Risk of medication errors and nurses' quality of sleep: a national cross-sectional web survey study

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Abstract. – **OBJECTIVE:** We aimed to evaluate quality of sleep and self-perception risk of medication errors, in a significantly-sized sample of nurses in Italy, using a web survey.

SUBJECTS AND METHODS: An anonymous questionnaire about self-perception of quality of sleep (Pittsburgh Sleep Quality Index - PSQI) and risk of medication errors (based on the 7 R-rule), was made up and delivered by social media, i.e., Facebook and Instagram. Risk of medication errors was intended as near misses, i.e., accidents that do not cause the patient harm.

RESULTS: A poor quality of sleep stated by PSQI score >5, was present in 87.9% of subjects and the risk of medication errors during the last shift was reported in 76% of them. However, more than half of nurses' sample (60.1%) reported a good or excellent self-perception quality of sleep. Risk of medication errors was associated with poor quality of sleep and it was independently associated with short resting time after night shift and bad self-perception quality of sleep (OR 3.165, 95% CI 1.468-6.827, p=0.003).

CONCLUSIONS: Absence of proper resting is crucial on performance even if nurses perceived a good quality sleep. The relationship between shift work, poor sleep quality, and risk of medication errors represents crucial point for all health professionals' community, and web-survey represents a valuable information in order to capture the risk of medication errors. Health care organizations should encourage such a type of research in order to show a more proactive approach towards patient safety.

Key Words:
  Risk of medication errors, Near misses, Nurses, Sleep quality, Circadian rhythm, Shift work.

Introduction

Health systems ensuring 24/7 assistance, are based on shift workers. This type of work, although warranting continuity of care, can undermine mental and biological health of professionals[1-3]. Shift work (SW) represents a risk factor for many disorders, i.e., stress, sleep disorders, cardiovascular, and metabolic derangements. It has been observed that night work, cumulative night work, and night work intensity are associated with several cardiometabolic indices, including higher waist circumference, body mass index, fasting glucose, blood pressure, and cardiometabolic risk score in female hospital employees[4]. Prolonged working hours, consecutive shifts, and sleep deprivation can have a negative impact on doctors' and nurses' staffs[3]. Moreover, SW has been associated with tiredness, attention deficit and low performance[3], so entailing an increased risk of medication errors[5]. Incidents, adverse events and patient complaints, which fully involve nursing activities, represent crucial points that health care professionals need to take into consideration aiming at improving patient safety[6]. A recent review has shown that nurses/ patient ratio, lack of staff, tiredness, sleepiness, and low performance (health and wellness of shift workers), can jeopardize patient safety and represent the main reason for risk of medication errors[3,5].

"Do not harm" represents the most important precept in medicine. World Health Organization defines near miss as "an error that has the potential to cause an adverse event (patient harm) but fails to do so because it is intercept"[7]. Risk of medication errors could be associated with near misses, especially when investigated by questionnaires. Nowadays, social media are popular and convenient methods for communicating on the Web, and they are widely used also for either recruiting participants for health research and conducting survey studies by questionnaires[8,9].

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Thus, the aim of this study was to evaluate the possible association between the risk of medication errors and quality of sleep in nurses, by means of a web survey.

Subjects and Methods

Authors employed a cross-sectional web survey design by using an online validated questionnaire for data collection, as already reported in previous studies[10]. To maximise the final sample size, the most frequently used social media, i.e., Facebook and Instagram, were used to deliver a self-administered web survey to a sample of Italian nurses willing (informed consent) to take part to the survey. Participation was voluntary and confidential. The survey was composed by a cover page (describing the purpose of the study and ensuring anonymity and voluntary participation) and three sections, including different items dealing with demography and social information (section A), self-perception about quality of sleep (Pittsburgh Sleep Quality Index, validated Italian version - PSQI)[11] (section B), and perception of the risk of medication errors (section C) based on the 7 R-rule. This last section (perception of medication errors risk) was measured by using the following questions:

– During the last shift, based on the 7 R rule, how many times did you (or any of your colleagues) run the risk of making a medication error?
– Why medication error was about to occur?

Risk of medication errors was intended as near misses, i.e., accidents that do not cause the patient harm[12].

Right patient, right drug, right dose, right time, right route, right reason, and right documentation represent the rules to ensure safe medication preparation and administration. Also, health care organizations should be involved in the responsibility of these 7 rights in order to improve nursing care[13].

The survey was administered via Google Forms® and data have been collected over 2 weeks starting from 15 June 2018. The convenience sample size for obtaining statistically significant results was estimated based on the total number of Italian registered nurses (450,000), obtaining the number of cases to be studied and the relative confidence interval (95%) and confidence level (5%). All parameters investigated are reported in Table I.

Analysis was performed by means of descriptive analysis, Spearman's rank correlation test, and multivariate logistic regression analysis. All variables were included in the logistic multivariate regression models, and only statistically significant differences between the variables have been discussed. A $p<0.05$ level was considered statistically significant. Statistical Package for Social Science (SPSS®) version 21.0 (IBM Corp, Armonk, NY, USA), was used for analyses.

Results

The final sample included 446 Italian nurses (84.3% women, mean age 31.7 years). More of five-years SW experience was recorded in 36.5% (n=163), and smokers were 142 (31.8%). Self-perception quality of sleep was reported as good or excellent in 60.1% (n=268), however, PSQI score was higher than 5 (indicating poor sleep quality) in 87.9% (n=392) of subjects. In agreement with literature data on either combusted and electronic cigarette[14], smoking habit was related to poor quality of sleep. Three-hundreds thirty-nine nurses (76%) reported a risk of medication errors (Table II) during the last shift due to:

– Wrong nurses/patient ratio not intended exclusively as the numerical relationship between nurses and patients (interruptions and distractions) (16.6%, n=74);
– Overcrowding, lack of staff (20%, n=89);
– Health and wellness of shift workers (tiredness, sleepiness, low performance) (14.8%, n=66).

Spearman's rank correlation coefficient showed that the risk of medication errors was correlated with poor quality of sleep, as measured by PSQI score >5 ($p<0.01$). For the logistic regression analysis model, the risk of medication errors was considered as the dependent variable, whilst short resting time after night shift associated with good self-perception quality of sleep, adequate resting

Table I. Parameters investigated in the web survey.

Age (years)
Gender (Male/Female)
Smoking habit
Physical activity
Resting time after night shift
Pittsburgh Sleep Quality Index
Risk of medication errors (7 R-rule)

Table II. Classification of risk of medication errors (based on the 7-R rule), reported by our sample.

Type of risk of error	Number of nurses	Percentage
Incomplete or missing documentation	85	19.1
Wrong dose/concentration/form	68	15.2
Wrong patient	55	12.3
Wrong time of administration	51	11.4
Wrong medication	45	10.1
Monitoring errors	45	10.1
Wrong route of administration	6	1.3

after night shift associated with bad self-perception quality of sleep, and short resting time after night shift associated with bad self-perception quality of sleep were the independent variables. Risk of medications errors were independently associated with short resting time after night shift associated with bad self-perception quality of sleep (OR 3.165, 95% CI 1.468-6.827, $p<0.01$) (Figure 1).

Discussion

The present study, conducted on a significantly-sized sample of Italian nurses, provides further confirmation that SW, disturbed sleep and risk of medication errors are tightly coupled. The correlation between SW and desynchronization of sleep-wake rhythm is known[15]. Recent studies showed that shift workers had more often overweight and a higher body mass index (BMI) than day workers, in particular among evening chronotypes[16], and sleep disturbances and circadian misalignment play crucial role[17]. Late chronotype, in fact, particularly exposed

to sleep deprivation, has been associated with poorer glycemic control and HbA1c levels in type 2 diabetes[18,19]. It has also been proposed that assessment of individual chronotype and sleep attitude by means of validated questionnaires, could provide an easy and inexpensive way to identify nurses at potential higher risk of developing metabolic diseases[20].

A few data are available on the association with sleep disturbances and risk of medication errors, and mainly referring to the emergency department setting. A study[21] focused on emotional exhaustion (EE), depersonalization (DP), and diminished feelings of personal accomplishment (PA), DP was associated with disturbed sleep [OR 6.44, 95% CI 1.45-28.49] and PA was associated with fear of medication errors [OR 3.61, 95% CI 1.26-10.37], while EE was not[21]. Furthermore, in agreement with our results, health and wellness of shift workers were the most important determinants of risk of medication errors[20].

It is known that SW, prolonged working hours, consecutive shifts, and sleep deprivation may have
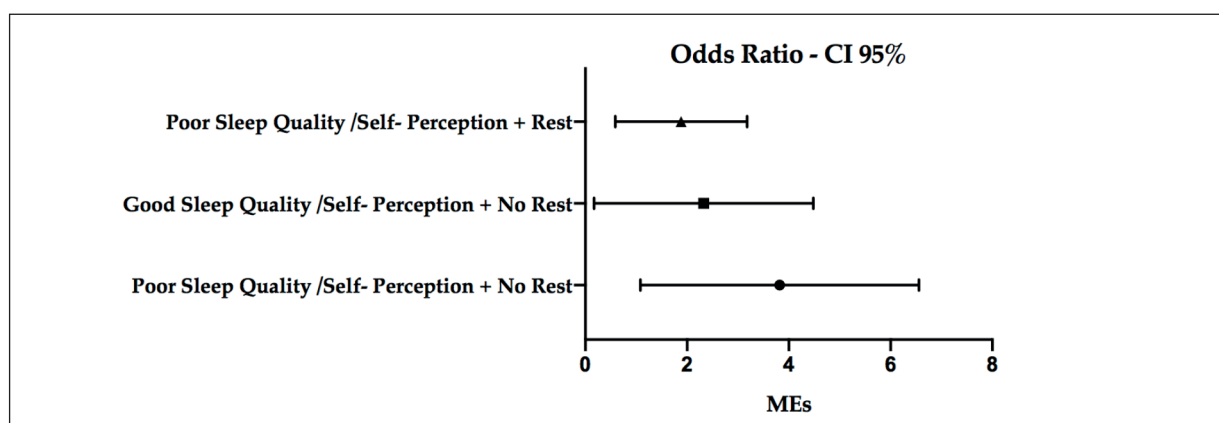

Figure 1. Logistic Regression. Dependent variable – Risk Error. Independent variables – Poor Sleep Quality/Self Perception + Rest, Good Sleep Quality/Self Perception + No Rest, Poor Sleep Quality/Self-Perception + No Rest. Poor Sleep Quality/Self Perception + Rest = bad self-perception associated with adequate resting after night shift. Good Sleep Quality/Self Perception + No Rest = good self-perception associated with short resting time after night shift. Poor Sleep Quality/Self Perception + No Rest = bad self-perception associated with short resting time after night.

a negative impact on medical and nursing staffs and may entail an increased risk of medication errors. Among the series of factors potentially affecting nursing activity[5], the present study highlights the pivotal importance of the association with poor quality of sleep (PSQI score >5). In fact, risk of medications errors was independently related with short resting time after night shift associated with bad self-perception of quality of sleep.

Chronotype, particularly late chronotype, affects also mental status and performance aspects, e.g., work results or school achievements, especially in younger age and in women[15]. Moreover, because of tiredness, attentional deficit, insomnia, sleepiness, and anxiety, SW could seriously jeopardize professionals' health and patient safety[22]. In our study, although nurses perceived a good quality sleep, the common finding of PSQI>5 indicates that lack of proper resting is crucial on performance.

Limitations

Some limitations should be mentioned. First, this is a cross-sectional study conducted by using a web survey on social media, therefore the sample is self-selected and based on social media users only. Thus, on one hand it is possible that the younger population is more prone to accept participation. On the other, it is not possible to know how many nurses declined. Second, the sample has been collected in a short timeframe (one week, month of June), since web surveys are more effective when based on speediness. However, June is the month with longer duration of daylight, and this could potentially affect sleep. In fact, even a minimal sleep deprivation secondary to daylight saving time shift could have unfavorable effects on cardiovascular system[23,24]. Third, being the study based on a web survey, we used questionnaires to investigate subjective sleep, even though the gold standard could probably be a sleep diary[25]. Fourth we could only evaluate risk of medication errors, considering the general definition of near misses. However different researchers considered the interception of an error and others took into consideration the prevention of harm. In fact, we did not distinguish between near misses and no harm incidents[26]. Last, the section C (perception of the risk of medication errors) is not fully validated yet.

Conclusions

This study provides support for more specific research and interventions. In fact, improving quality of sleep of nursing staff could possibly reduce risk of medication errors. On one hand, awareness and prevention of medication errors deserves more research and specific training programs[27], on the other, global interest on SW should be implemented[28,29]. The relationship between SW, poor sleep quality, and risk of medication errors represents crucial point for all health professionals' community. Moreover, a new interesting approach could derive from sex and gender-specific studies. The sleep-wake cycle and circadian rhythmicity both contribute to brain function and may impact on cognition. The amplitude of the circadian modulation was larger in women in at least one third of performance measures, being lower in women during early morning hours[30]. This opens up the interesting potential for further research on sex-dependent effects of sleep deprivation and SW. Evaluation of risk of medications errors could provide important information especially if investigated by web-survey, avoiding the risk of blame, shame or legal litigations for reporters. This way of conducting research may positively influence the health care professionals' willingness to report incidents, adverse events and patient complaints without any fear. Health care organizations should encourage such a type of research in order to develop large database for analysis and to show a more proactive approach towards patient safety.

Conflict of Interest
The Authors declare that they have no conflict of interests.

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