Systematic Literature Review: Physical Work Environment Factors Associated with Work Fatigue in Hospital Nurses

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Abstract
Fatigue in hospital nurses can endanger the safety of both the nurse and the patient. One of the factors that can cause fatigue in hospital nurses is the physical environmental, such as lighting, noise, and work climate. The purpose of this study is to analyze the physical work environment factors (lighting, noise, and work climate) associated with work fatigue in hospital nurses. This is a systematic literature review on studies that discuss physical work environment factors related to work fatigue in hospital nurses published in international journals and local journals that can be accessed through the UI Library, especially those that are Full Open Access. Fourteen articles that discussed the relationship between physical environmental factors and work fatigue in hospital nurses were identified, consisting of 11 articles on the effect of lighting on work fatigue in hospital nurses. 6 articles discussed how noise influenced work fatigue in hospital nurses, and 3 articles discussed the effect of hot work climate on work fatigue in hospital nurses. Based on the review, lighting, noise, and work climate significantly link to work fatigue in hospital nurses.

Keywords: Hospital, Lighting, Noise, Nurses, Work Climate, Work Fatigue

Background
Fatigue may lead to the loss of efficiency, decreased work capacity, health problems, and reduced ability of the body to survive, which may result in work accidents. Fatigue can be triggered by work-related or non-work-related factors. Nurses comprise the largest health professional group in almost all countries around the world with 60% of workers in the hospitals are nurses (Bazazan *et al.*, 2019). In 2015, the National Agency for Human Resource Development and Empowerment for Health (*Badan Pengembangan dan Pemberdayaan SDM Kesehatan,* PPSDM) of the Ministry of Health stated that nurses comprise the largest number of health workers with 122,689 of them working in hospitals. Nurse is the health care worker who plays an important role in health service provision and is always present in every hospital (Kawatu and Akili, 2016)(Riska Pramitasari, 2016).

Several previous studies have compared different health professionals and revealed that nurses have a high level of work fatigue. In China, several schools reported that Chinese nurses have a high prevalence of work fatigue (Fang *et al.*, 2008). According to (Association, 2010), fatigue affects nurses, both during work and after work. The study reported that 55% of nurses experience fatigue during work. There is a trend of increasing fatigue among nurses with 67.7% of nurses reported that their fatigue relates to the lack of sleep. Fatigue has also become one of the reasons why nurses leaving their jobs (26%). Based on a survey conducted by the Indonesian National Nurse Association (PPNI) in 2006 on work fatigue among nurses in 4 provinces, it was discovered that 50.9% of the

nurses experienced work fatigue (Sukmaretnawati C, Rosa EM, 2013). Work environment factors can also cause fatigue in hospital nurses. Work environment factors here are defined as factors related to the conditions of a person's workplace that consist of physical work environment factors and non-physical work environment factors. Physical work environment factors include, among others, lighting, noise, work climate, vibration, working equipment conditions, room layout, and space while non-physical work environment factors consist of, among others, relationships between workers, relationships with leaders, organizational structure, and job demands. Work environment factors play an important role for every worker in a workplace as they affect the productivity, performance and welfare of the workers. A good work environment can make workers feel comfortable when doing their job. If the work environment is not good, workers may feel uncomfortable doing their job and this can cause the employee's productivity and performance to decline

Work environment factors such as noise, lighting, and work climate can also lead to work fatigue among nurses. When those factors are substandard, work fatigue will be experienced by the nurses.

Based on previous studies, fatigue in nurses has a significant impact on nurses' occupational health safety, job performance, stress, absenteeism, burnout, and job satisfaction. This is an important concern as nurses have a big influence on the quality of care and patient safety (Bazazan *et al.*, 2019). Patient safety is fundamental in nursing care, which is not just a mandate of the job but also required from the moral perspective.

Based on a survey conducted in Europe and Canada, nurses who work long shifts reported to show poor service quality and patient safety. Nurses working shifts of more than 8 hours, in 2-3 times, often make clinical errors and contribute to poor treatment outcomes for patients, including an increase in patient deaths (Gander *et al.*, 2019)

Previous studies also demonstrated that there are several factors that cause work fatigue in nurses, including individual factors, lifestyle factors, occupational factors, and psychosocial factors. Studies on the effect of the physical work environment factors on fatigue in hospital settings are still lacking despite the fact that nurses in hospitals experience fatigue due to the exposure to poor physical environment in their workplace, which give immediate impacts.

Purpose

This study was conducted to analyze the relationship between the physical work environment factors and work fatigue in hospital nurses through a systematic review.

Method

This study was a descriptive systematic review on articles on results of studies on the relationship between physical work

environment factors and work fatigue in hospital nurses that were published in international journals and local journals and could be accessed through the UI Library, especially journals with Full Open Access. The sample of this study was all articles that meet the selection criteria, meaning that the sampling method used is the total sampling. Data were collected by making a research question (RQ) first by taking into account the criteria of population, intervention, comparison, and outcome. The keywords used in this analysis were fatigue, nurse, hospital, workplace environment, noise, lighting/illumination, work climate/heat stress and cold stress. The conjunctions used in the literature search was "and". The inclusion and exclusion criteria were established and include published between 2005 and 2020. The articles then went through the selection stage which comprised of the title review, abstract review, and full text review. The last criterion used was that the selected articles reported literature review, individual research, and research report.

Results

The steps of the Systematic Literature Review used in this study were identification, feasibility selection, and article selection. Researchers searched for publications using search engines and databases, such as Science Direct, Proquest, Google Scholar, and Taylor & Francis Online. The data collection method that was used was the documentation method. Data were obtained from the Full Open Access Library of the University of Indonesia. A "hand searching" approach was also performed (hand searching is literature search other than using search engines and databases, local journal publications). **(Figure 1)**

A literature search of the four databases resulted in 177,341 literature. When the inclusion and inclusion criteria were applied, the number became 96,659. (**Table 1**) Then a quality analysis was performed on the 14 articles using 5 predetermined criteria. The criteria of the quality analysis used were: having a clear description of physical environmental factors and work fatigue (1), population is explained (2), there are physical environmental factors in the study (3), research method, method of measurement, and measuring instrument used is explained (4), There is a suitability between the research objectives and research results (5).

Discussion

Lighting is found to have a relationship with work fatigue in hospital nurses. One study (Hermawan Ady Prayoga, Irwan Budiono, 2014) demonstrated that the statistical results for the relationship between light intensity and eye fatigue presented a p-value of 0.011, meaning that there is a relationship between light intensity and eye fatigue. For the relationship between eye refractive error and work fatigue, the p-value is 0.018, showing that there is a relationship between eye refractive error and

eye fatigue. Another study conducted by (Azmoon *et al.*, 2013) on 88 shift nurses also showed a relationship between light intensity and eye fatigue with r = -0.38 and p = 0.002, which present a significant relationship between lighting and eye fatigue. The negative correlation and strength are very weak.

A study by (Querstret *et al.*, 2020) showed that exposure to dynamic lighting has an impact on work and sleep fatigue. Dynamic lighting can reduce fatigue and improve sleep quality. Work fatigue can also be caused by work stress felt by workers. According to (Hengky Ardian, 2019), nurses at the Deli Serdang Lubuk Pakam Regional General Hospital (RSUD) experience work fatigue due to inadequate lighting while work fatigue related to work stress is experienced by nurses at the Regional General Hospital (RSUD) Deli Serdang Lubuk Pakam. Another study conducted by (Maurits R.L. et al., 2008) also showed a relationship between lighting and work fatigue (p = 0.033). The ability to work also affects work fatigue in hospital nurses. A study by (Vasconcelos *et al.*, 2011) nalyzed the factors associated with inadequate work ability and fatigue felt by nurses. The ability to work was assessed based on the sociodemography, working conditions, lifestyle and work environment conditions such as lighting and temperature. The result shows a significant relationship between lighting and work fatigue in nurses in the hospital (p = 0.010).

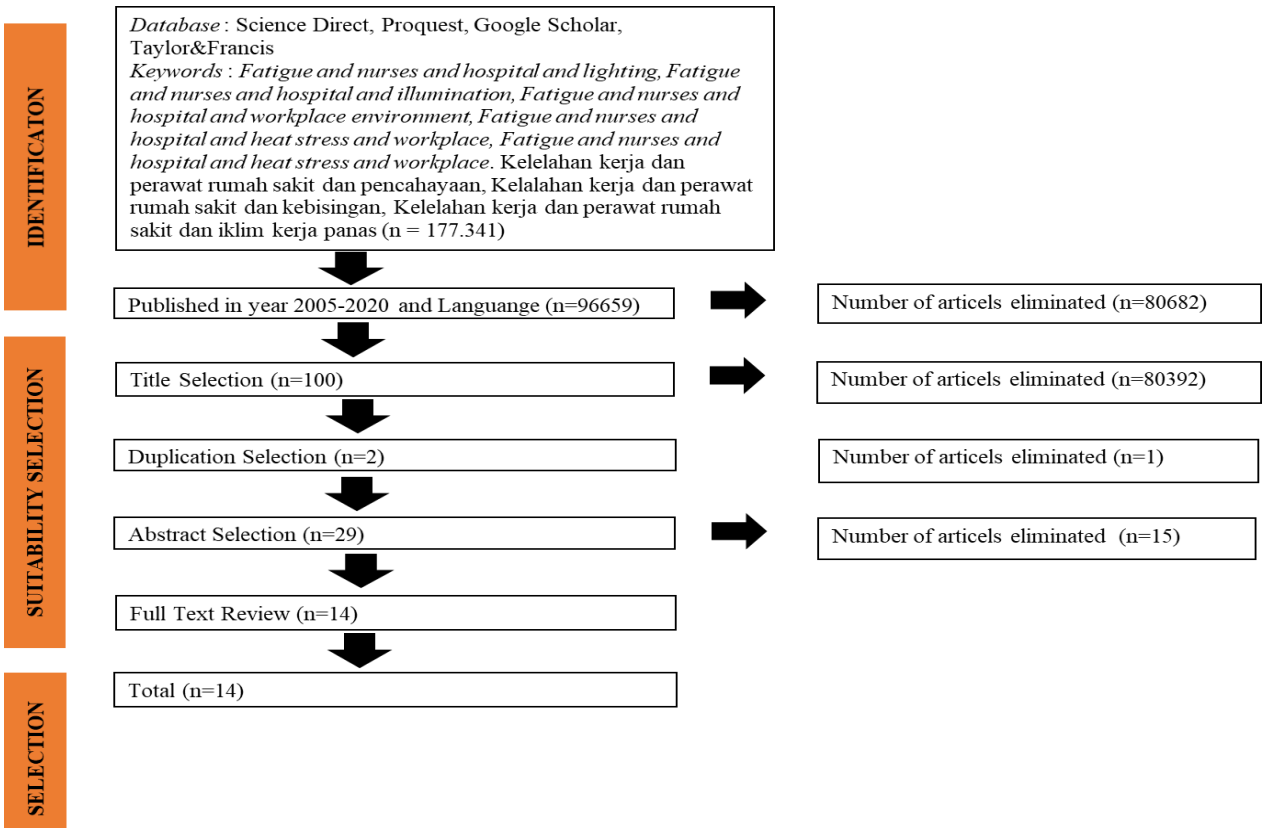

Figure 1. Steps in Systematic Literature Review

Table 1 Literature Search Results

Data Portal	∑ articles first appeared	∑ articles based on keyword and inclusion selection	∑ articles based on title relevance	∑ articles after duplication	∑ articles based on Abstract	∑ *articles based on Full Text*
Science Direct	9,102	1,625	35		8	3
Proquest	139,867	107	40		6	1
Google Schoolar	186,822	88,890	15		10	7
Taylor & Francis Online	28,372	6,037	10	2	5	3
Total	**364,163**	**96,659**	**100**	**2**	**29**	**14**

Another previous study by (Olson *et al.*, 2019) shows that fatigue caused by lighting can be reduced by providing bright lighting. Griepentrog *et al.*, 2018 also performed an experimental study on 31 ICU nurses. The background of this study is that nurses have to work shifts and can experience SWSD (Shift Work Sleep Disorder). SWSD is characterized by insomnia, fatigue, and excessive sleepiness, and can lead to reduced work performance, processing errors, accidents, absences, and decreased quality of life. This study was conducted on ICU nurses working night shifts with exposure to white light of 1500-2000 lux for 10 hours compared to the standard ambient light in the hospital. The statistical results showed a p-value of 0.03, showing that the use of light significantly reduced nurse sleepiness. In terms of the relationship between the exposure to light and salivary melantonin demonstrated an increase in saliva in the morning, albeit not significant ($p = 0.39$). This also shows that light can reduce SWSD that consists of insomnia, fatigue, and drowsiness in nurses.

Exposure of noise can also be felt by workers in hospitals. One of the causes of fatigue in nurses is noise (Iva Noviyanti, Supriyadi, 2020) (Hengky Ardian, 2019). A study conducted by (Oksandi and Karbito, 2020) to determine the factors associated with work fatigue in nurses at Dr. H. Bob Bazar Kalianda Hospital, South Lampung District, also showed a relationship between noise and work fatigue ($p = 0.031$). According to (Konkani and Oakley, 2012) noise in hospitals has an

impact on hospital workers and patients. Noise is heard in different levels based on different time and sites in the hospitals. Noise will be noticeably higher on weekdays than on weekends. Sources of noise in the hospital are the equipment used in the hospital, hospital buildings (doors, broken desk drawers), conversations from fellow hospital nurses, activities of health workers, telephones, television and falling objects. The noise in the hospital is more apparent in the nurse's office than in the patient's room.

A systematic literature review conducted by (Konkani and Oakley, 2012), (shows that noise makes a negative impact on nurses in performing their routine activities (91%). It also triggers irritation and fatigue (66%), concentration problems (43%), and headache (40%). The noise heard in the ICU exceeds 62 dB on average, and this becomes a source of inconvenience for nurses, leading to 80% of nurses feel dissatisfied with their work. Noise can affect nurses' performance as well as becoming a precursor of disease symptoms.

Noise that exceeds the predetermined standards is the cause of work fatigue in nurses. A previous study by (Mahmood, Chaudhury and Valente, 2011) showed that fatigue caused by noise causes errors in patient treatment. Based on the statistical test performed, a significant relationship was identified between noise-related fatigue and errors in treatment ($r = 0.03$, $p < 0.01$) The correlation strength of the two variables is very weak. Errors in treatment affect patient safety. In a previous study by (Mahmood, Chaudhury and Valente, 2011), Noise is one of the important issues that must be resolved to overcome errors in patient treatment. Noise is also associated with insomnia, depression, and declined physical and mental health among nurses (Eivazzadeh *et al.*, 2019)

A low noise level has a positive impact on nurses, as it can reduce job demands, increase social support in the workplace, improve the quality of patient care, and clearer speech (Applebaum *et al.*, 2010). Meanwhile, a high noise levels can create other negative impacts in addition to increasing work fatigue, such as increasing work pressure, stress, disturbed feelings, emotional exhaustion, difficulty in communicating which can lead to errors and even cause *burnout* (Joseph *et al.*, 2007). Noise does not only causes fatigue in nurses but can also disturb the health of nurses by triggering somatic symptoms, insomnia, anxiety, social dysfunction, and severe depression (Eivazzadeh *et al.*, 2019). Noise can also lead to an increased risk of hypertension and ischemic heart disease. In addition, noise in the hospital has the potential to be a significant contributor to higher heart rate, tachycardia, and stress. Noise also disturbs the nurses.

Based on the literature search, there are 3 articles discussing hot work climate in relation to work fatigue. No article has discussed the effect of cold working climate on work fatigue. A study by (Hengky Ardian, 2019) and (Oksandi and Karbito, 2020) Showed that hot

work climate correlates to the work fatigue experienced by nurses. Another study by (Azmoon *et al.*, 2013) sought to determine the relationship between thermal comfort, light intensity. and eye fatigue in hospital nurses. The results showed a weak relationship between thermal conditions and eye fatigue ($p = 0.002$, $r = -0.38$). However, there is a significant relationship between thermal conditions and eye fatigue. The two variables are negatively correlated, and the strength of the correlation is weak.

With the current COVID 19 pandemic, the risk of nurses for being exposed to a hot working climate is getting bigger due to the use of PPE and hot working conditions. A study by (Lee *et al.*, 2020) on health workers in India and Singapore during the COVID 19 pandemic showed that the hot working climate has a negative impact on health workers. Nurses must wear PPE that consists of special clothes, gloves, N95 respirator, *face shield* or googles. The temperature measurement in this study were performed using a heat stress monitor (QUESTTemp QT-44, 3 M, Shoreview, Minnesota, US). The temperatures in India and Singapore during the study (June 2020) were 42.2 C and 32.7 C, respectively, and heat exposure was a concern in these two countries. A lot of nurses have reported experiencing fatigue and other symptoms during the COVID 19 pandemic. Other symptoms reported were heat-related illnesses such as headache, dizziness, difficulty breathing, and dehydration. The hot working climate is the cause of work fatigue.

Conclusion

Lighting, noise, and hot working climate link to the fatigue felt by hospital nurses. Lighting significantly links to the work fatigue experience among hospital nurses; however, the correlation between the two variables were weak or very weak. Noise and hot work climate also have a significant relationship with the fatigue felt by hospital nurses.

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