Review Article

Napping during the night shift in prehospital emergency medical services—a narrative review

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Background and Objective: The acute and chronic consequences of shift work are well known. Fatigue can impair the willingness to perform and can lead to decreased performance during work. The aim of the narrative review was to determine the effects of on intermittent naps during the night shift on several variables.

Methods: A literature search was conducted in various databases (PubMed, MEDLINE, Web of Science, Psyndex, and EbSco Host). Inclusion criteria were language of full text in English or German, only employees of prehospital emergency medical service (EMS), possibility of napping during the shift work, more than 10 participants. A manual search of reference lists was completed. Only studies on prehospital EMS personnel (EMSP) who engage in shift work were considered.

Key Content and Findings: From a total of 5,113 references, only two studies about prehospital EMS could be included. Both studies reported the benefits of napping during a night shift. Napping reduced subjective fatigue and physiological functions during the night shift.

Conclusions: Despite the lack of existing evidence-based studies, conclusions can be drawn from other health care workers (e.g., emergency department hospitals) and applied to prehospital EMSP. It should be noted that there are job-specific requirements and stressors among prehospital EMSP (e.g., driving the ambulance). Measures for preventing fatigue behind the wheel of a vehicle due to shift work are listed.

Keywords: Sleep; shift work; ambulance service; prehospital; prevention

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Introduction

Background

Prehospital emergency medical service (EMS) and EMS personnel (EMSP) (EMSP also includes emergency physicians) constitute a system-relevant profession. The diverse psychological, physical and organizational workloads of this profession have been described in numerous publications (1-5). The 24/7 shift service is the basis of the EMS, thereby providing assistance for life-threatening situations in a quick and effective manner (6). Shift models can vary depending on the health care facility; shifts typically last for 8, 12 or 24 h, but other models exist (7). Shift schedules can be permanent or may rotate continuously (8). A review of EMSP revealed high rates of fatigue and poor sleep quality compared with shift workers in nursing and industry professions, as well as high rates of insomnia, depression, posttraumatic stress disorder, and anxiety among EMSP (6,9). Previous studies have also shown a lack of metabolic product removal in the brain during sleep deficit. Thus, insufficient removal of ß-amyloid from the lymphatic system in the brain (10) can provoke or worsen dementia (11). In

addition, gastrointestinal disorders and an increased risk of diabetes mellitus or cardiovascular diseases may occur (8,12). It is known that shift work influences circadian rhythmicity (13,14). The circadian rhythm is the ability of an organism to synchronize physiological processes to a period length of about 24 hours, which includes the sleep-wake rhythm. Thus, increased oral temperature, resting heart rate, and urinary free norepinephrine have been observed during the night shift. Diurnal variations in serum cortisol and urinary free adrenaline were also strongly altered (13). In a direct comparison of shift patterns with different shift lengths, fatigue levels, sleep quality, and alertness were found to be worse for longer shifts than for shorter shifts (6,15). Shift work can affect health and wellbeing from both physiological and psychological perspectives, and shift work can impact aspects of an individual's professional and personal life (15). A randomized crossover design involving three experimental conditions concluded that an impairment of performance after 20–25 h of wakefulness is similar to a blood alcohol concentration (BAC) of 0.10% (16). In contrast, one study among air ambulance medical personnel failed to demonstrate differences in psychomotor performance (measured by successful endotracheal intubation) and shift duration (17). Two Canadian studies of EMSP and nurses also found no differences between fatigue and shift length (18,19).

The clinical judgment and decision-making of paramedics is complex and multifaceted and often must be made in uncertain environments. Consequently, patient safety depends on this judgement (20), including physiological variables, equipment malfunction, self-reported perceived barriers (e.g., fatigue, mistakes during medication dose calculation, endotracheal intubation success rates), and patient death (21).

Individual factors that are important for shift work can be identified during occupational health screening. A study of German EMSP showed that more than half of the included EMSP were poor sleepers (7). A longitudinal study also indicated that certain work-related behavioral and experience patterns decrease sleep quality, especially for patterns that are hazardous to health (22). One study showed that fatigued EMSP exhibit up to a 3.6-fold increase in safety-threatening behavior (9). In summary, shift work can lead to negative effects on health [in the sense of the holistic World Health Organization (WHO) definition regarding physical, psychological, and social health] (23) and is definitely a source of illness; thus, it is of great interest to occupational medicine as a prevention-oriented discipline. Based on knowledge of epidemiologic evidence-based studies, health policy decisions were made so that "night workers" in the European Union have a right to medical health examinations (24).

Rationale and knowledge gap

The literature to date certainly shows a loss of personnel performance power among shift workers due to fatigue. EMS, unlike hospital personnel, are exposed to special situations, such as driving ambulances despite being tired, working in the dark or cold outdoors, etc. Studies show that naps during shift work can improve performance. Known reviews on the introduced topic included other professional groups in shift work in addition to EMS. There is no known review that only deals with EMS.

Objective

The objective of the narrative review was to screen and evaluate studies on napping during shift work among EMS. In particular, the aim was to look for safety, performance, health consequences of EMS and patient safety. We present this article in accordance with the Narrative Review reporting checklist (available at https://jphe.amegroups.com/article/view/10.21037/jphe-23-134/rc).

Methods

We performed a literature search in the following databases: PubMed, MEDLINE, Web of Science, Psyndex, and EbSco Host. The databases were searched up to July 19, 2023. The literature search took place in several phases. Because of the high number of search results, the outcome variables were changed in each literature search. Each search included EMS (or an equivalent term), shift work (or an equivalent term), and napping (or an equivalent term). The searches did not include setting hospital (with emergency department), nurses, patients, or practice. *Table 1* provides more information about the search strategy of the narrative review. The two authors reviewed the literature and searched for outcome variables, which are shown in *Figure 1*. Possible influencing factors of the results were considered, e.g., sex, age, chronotype, preexperience with napping, duration of service, profession versus voluntariness, frequency of operation during the day, day *vs.* night, and placebo effect (i.e., the illusion of fatigue because it was queried). Because there are presumably few studies that explicitly address only EMSP, the outcome variables varied widely.

Table 1 The search strategy summary

Items	Specification
Date of search	Literature search: 19 Jul, 2023
	Manual search: up till 01 Oct, 2023
Databases and other sources searched	PubMed, MEDLINE, Web of Science, Psyndex, and EbSco Host
	Reference lists of relevant literature
Search terms	Emergency medical service OR emergency medical personnel OR prehospital ambulance service OR rescue service OR emergency medical technicians OR paramedic
	AND shift work OR rotating shift OR night shift OR chronotype
	AND napping OR nap OR powernap OR intermittent sleep OR sleep
	Different steps:
	• AND fatigue OR tiredness OR health OR personnel performance OR efficiency OR effectiveness OR productive
	• AND accidents OR vehicle accidents OR needle sticks OR occupational hazards
	• AND medication errors OR procedural complication OR patient safety OR error rate
	• AND heart rate OR heart rate variability OR response rate OR body temperature OR pulse rate OR pulse rate variability
	• AND health complaints OR diseases OR cardiovascular diseases OR illness OR mental illness OR costs to the system OR pain OR cancer OR diabetes mellitus OR metabolic disorders
	• AND job satisfaction OR job dissatisfaction OR wellbeing
	• NOT nurses OR patients OR hospitals OR clinic OR practice
Timeframe	2000 up till 01 Oct, 2023
Inclusion criteria	Employees of prehospital emergency medical service
	Possibility of napping during the shift work
	More than 10 participants (in each group)
	Measurement outcome variables
	Full-text in English or German language
	Humans
Exclusion criteria	Other professions
	Not napping during shift work
	Reviews, commentaries
	Publications that studied hospital emergency department personnel or other shift workers and did not identify it in the title
Selection process	Independent selection process by the two authors

Results

In total, 5,113 references were retrieved. Only two studies from Japan could be included (25,26). Fifty-five middle-aged EMSP were included in both studies. Both studies were cross-sectional studies with healthy EMSP. Main results or conclusions are presented in *Table 2*.

Motohashi and Takano investigated 42 EMSP in Japan who were divided into the good tolerance group (n=30) and the poor tolerance group (n=12) (25). Poor tolerance means clinical intolerance regarding shift work. This

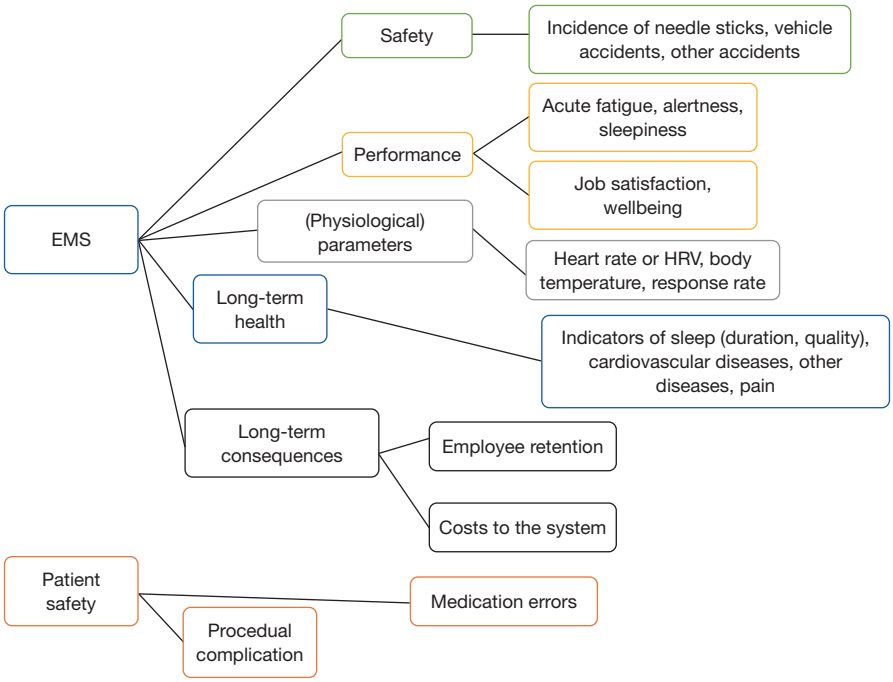

Figure 1 Outcome variables of the literature search considering the possibility of napping EMSP during their shift. EMS, emergency medical service; HRV, heart rate variability; EMSP, EMS personnel.

Table 2 Main results/conclusions and recommended measures of prevention of the included studies

First author, year, country	Conclusions	Measures of prevention
Motohashi (25), 1993, Japan	Desynchronization does not closely indicate poor tolerance of shift work Nightly naps over 4 hours stabilize the circadian rhythms	EMSP with high night workload and complain of shift intolerant symptoms should be shift rotated or transferred to a team with lighter night workload
Takeyama (26), 2009, Japan	New modified night shift system ensures that EMSP have time to take long and restful naps Napping reducing the number of complaints of subjective fatigue, and the physiological functions during the night shift	Recommendation of single rooms for napping, and the possibility of a restful nap. Data show no effect of which half of the night was slept

EMSP, emergency medical service personnel.

means that these people exhibit various symptoms or complaints. In contrast, people without symptoms have a good tolerance. The age was 39.6±6.2 years, and the work experience with shift work was 16.2±6.0 years. The EMSP worked in 24-hour shifts. No statistically significant differences among oral temperature, grip strength, heart rate, drowsiness, fatigue, attention, and depression scale were observed between the two groups. Subgroup analyses were performed regarding desynchronized (n=27) and well-synchronized (n=15) subjects regarding circadian rhythms. In this subgroup analysis, the subjects with poor tolerance were more likely to be in the desynchronized group (n=11) than in the well-synchronized (n=1) group. Significantly desynchronized subjects (83.3%) were found in the longer nighttime service group (more than 100 minutes of service in the nightshift between 00:00 and 08:00). In the group with shorter night-time service (under 100 minutes of service), 45.8% of the subjects were functionally desynchronized.

The authors concluded that desynchronization does not closely indicate poor tolerance of shift work. This is

explained by the fact that the EMSP in this study worked a 24-hour shift with the possibility of nightly naps. On less busy nights, EMSP were able to sleep for more than 4 hours continuously, which corresponds to "anchor sleep" (25). It is known that "anchor sleep" has a stabilizing effect on body temperature circadian rhythms and possibly other circadian rhythms (25). Napping is also beneficial for EMSP because it has a positive effect on preventing performance problems in the early morning hours, when emergency calls are frequently received.

Takeyama *et al.* examined 10 EMSP in Japan (26). The mean age was 36.1 years and ranged from 29 to 51 years. All subjects worked 24 hours. During the night shift, the EMSP were divided into teams working consecutive 2-h shifts (22:00–00:00) for duty of emergency calls and had the possibility of napping in a private room. One shift team took a nap between 21:30–03:00 (c-shift), and the other took a nap between 03:00–08:45 (b-shift). The two groups were compared to traditional shifts over 24 h (usually from 08:45 to 08:45 the following day) and firefighters.

The mean number of emergency calls showed no significant differences. The length of nap duration was significantly different (P=0.009) between the c-shift and the traditional shift. A frequency-related parameter of heart rate variability in the high frequency band (P<0.05 traditional shift *vs.* b-shift), and the oral temperature was higher in b- or c-shift compared to the traditional shift (P<0.05). HF means high frequency and declared parasympathetic activity of the autonomic nervous system. A critical flicker fusion frequency (CFF), a parameter for the measurement of tiredness states, showed no significant difference between the groups and declined after the night shift. The mean response time in the traditional shift was longer after the night shift than in the c-shift without significance. Feeling of drowsiness and feeling of local pain or dullness were identical between the groups.

In summary, the napping time was longer for the b- or c-shift than for the traditional shift. The parasympathetic activity was higher in the b- and c-shifts than in the traditional shift. Here, the authors discussed that psychological stress due to uncertainty about wake times may affect sleep quality.

Strengths and limitations of this review

This narrative review brings together the current state of research and current recommendations for reducing fatigue in EMS shift work. Due to the scarcity of literature, another relevant research gap emerges. Common and large databases were used. More than 5,100 studies were reviewed. Only English- or German-language literature was reviewed; thus, studies in other languages were not included. However, English is the language of science by itself. Due to the narrative design, no assessment tool was used to evaluate the studies. In the end, however, this did not seem to make sense, since the studies were below the actual expectations of the authors.

Conclusions

The review shows that there is little data on naps during the night shift among EMSP. The two studies that explicitly examined prehospital EMSPs show a benefit to naps during the night shift. However, the studies here tend to show a cross-section and can be assessed to a limited extent. The evidence is considered to be low. In summary, there is a great need for research in this area. Personnel working in clinics (e.g., nurses or physicians) or shift workers working in industry are sometimes better studied. The prehospital ambulance service should be considered separately (27) because the particular setting of "patient residence or location" presents special challenges. The ability to drive during night duty due to increased fatigue should also be considered. No studies exist that examine naps and their effects on EMSP safety, long-term health consequences, or patient safety.

Measures are needed to prevent impairment of EMSP well-being. Complaints of shift-intolerant symptoms due to long nighttime work activities should be taken seriously. Studies of other professions show that naps have positive effects on employees.

A nonrandomized controlled interventional pilot study among 18 residents showed that a short, mid-day nap can improve cognitive functioning and alertness among residents (28). Another nonrandomized crossover study investigated 30- or 50-min naps during night shifts and compared them with a control group without naps among 14 shift workers in an oil refinery and showed that the naps increased the reaction to visual signals during the second half of the night shift and reduced subjective sleepiness. Daytime sleep was slightly impaired by the group of 50-min naps (29). A randomized crossover study among nine nurses and medical scientists in an Australian hospital evaluated the effect of a 30-min nap during the night shift and found benefits for personnel performance and acute fatigue, but there were no effects of personnel safety and sleep and

sleep quality (30). Another randomized controlled trial among nurses and physicians in an emergency department of a hospital profited from a 40-min nap at 3 a.m. at night shift regarding performance laps, more vigor, less fatigue, and patient safety (faster procedure during intravenous insertion) (31). Purnell *et al.* concluded in a crossover study that a nap during the first half of the night shift (12 h shift of aircraft engineers) compensated for performance deficits (32). Similar results were shown in a randomized controlled trial of nurses working an 8-hour shift and napping between 2 and 3 a.m. (33). A systematic review and meta-analysis concluded that scheduled naps during shift work increased personnel performance and decreased fatigue during the shift. Although the included studies did not examine EMSP, the authors concluded that it also applies to EMSP because they work in shifts (34). A narrative review among nurses and physicians in hospitals titled that night shift naps improve patient and workforce safety, especially errors or near errors decreased or quicker insertions of intravenous catheters (35).

Ultimately, no precise findings are available as to whether long-term shift work is to be assessed as harmful and which shift systems are associated with low stress for the individual. Particularities in the individual occupations should be taken into account.

Recommendations for the EMS regarding risk management

Performance measures for fatigue risk management in EMS are considered clear, relevant and necessary (36). These measures are demonstrated in a guideline for EMS and include the use of:

- Survey instruments for fatigue or sleepiness (survey and assessment of fatigue quarterly);
- Knowledge about the optimal length of shifts (depending on the frequency of emergency calls);
- Access to caffeine to counteract fatigue (free or for purchase);
- Enabling naps during shift work (ideally in single rooms); and
- Providing fatigue risk management training for EMSP (36,37).

For EMSP, a weak recommendation with very low certainty in effect was voiced for work shifts shorter than 24 hours in duration (36). However, the preference of the EMSP should be considered here, as 24-hour shifts are often preferred. EMSP working 24 h shifts report significantly better well-being and life satisfaction than emergency responders on 12 h shifts (38). Access to free coffee can increase feelings of appreciation. A checklist for the implementation of fatigue in EMS evidence-based guidelines was demonstrated in the guidelines of fatigue risk management (36).

Short forward rotating layers are preferable. Consequently, weekly or backward rotations are to be avoided (8). After a night shift phase, a rest period of more than 24 hours should be ensured as long as possible (39). However, risk management measures are not a one-way street. Sleep hygiene should also be observed at home. A cross-sectional study among 171 Australian EMSP showed a limited understanding of the concept of sleep hygiene (40). Typical reported sleep hygiene practices were limiting daytime sleep or napping, limiting the consumption of alcohol and nicotine, and exercising (40). Other sleep hygiene measures include avoidance of coffee 6–8 h before bedtime, performing relaxing activities as a routine before sleep (e.g., reading, meditating), reducing time of television in bed or playing computer games or using apps, adequate light, noise and temperature (40). Recommendations for adequate nutrition in shift work include the maintenance of the daily meal rhythm (41). Especially in the second half of the night, workers should eat nothing more than a small snack (41). Drinking of water, tea should be distributed throughout the shift (41). Consume of caffeinated drinks such as coffee, green or black tea in moderation (max. 3 cups per day) (41).

EMSP who work nights and shifts live against both the "internal clock" and the social rhythms prevalent in our evening and weekend society. This should be taken into account by the employer. Company measures for prevention and health maintenance should be established. Under European law, policy 2003/88/EG exists (24), which must be implemented by the member states with regard to the targets to be achieved. In this respect, "night workers" are regularly entitled to a free examination of their state of health. EMS companies may endorse naps on shifts.

The benefits for napping during the night shift are, for example, chronic sleep deprivation increases the risk of depression and burnout (42,43), chronic sleep deprivation reduces empathy (42), fatigue increases faulty performance or influences decision-making (9,27), and increases injuries (9,18). Napping decreased errors or near errors (44,45), increased reaction time (45), and napping reduced dangerous end-of-shift driving (31,44,45).

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Footnote

Reporting Checklist: The authors have completed the Narrative Review reporting checklist. Available at https://jphe.amegroups.com/article/view/10.21037/jphe-23-134/rc

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