, and muscle relaxants) to induce sleep (Handel et al., 2006).

Poor sleep quality and sleep deprivation are common among EMS workers. Their sleep disorders are often overlooked, even though good quality sleep is important for both physical and psychological well-being. Sleep quality in paramedics has not been adequately investigated. More knowledge is needed, therefore the present study aimed to investigate the quality of sleep in EMS workers, to compare certain relationships between variables (gender, age, length of experience, type of crew), and to assess whether a cut-off score of 10 is appropriate for the discriminatory ability of the selected instrument in the Czech clinical setting.

Materials and methods

Sample

The sample comprised a total of 191 respondents from four Czech regions. The inclusion criteria were being a paramedic in a response unit, working rotating shifts, having at least one year of work experience, and giving voluntary consent to participate in the survey.

Measurements and data collection

The survey was conducted between December 2022 and February 2023. Four regions of the EMS were approached for the research, namely South Moravian, Moravian-Silesian, Olomouc, and Zlín. Respondents were paramedics on the crews. The distribution of the questionnaires in all regions was mediated by a competent person of each EMS. This person sent the questionnaires electronically to individual field crews or posted them on the intranet of the EMS.

We made use of the Pittsburgh Sleep Quality Index (PSQI). The questionnaire consists of 19 self-rated items combined into seven clinically derived components reflecting past sleep problems (subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction). Each of these components is equally weighted on a 0–3 scale. Summing the seven subscores yields a total PSQI score that ranges from 0 to 21. Consent to use the questionnaire was obtained directly from the author (Buysse et al., 1989). In the Czech Republic, the instrument was validated by a group of researchers from Prague (Manková et al., 2021); with their consent, the Czech version (PSQI-CZ) was used for the present study. At the end, the respondents subjectively evaluated their overall sleep quality (good/bad).

Defining sleep disorders

The study used the PSQI total score to classify sleep as good (PSQI total ≤10) or poor (PSQI total ≤10). The cut-off was arbitrarily set based on literature data (Manková et al., 2021) confirming good statistical results (sensitivity 0.635; specificity 0.793; area under the receiver operating characteristic curve 0.80 within a 95% confidence interval [CI]).

Ethical aspects

The study was conducted in accordance with the Declaration of Helsinki. Participation in the survey was voluntary and respondents' anonymity was protected. Consent for research was obtained from each EMS separately.

Data analysis

Descriptive statistics (absolute/relative frequency, mean, and standard deviation [SD]) were used to analyze demographic and clinical data and to evaluate individual questionnaire items. Statistical analysis of results was performed using TIBCO Statistica software. The Cronbach's α statistic was calculated using a statistical software NCSS 12 from Number Cruncher Statistical Systems LLC. (Kaysville Utah, USA).

The relationship between PSQI-CZ score and gender was tested using Welch's *t*-test for independent samples based on Pearson's correlation coefficient; the relationship between PSQI-CZ score and age was tested using an independence test based on Pearson's correlation coefficient; the relationship between PSQI-CZ score and length of experience was tested using an independence test based on Spearman's rank correlation coefficient; and the relationship between PSQI-CZ score and job position was tested using analysis of variance. The significance level was set at 0.05.

Results

The sample of 191 paramedics consisted of 138 males (72%) and 53 females (28%). The largest age group was 41–50 years (37%) and the smallest was 61 years and older (4%). One third of the participants (n = 66) had worked in the field for over 21 years, whereas the least represented group had less than 5 years of experience (15%). Most frequently, respondents worked as members of an ambulance crew consisting of a paramedic and a driver (51%) (Table 1). The mean PSQI-CZ total score in the study sample was 7.45 (SD 3.60), indicating poor sleep quality. The lowest scoring component was sleep duration 1.45 (SD 1.01), while the highest scoring one was use of

Table 1. Descriptive statistics of major characteristics and variables of the sample (n = 191)

Variables	*n* (%)
Gender	
male	138 (72)
female	53 (28)
Age	
22–30	22 (12)
31–40	61 (32)
41–50	71 (37)
51– 60	29 (15)
61 and older	7 (4)
Length of experience	
up to 5 years	29 (15)
6–10 years	37 (19)
11–20 years	58 (31)
more than 21 years	66 (35)
EMS crew type	
physician, paramedic/nurse, and driver	39 (20)
physician and paramedic	47 (25)
paramedic/nurse and driver	98 (51)
physician, paramedic, and pilot	7 (4)

sleeping medication 0.26 (SD 0.74). The other components scored as follows (in ascending order): habitual sleep efficiency 0.68 (SD 0.93); subjective sleep quality 1.19 (SD 0.79); sleep disturbances 1.23 (SD 0.54); sleep latency 1.27 (SD 0.94); and daytime dysfunction 1.37 (SD 0.76) (Table 2). The internal consistency of the Czech version of the PSQI was evaluated in 191 paramedics Cronbach's α = 0.79 (Table 3). Usually, as the acceptable minimum is stated α > 0.70 and the value 0.7 ≤ α < 0.8, it is therefore interpreted as fairly high degree of internal consistency (Taber, 2018).

Table 2. Descriptive statistics of PSQI-CZ scores and its components (*n* = 191)

PSQI-CZ components	Component score	*n* (%)	Mean	SD	Median	Min	Max
1 Subjective sleep quality	0 1 2 3	34 (18) 97 (51) 49 (26) 11 (6)	1.19	0.79	1	0	3
2 Sleep latency	0 1 2 3	41 (21) 81 (42) 45 (24) 24 (13)	1.27	0.94	1	0	3
3 Sleep duration	0 1 2 3	41 (21) 59 (31) 59 (31) 32 (17)	1.45	1.01	1	0	3
4 Habitual sleep efficiency	0 1 2 3	111 (58) 44(23) 25 (13) 11 (6)	0.68	0.93	0	0	3
5 Sleep disturbances	0 1 2 3	10 (5) 132 (69) 47 (25) 2 (1)	1.23	0.54	1	0	3
6 Use of sleeping medication	0 1 2 3	167 (87) 7 (4) 10 (5) 7 (4)	0.26	0.74	0	0	3
7 Daytime dysfunction	0 1 2 3	19 (10) 98 (51) 61 (32) 13 (7)	1.37	0.76	1	0	3
PSQI-CZ total score			7.45	3.60	7	0	17

Table 3. Item reliability statistics

Variable	Mean	Standard deviation	Total mean	Total std. dev.	Coef alpha	Corr total
Subjective sleep quality	1,194706	0,799544	14,72941	5,524178	0,7994	0,6514
Sleep latency	1,276471	0,945533	16,71765	5,577794	0,7336	0,6119
Sleep duration	1,456471	1,133954	18,36765	5,51668	0,7989	0,656
Habitual sleep efficiency	0,680588	0,939381	12,32353	5,538924	0,7334	0,6122
Sleep disturbances	1,231765	0,540392	13,53235	5,836677	0,8114	0,4161
Use of sleeping medication	0,267059	0,740188	16,09706	5,670864	0,8379	0,5731
Daytime dysfunction	1,378235	0,762141	14,70588	5,519765	0,8628	0,618
Total			18,64412	6,243897	0,7917	
Cronbach's alpha 0.79172						

We studied the relationships between gender and both overall sleep quality (i.e., good [PSQI total ≤10] or poor [PSQI total ≤10] sleep) and individual questionnaire components. For both males and females, the highest scoring component was use of sleeping medication (0.29 [SD 0.76] and 0.19 [SD 0.68], respectively) and the lowest scoring was sleep duration (1.47 [SD 1.06] and 1.38 [0.86], respectively). None of the components were rated as a statistically significant factor ($p > 0.05$) affecting sleep quality, suggesting that there is no relationship between gender and sleep quality (Table 4).

When assessing the differences between the individual components with regard to age, the relationship was verified using Welch's *t*-test and its power was expressed using Pearson's correlation coefficient r (95% CI), where an increas-

ing value indicates the power of the relationship, and positivity (or negativity) indicates a direct (or inverse) relationship. Two positive correlations were identified, namely sleep disturbances r = 0.18 (p = 0.015) and sleep latency r = 0.04 (p = 0.577). The other correlations were negative (in ascending order): daytime dysfunction r = –0.24 (p = 0.001); habitual sleep efficiency r = –0.06 (p = 0.405); sleep duration r = –0.05 (p = 0.500); subjective sleep quality r = –0.04 (p = 0.568); and use of sleeping medication r = –0.003 (p = 0.962). Two components (sleep disturbances and daytime dysfunction) were found to be statistically significant (p < 0.05) (Table 5).

Table 4. Differences in PSQI-CZ component scores (mean, SD) by gender (*n* = 191)

PSQI-CZ components	Gender	*N*	Mean	SD	*p*-value
1 Subjective sleep quality	male female	138 53	1.19 1.21	0.78 0.84	0.882
2 Sleep latency	male female	138 53	1.24 1.36	0.92 1.00	0.433
3 Sleep duration	male female	138 53	1.47 1.38	1.06 0.86	0.567
4 Habitual sleep efficiency	male female	138 53	0.69 0.66	0.97 0.83	0.852
5 Sleep disturbances	male female	138 53	1.17 1.36	0.53 0.56	0.034
6 Use of sleeping medication	male female	138 53	0.29 0.19	0.76 0.68	0.396
7 Daytime dysfunction	male female	138 53	1.40 1.28	0.77 0.74	0.350

Table 5. PSQI-CZ component correlations with age (*n* = 191)

PSQI-CZ components	*r*	*p*-value
1 Subjective sleep quality	–0.04	0.568
2 Sleep latency	0.04	0.577
3 Sleep duration	–0.05	0.500
4 Habitual sleep efficiency	–0.06	0.405
5 Sleep disturbances	0.18	**0.015**
6 Use of sleeping medication	–0.003	0.962
7 Daytime dysfunction	–0.24	**0.001**

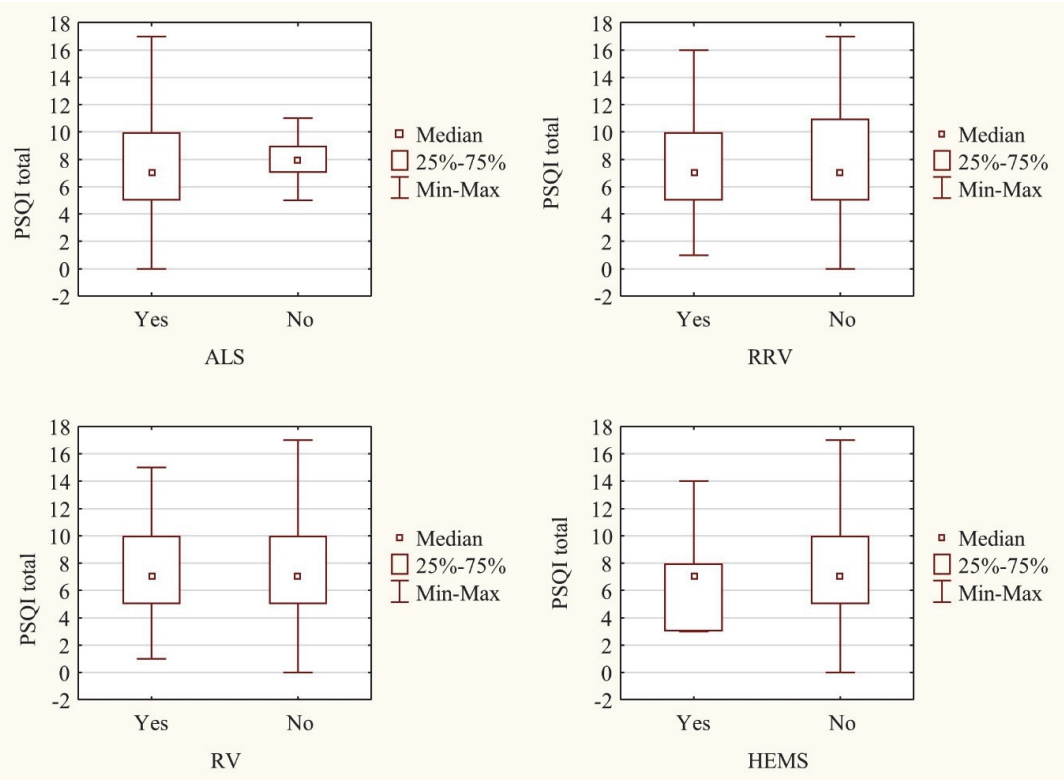
Table 6. PSQI-CZ component correlations with length of experience (*n* = 191)

PSQI-CZ components	*r*	*p*-value
1 Subjective sleep quality	–0.03	0.726
2 Sleep latency	0.02	0.749
3 Sleep duration	–0.09	0.214
4 Habitual sleep efficiency	–0.04	0.588
5 Sleep disturbances	0.09	0.221
6 Use of sleeping medication	–0.08	0.246
7 Daytime dysfunction	–0.24	**0.001**

In the same way, the relationship between sleep parameters and length of experience was analyzed and the following results were obtained (in descending order): sleep disturbances r = 0.09 (p = 0.221); sleep latency r = 0.02 (p = 0.749); subjective sleep quality r = –0.03 (p = 0.726); habitual sleep efficiency r = –0.04 (p = 0.588); use of sleeping medication r = –0.08 (p = 0.246); sleep duration r = –0.09 (p = 0.214); and daytime dysfunction r = –0.24 (p = 0.001). Daytime dysfunction was found to be statistically significant. This was an inverse relationship, meaning that scores for this component decreased with increasing length of experience. However, its dependence was weak (Table 6).

The sub-analysis aimed to determine if there is a relation between sleep quality, assessed by the total PSQI, and the type of crew, including RRV (rapid response vehicles) crew with physician, ALS (advanced life support) crew comprising a paramedic and a driver person, HEMS (helicopter emergency services), and RV (Rendesvous) crew. The analysis revealed no statistically significant effect on the PSQI score ($p > 0.05$) for any of the crew types (Chart 1).

A statistically significant difference was found when assessing the differences between subjective sleep quality and PSQI-CZ scores (a cut-off of 10) across groups. As many as 96% of respondents who rated their sleep quality as good had PSQI total scores ≤10. And 62% of respondents rating their sleep quality as poor had PSQI total scores >10. Thus, the cut-off was shown to discriminate between good and poor sleep quality in a statistically significant manner (Table 7).



Note: ALS – Advanced life support crew; RV – Rendesvous crew; RRV – rapid response vehicles crew; HEMS – helicopter emergency services

Chart 1. Association between PSQI total and EMS crew type

Table 7. Comparison of agreement between subjective assessment and PSQI-CZ total score (*n* = 188)

p-value: 0.000	PSQI-CZ total				
	≤10		>10		
Quality of sleep (subjective)	*n*	%	*n*	%	Total (*n*)
Good	123	96	5	4	128
Poor	23	38	37	62	60
Total	146		42		188

Discussion

The present study focused on sleep quality in prehospital EMS paramedics working shifts. Sleep quality analysis using the PSQI-CZ instrument found paramedics to have poorer sleep (PSQI-CZ total 7.45; SD 3.60). This is consistent with the results of a robust study of 17,522 EMS workers, of whom 64% reported poor sleep quality with a mean PSQI total score of 7.3 (Cash et al., 2020). In other studies, mean PSQI scores ranged from 4.97 to 9.20 (Patterson et al., 2010; Vladič and Kren, 2021). In the present study, the lowest scoring component was sleep duration (1.45; SD 1.01), demonstrating shorter sleep time. Recent epidemiological studies have shown that not only chronically reduced sleep duration, but also prolonged and excessive sleep may pose a risk. It has been found that the lowest risk of death is associated with night-time sleep lasting six to seven hours. The risk increased significantly with sleep duration of less than five or more than nine hours (Patel et al., 2004). Studies of cause-specific mortality risks also yielded interesting results. Sleeping more than nine hours per night is associated with the highest risk for cardiovascular disease, malignancies, and stroke (Kwok et al., 2018).

Contrary to our assumptions, sleep quality was not found to be associated with gender ($p > 0.05$). This finding is in contrast to a study analyzing sleep quality in shift workers, where the proportion of females with poor sleep quality was significantly higher than the proportion of males with good sleep quality ($p < 0.001$) (Park and Suh, 2020). In a general population sample ($n = 9284$), females reported significantly more sleep problems than males (PSQI 5.5 and 4.4, respectively; [d = 0.35]) (Hinz et al., 2017).

When analyzing the relationship between sleep quality and age, two components were identified as significant (sleep disturbances, daytime dysfunction). Numerous epidemiological studies suggest that as many as 50% of older persons complain of poor sleep (Vitiello, 2000). On the other hand, even though aging is associated with significant changes in sleep, it does not necessarily lead to complaints of disturbed sleep by older adults with objectively confirmed poor sleep quality (Vitiello et al., 2004). A growing body of evidence supports the view that sleep disturbances are associated with impaired daytime well-being and functioning. Poor sleep can seriously compromise social and work performance and increase the risk of injuries and road traffic accidents (Léger et al., 2014). At the same time, there is evidence that some of the factors influencing the incidence of medication errors in the pre-hospital setting are shift work and sleep disturbances (Walker et al., 2023). Medical errors and adverse events were 50% more likely in respondents with poor sleep than in those with good

sleep (odds ratio 1.5; 95% CI 1.0, 2.1) (Patterson et al., 2012). This finding supports the need for greater attention to sleep problems, particularly as fatigue is associated with potential errors. In the USA, a special education program tailored to EMS workers (*Fatigue Risk Management in Emergency Medical Services Education Program*) has been designed (Patterson et al., 2023).

Based on literature data (Manková et al., 2021), a PSQI cut-off score of 10 was set for the test to discriminate between good and poor sleep. This higher threshold proved to be appropriate for the population in the present study. The original article defined a PSQI total >5 as the cut-off for poor sleep (Buysse et al., 1989). However, more recent studies mostly recommend higher cut-off scores, namely 6 (Backhaus et al., 2002), 7 (Zhang et al., 2020), 8 (Tzeng et al., 2012), or even 8.5 (Sohn et al., 2012).

Implications for practice

Sleep disturbance may constitute a modifiable risk factor for daytime activities for EMS workers.

The PSQI with a cut-off score of 10 was found to be a suitable instrument with good discriminatory ability.

Sleep quality in paramedics has not been adequately investigated. More knowledge is needed on how to promote sleep in EMS workers and to analyze the impact of sleep disturbances.

Conclusion

EMS workers are a vulnerable group prone to sleep disorders. In the future, consideration should be given to implementing appropriate strategies to prevent and eliminate the harmful effects of shift work. Parallel efforts targeting health professionals may lead to new studies and research that will improve our understanding of the causal relationships between fatigue, sleep, shift work, and safety outcomes.

Limitations

As the study used a small sample size, the generalizability of its findings is limited. A future survey should be conducted with a larger representative sample of pre-hospital EMS workers.

Authors' contributions

HL: Conceptualization, methodology, investigation, software, resources, data curation, visualization, writing – review and editing, supervision, project administration. *BKB:* Conceptualization, methodology, investigation, software, resources, data curation, visualization, writing – review and editing. *RZ:* Conceptualization, methodology, formal analysis, investigation, writing – review and editing. *JH:* Conceptualization, data curation, methodology, analysis and interpretation of data, writing – original draft, final approval. *MB:* Conceptualization, data curation, methodology, analysis and interpretation of data, writing – original draft, final approval.

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Ethical aspects and conflict of interest

The authors declare that there is no conflict of interest regarding the surveillance study, and the ethical aspects were respected while processing the results. All the used bibliographical sources were properly cited.

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