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DETERMINANTS OF POOR SLEEP QUALITY AMONG EDUCATIONAL WORKERS

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Abstract

Background: In educational workers, poor sleep quality has a major impact on health and productivity. Although there are many known risk factors for poor sleep quality, data on these risk factors in Indonesian educational workers are lacking. Therefore, this study aims to determine the most influential risk factors for poor sleep quality in Indonesian educational workers.

Methods: An observational analysis study with a cross-sectional design was conducted in October-December 2020 involving 81 participants at Yayasan Pendidikan Pelita Raya, Jambi. Sleep quality, vitamin D intake, and job stress were measured using the Pittsburgh Sleep Quality Index (PSQI), Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ), and Health & Safety Executive questionnaires (HSE), respectively. Data analysis was done by multiple logistic regression, with a significant level of $p < 0.05$.

Results: The median age was 29 (range 21-55) years, poor sleep quality was found in 30 (37%) participants, 42 (51.9%) of participants had low vitamin D intake, and 48 (59.2%) reported moderate-to-high stress levels. Age < 30 years ($p < 0.040$), moderate-to-high stress level ($p < 0.013$), and low vitamin D intake ($p < 0.003$) were significant associated risk factors for sleep quality in educational workers, with low vitamin D intake being the most influential risk factors.

Conclusion: Younger age, stress level, and low vitamin D intake were determinants of poor sleep quality in educational workers, with low vitamin D intake being the most influential risk factors. Management of stress and vitamin D intake are needed to improve sleep quality in educational workers.

Keywords: educational workers, Indonesia, poor sleep quality, risk factors, vitamin D intake

Introduction

The main task of educators and teaching staff is to educate, teach, guide, direct, train, assess, and evaluate students.[1] The educators themselves are subject to ever-changing priorities, pressures, resources and reforms.[2]Additionally, teachers also bear the work-related social burden, such caregiving to students. High job demands and social burden render teachers vulnerable to stress, thus affecting sleep quality.[3]

Sleep is a condition of the periodic rest of the body and nervous system which is necessary for the learning, performance, and health of workers.[4] Poor sleep quality constitutes a community health problem due to its high prevalence from 21.7% to 61% and associated health problems. [5, 6] Differences in sleep quality may be due to variations in inter-regional job characteristics and types. Poor sleep quality is also related to weak working memory,[7, 8] executive function, decision making, decreased work productivity,[(9)] and increased absenteeism and healthcare costs.[10] The long-term effects of poor sleep may impact on worker health and safety.[11]

Risk factors of poor sleep quality are age, educational level, income, marital status, chronic disease, [12] gender, [13] body mass index, physical activity, [14] stress level, [3] and vitamin D level. [15]

Elderly aged 65 years and over tend to have considerably poor sleep quality.[12] However, Berhanu et al. [16] found a two-fold increased risk of poor sleep quality only in younger persons aged 40 – 49 years.

It is a well-known fact that there are differences in job-stress levels between professions [17] and that job stress and poor sleep are interrelated. Kottwitz et al. [3] reported an association between job stress and poor sleep in teachers, but did not determine the magnitude of the risk. The objective of Musa et al. [6] was to determine the risk factors related to poor sleep quality in high school teachers and found that stress is the only risk factor related to poor sleep quality in multivariate analysis. Teachers undergoing stress have a 1.04-fold significantly higher risk of poor sleep quality than those not experiencing stress. The study of Li et al. [18] on oil field workers found that higher work stress score was associated with lower sleep quality. Furthermore, the

study of Visvalingam et al. [19] on underground workers showed that respondents under stress had a 3.14-fold greater risk of poor sleep quality.

One of the roles of vitamin D in health is sleep regulation, [20] but there are few studies on the association of vitamin D intake with sleep quality. The study of Song et al. [15] showed that inadequate vitamin D intake had a 2.3-fold significantly greater risk of poor sleep quality than did an adequate intake and showed that respondents aged 65 years and above may have comorbid heart failure. The National Health and Nutrition Examination Survey study for 2007–2008 by Grandner et al. [21] showed that low vitamin D intake was associated with difficulty in maintaining sleep.

To the best of our knowledge there are no studies on the risk factors of sleep quality in Indonesian educational workers. Differences in socio-demographic characteristics, inter-professional stress levels, dietary intakes and inconsistencies in study results emphasize the need for such a study. Therefore, our objective was to find risk factors with the most influential role for poor sleep quality in educational workers.

Methods

Design and subject

A cross-sectional study carried out between October and December 2020 at Pelita Raya Education Foundation (Indonesian: Yayasan Pendidikan Pelita Raya), Jambi. The total of respondents is 81 subjects who were recruited using the consecutive sampling method. Inclusion criteria were 19 – 64 year old males and females active as teacher or administrative staff. Exclusion criterion: history of chronic disease (diabetes mellitus, hypertension, gastroesophageal reflux disease, or bronchial asthma).

Sample size estimation

For the sample size estimation, researchers used the following formulas.

Infinite population formula:

$$n = \frac{Z\alpha^2 \times p \times q}{d^2}$$

Finite population formula:

$$n = \frac{n0}{(1+\frac{n0}{N})}$$

The prevalence of productive adults with poor sleep quality was obtained from the study of Jung et al.[5], where the prevalence was 21.7%, with Zα at α 5% = 1.96, and a measurement accuracy of 0.05. Furthermore, the number of finite populations at data collection sites was 83 persons. Therefore, the estimated minimal sample size in this study was 63 persons.

Measurements

The collected data consisted of demographic characteristics (age, sex, education, and marital status), work stress, vitamin D intake, and sleep quality. Sleep quality was measured with the Indonesian version of the Pittsburgh Sleep Quality Index (PSQI) [22], a self-rated questionnaire measuring sleep quality in monthly intervals. The PSQI measures 7 sleep components, namely subjective quality, latency, duration, habitual efficiency, disturbance, medication, and daytime dysfunction (concentration problems during the day). The PSQI consists of 19 items, each item is rated on a four-point scale ranging from 0 (no complaints in the previous month) to 3 (three times a week). Total PSQI score is between 0 and 21. Total score > 5 = poor sleep quality and total score ≤ 5 = good sleep quality. Indonesian PSQI has adequate reliability and validity. Reliability was supported by internal consistency with a Cronbach's alpha of 0.72. [22]

Assessment of dietary vitamin intake was carried out through interviews using a modified Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ), that had been validated for Indonesia and comprised a list of foods, drinks, and vitamin D-containing supplements. [23] Vitamin D intake was determined based on household measures which was converted into grams, then analyzed using the Nutrisurvey 2005 nutrition software program and compared to the 2013 Indonesian Recommended Dietary Allowances (IRDA). Vitamin D was categorized into two groups, namely low intake (< 15 µg/day) and adequate intake (≥ 15 µg/day). [24]

Work stress was determined by means of a work-related stress assessment questionnaire based on the Indonesian version of the 2003 Health and Safety Executive (HSE) instrument. [25] The assessment was carried out using the scoring method with a Likert scale consisting of 5 choices (never, rarely, quite often, often, and always). There are 35 question items in this questionnaire, in which the lowest total score is 35 and the highest total score is 175. The respondent's work stress level is categorized into the low-stress level (a total score of 140 – 175), medium stress level (a total score of 105 – 139), and the high-stress level (a total score of 70 – 104).

Demographic characteristics (age, gender, education, marital status) were collected using a questionnaire. Age was categorized into two groups, namely < 30 years and ≥ 30 years, gender was categorized into male and female, education was categorized as high (diploma or bachelor) and low (high school or below), and marital status was categorized into married and single.

Data analysis

Descriptive analysis was performed on all collected variables. Categorical data were presented in the number

of respondents (n), percentage (%), odds ratio (OR), and 95% confidence interval (95% CI). Analysis of the association between risk factors and sleep quality was by means of Chi-squared test. Risk factors with a p-value of < 0.25 in the Chi-square test were candidate variables to be analyzed with multiple logistic regressions. Statistical significance for multiple logistic regressions was set at $p < 0.05$.

Ethical

This study protocol was approved by Research Ethics Commission, Faculty of Medicine, Universitas Trisakti, under number 30/KER-FK/10/2020.

Results

Subject characteristics

Table 1 shows the sociodemographic characteristics, work stress levels, vitamin D intake, and sleep quality of the subjects.

Tabel 1: Distribution of sociodemographic characteristics, work stress level, vitamin D intake, and sleep quality of respondents (n=81)

Characteristics	Median (Min –Max)	Frequency(n)	Percentage (%)
Age (years)	29 (21 – 55)		
19 – <30		43	53.1
≥30 – 45		28	34.6
>45 – 55		10	12.3
Gender			
Female		41	50.6
Male		40	49.4
Level of education[a]			
High		56	69.1
Low		25	30.9
Marital status[a]			
Single		36	44.4
Married		45	55.6
Work stress level[a]	138 (104 –171)		
High		1	1.2
Moderate		47	58
Low		33	40.7
Vitamin D intake[a]	12 (1 – 24.6)		
Low		42	51.9
Sufficient		39	48.1
Sleep quality	5 (1 – 15)		
Poor		30	37
Good		51	63

[a]Classification of categorical data: level of education: high (bachelor – diploma), low (senior high school or below); work stress level: high (HSE score of 70 – 104), moderate (HSE score of 105 – 139); low (HSE score of 140 –175); vitamin D intake (RDA): low (< 15 µg/day), sufficient (≥15 –20 µg/day); sleep quality: poor (PSQI score of > 5), good (PSQI score of ≤ 5)

Relationship between sociodemographic characteristics, work stress, and vitamin D intake in the good and poor sleep quality group

Table 2 shows a comparison of sociodemographic characteristics, work stress, and vitamin D intake between good and poor sleep quality groups. Most respondents with poor sleep quality were < 30 years old (53.5%), unmarried (58.3%), and had low vitamin D intake (54.8%). Chi-squared test results found 4 risk factors with p-value < 0.25, namely age, marital status, work stress level, and daily vitamin D intake, so that these factors qualify for further analysis using the multiple logistic regression test.

Table 2: The relationship between sociodemographic characteristics, work stress, and vitamin D intake in the good and poor sleep quality groups (n=81)

Risk factors	Sleep quality		OR[c]	95%CI[c]	p- value
	Poor	Good			
	N (%)	N (%)			
Age (years)					
< 30	23 (53.5)	20 (46.5)	1		
≥ 30			5.09	1.84 –14.06	0.001[d]
Gender					
Female	17 (41.5)	24 (58.5)	1		
Male	13 (32.5)	27 (67.5)	1.47	0.59 – 3.65	0.404
Level of education					
Low	11 (44.0)	14 (56.0)	1		
High	19 (33.9)	37 (66.1)	0.65	0.25 – 1.71	0.386
Marital status					
Single	21 (58.3)	15 (41.7)	1		
Married	9 (20)	36 (80)	5.60	2.09– 15.01	0.001[d]
Work stress Level[b]					
Moderate-to-high	24 (50)	24 (50)	1		
Low	6 (16.2)	27 (81.8)	4.50	1.58 –12.86	0.004[d]
Vitamin D Intake[b]					
Low	23 (54.8)	19 (45.2)	1		
Sufficient	7 (17.9)	32 (82.1)	5.53	2.00 –15.33	0.001[d]

[b]Classification of categorical data: work stress level: moderate-to-high (HSE score of 70 – 139), low (HSE score of 140 – 175); vitamin D intake: low (RDA < 15 µg/day), high (RDA ≥ 15 µg/day)
[c]Abbreviation: OR = odds ratio, CI = confidence interval
[d]Statistical analysis with Chi-square test; p<0.25 fulfill requirement for multiple logistic regression analysis.

Factors with the most important role in poor sleep quality among educational workers

Multiple logistic regression test results showed that 3 risk factors were significantly associated with sleep quality, namely age (p < 0.040), work stress level (p < 0.013), and vitamin D intake (p < 0.003), with the most important risk factor for poor sleep quality being low vitamin D intake (see Table 3)

Table 3: Results of multivariate analysis between age, marital status, work stress level, vitamin D intake, and sleep quality (n=81)

Risk factors	Adjusted OR	95%CI	p-value
Age (years)			
< 30	1		
≥ 30	4.38	1.07 – 17.9	0.040[f]
Marital status			
Single	1		
Married	1.94	0.51 – 7.3	0.329
Work stress level[e]			
Moderate-to-high	1		
Low	4.96	1.40 – 17.6	0.013[f]
Vitamin D intake[e]			
Low	1		
Sufficient	6.01	1.80 – 20.0	0.003[f]

[e]categorical cofactor data: work stress level: low (HSE score of 140 – 175), moderate-to-high (HSE score of 70 –130); vitamin D intake: low (RDA < 15 µg/day), high (RDA ≥ 15 –20 µg/day)

[f]Statistical analysis with multiple logistic regression test; at level of significance p<0.05.

Discussion

The prevalence of poor sleep quality in this study was quite high, accounting for 37% (Table 1) and is greater than that in China (21.7%) [5] and Thailand (33.7%), [26] but lower than in Singapore (42.5%), [19] and Malaysia (61%). [6] The difference in prevalence between our study and the other studies could be due to differences in socioeconomics, culture, and study location (research setting). Studies conducted in rural areas report a higher prevalence of good sleep quality than do studies in urban areas, due to differences in sleep habits, sleep hygiene, lifestyle, stressors, and others. [16]

The median age of the subjects in this study is 29 years (between 21–55) (see Table 1). According to age range, the respondents of this study are of productive age and none of them are in the retirement age. Our study results are in agreement with data from the Indonesian Central Bureau of Statistics stating that the Indonesian population is dominated by the productive age group (15–64 years). [27]

Our results show that respondents < 30 years old are at higher risk of poor sleep, which is 4.38 times that of respondents aged ≥ 30 years (see Table 3). These results differ from those of Dong et al. [12] where poor sleep quality is more common in the elderly group, namely 65+ years (35.1%, 95%CI = 30.4–39.8%) compared to 45–54 years (21.4%, 95%CI= 18.0–25.4%; $p < 0.001$).

The study conducted by Berhanu et al. [16] showed that the 40 - 49 year age group had twice the risk of poor sleep quality than that of other age groups (Adjusted Odds Ratio (AOR) = 2; 95%CI = 1.1–3.6; $p < 0.03$). Madrid-Valero et al. [13] showed that older age is associated with a 1.05-times greater risk of poor sleep quality. The difference in the results of our study and those of other investigators could be due to differences in respondent characteristics, including the younger age range of respondents (21–55 years) and the higher percentage of young persons in our study compared to those of Berhanu et al.[16] and Madrid-Valero et al..[13]

The effects of aging on sleep quality have been well identified. The physiological changes due to aging cause normal elderly persons to take longer to sleep, reduce their ability to maintain sleep, increase the frequency of daytime naps, reduce night-time sleep, and result in slow-wave sleep.

The performance of the circadian system and sleep homeostasis is also reduced. Changes in the amount and pattern of sleep hormone secretion can cause sleep quality disturbances in the elderly. [28] The causes of poor sleep quality are not exclusively due to the aging process. The subjective decline in sleep quality starts in young adults and is linear up to the age of 60 years. Thereafter there is a transient increase in quality of life (coinciding with the retirement period due to reduced work stress). Furthermore, after the age of 66 years, the quality of sleep deteriorates again. [29]

In the present study, most of the respondents were < 30 years old (53.1%) and none were elderly (> 60 years). Although sleep quality is definitely influenced by physiological changes due to aging, the aging process between individuals is highly variable. Therefore, it seems that age is not the only factor that plays a role and contributes to the differences between our study results and those of the other studies.

Our study showed no relationship gender and sleep quality (Table 2). In general the relationship between gender as a risk factor and sleep quality is inconsistent. The study of Madrid-Valero et al. [13] showed that women had a 1.88-times greater risk than men of a significantly poor sleep quality (OR = 1.88; 95%CI = 1.54–2.28). In contrast, the study by Songkham et al. [26] on industrial workers found that the risk of poor sleep quality was 2.74 times greater in men than in women.

It is known that gender differences in sleep quality are influenced by hormonal factors. [30] However, the absence of a relationship between gender as a risk factor and poor sleep quality could be due to other factors accounting for poor sleep in younger adults, such as body mass index [31, 32] and physical activity. [14]

In our study there was no relationship between educational level and sleep quality (Table 2), which agrees with the study results of Musa et al. [6] and Deng et al. [33] of no association between educational level and sleep quality. Our study also showed no significant relationship between educational level and work stress, which may have been due to the smaller number of respondents (30.9%) with low educational level. This is because in the recruitment of employees certain educational level criteria are applied, including the prospective workload.

The present study found a relationship between marital status and poor sleep quality that was statistically not significant (see Table 3). This is in contrast with the study of Jung et al. [5] and Dong et al. [12] who found a significant relationship between marital status and sleep quality. The study of Jung et al.[5] demonstrated that unmarried respondents experience a significantly poorer quality of life than do married respondents (26.2% vs. 17.6%; $p<0.001$). Dong et al.[12] found that unmarried respondents had a 1.51-times significantly greater risk of poor sleep quality (AOR = 1.51, 95%CI = 1.03–2.22). This agrees with 2013 -2014 US National Health Interview Survey data for single parents. [34]

The present study showed that persons with moderate-to-high work stress had a 4.96-times significantly greater risk of experiencing poor sleep quality than those with low work stress. This is higher than in the study by

Musa et al. [6] who found that school teachers under stress had a 1.04-fold significantly greater risk of poor sleep quality than did those not under stress (OR= 1.04; 95%CI = 1.01-1.05). Our study also found a greater risk of poor sleep quality as compared with the study of Visvalingam et al. [19] on workers in underground workplaces, showing that subjects under stress had a 3.14-times greater risk of poor sleep quality (OR = 3.14; 95%CI = 1.39–7.09). Our study confirms that work stress is a risk factor of poor sleep quality, with many factors that may cause variations in the magnitude of the risk, even in the same profession, such as differences in the characteristics of work requirements. In addition, the study of Li et al. [18] showed that a high glucocorticoid level in the body protects against sleep disorder.

Furthermore, our study showed that persons with an inadequate daily intake of vitamin D had a 6.01-times significantly greater risk of poor sleep than did persons with an adequate vitamin D intake (Table 3). The study of Song et al. [15] on subjects aged > 65 years with comorbid heart failure also showed that persons with inadequate vitamin D intake had a 2.3-times greater risk of poor sleep than did those with adequate intake.

The National Health and Nutrition Examination Survey for 2007 – 2008 [24] showed a relationship between low vitamin D intake (OR = 0.84) and difficulty of maintaining sleep, while the 2005-2016 survey [35] showed a relationship between short sleep time and lower intake of calcium, magnesium, and vitamins A, C, D, and E in women. On the other hand, in men, short sleep time is only the effect of insufficient vitamin D intake. Another finding of the 2005-2016 survey was that sleep is also influenced by gender and intake of vitamins and other supplements. [35]

One of the many roles of vitamin D in health is sleep regulation. [20] Vitamin D receptors and their activating and degrading enzymes are located in brain areas that regulate sleep-wake cycles, e.g. the hypothalamus, the prefrontal cortex, and the substantia nigra. [36] Vitamin D is also associated with melatonin metabolism (the hormone regulating circadian rhythms and sleep). [37] Vitamin D may also inhibit the release of the inflammatory cytokines TNF-α, IL-1 and prostaglandin D2 which also play a role in sleep regulation. [38]

The results of our study indicate that low vitamin D intake is an influential risk factor for poor sleep quality among educational workers. The subjects of the present study were educational workers who habitually performed indoor activities throughout the day. In addition to vitamin D intake, it seems that sun exposure also needs to be considered as a factor in maintaining the adequacy of vitamin D in the body, considering the high prevalence of vitamin D deficiency in Indonesia (43.3% in male adolescents). [39]

Existing evidence shows that there is a relationship between vitamin D adequacy and type of work, in which indoor workers are more susceptible to vitamin D deficiency due to lower vitamin D intake and sun exposure than other professions who work outdoors. [22] This is consistent with a systematic review conducted by Sowah et al. [40] which shows that there are differences in vitamin D levels related to work, in which indoor workers have lower levels of vitamin D than field workers.

The relationship between vitamin D intake and sleep quality is limited, inconsistent, and comes only from observational studies. The differences in the results of those studies could be due to variations in the applied method of measuring vitamin D intake and sleep quality and differences in population and characteristics. The results of the present study, at least, lead to the notion that low vitamin D intake is a risk factor for poor sleep quality in adults, which notion still needs to be confirmed by cohort studies and randomized control trials.

The implications of our study are that the knowledge of risk factors of poor sleep quality in teachers is of benefit to them as well as to health workers. It may also be of use to policy makers who have the task of instituting preventive and organizational measures in stress management and vitamin D intake to improve sleep quality in educational workers.

This study has several limitations, namely: (1) the sleep quality measurements are subjective and self-reported so they are prone to recall bias in which objective measurements using polysomnography would be more valid but difficult to do in the community, (2) the design of this study is cross-sectional so that it cannot confirm the causal effect of various risk factors on sleep quality, (3) vitamin D levels were assessed from food intake using a semi-quantitative food frequency questionnaire which only provided an overview of vitamin D based on intake, whereas a more accurate but more expensive method would be to determine the vitamin D level in the blood, and (4) the HSE questionnaire, although much used in Indonesia for measuring work stress, has not yet been validated in Indonesians.

The strength of this study lies in its collection of epidemiological data on poor sleep quality among educational workers and several risk factors related to sleep quality. Prospective cohort studies are still needed to analyze the causal effect of various risk factors on sleep quality.

Conclusion

The prevalence of poor sleep quality in educational workers is high. Age of < 30 years, moderate-to-high work stress level, and low vitamin D intake are risk

factors for poor sleep quality in educational workers. Low vitamin D intake is the most influential risk factor for sleep quality in educational workers.

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