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RESEARCH ARTICLE

EFFECTIVE RISK MANAGEMENT FOR WORK-RELATED FATIGUE AMONG NURSES: A SYSTEMATIC REVIEW

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ABSTRACT

Aims and Objectives: The literature review aims at examining the most effective risk management strategies to handling nursing fatigue. As such, it seeks to determine the effective methods of managing work-related fatigue among nurses working in a hospital setting. **Background:** work-related fatigue among nurses has been implicated in decreased performance, concentration, alertness, memory, and decision making. Studies reported excessive workload, unfavourable shift work pattern, inadequate staffing and support from colleague and management as the factors promoting fatigue in nurses. Given different studies reported different contrasting findings about management of fatigue in nurses, an effective method of managing work-related fatigue in nurses need to be investigated. **Methods:** we conducted a literature search in October 2020 using PUBMED database and manual search from references to find studies related to effective management of work-related fatigue using keywords such Fatigue, Nurses, risk management, intervention, night shift, shift work, circadian rhythm and biological clock without restriction to date of publication. The review quality was checked through the PRISMA tool checklist for conformance with standard systematic review article guidelines. **Results:** our search yielded 452 articles out of which 16 met our inclusion criteria. we have found that napping for 30-40 minutes during night shift, 8 hours pattern of shift, adequate rest in between shifts, support from co-workers and family, and educational intervention on the fatigue, its effects and management were the effective strategies in managing work-related fatigue among nurse working in hospitals. **Conclusion**: this review identified napping, adequate spacing in between shift, family, and co-worker support, awareness about fatigue, its management and implications were the effective methods of managing fatigue among hospital nurses. Implementation of these strategies in our hospitals will go a long way in solving the problems related to work-related fatigue in nurses.

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INTRODUCTION

Fatigue is regarded as one of the major components of chronic fatigue syndrome (Barofsky & Legro, 1991). This can lead to distress or burnout because of exhaustion, tiredness, or decreased energy level (Shen *et al*., 2006). Furthermore, fatigue may cause sleepiness, decline in concentration and alertness, impairment of memory and decision-making process which may affect ones' working performance (Abd-Elfattah *et al*., 2015).

Due to the negative impact of fatigue, it has been declared as threat to nurses and their patients by American Nurses Association (Association, 2006). Nurses forms large part of the healthcare providers. According to world health organization (WHO), about 50% of the healthcare provider were nurses and that out of the 43.5 million healthcare worker, 20.7 were nurses and midwifes (WHO, 2016). Their job needs them to work 24/7 to look after patients who are in dire need of their services and this type of job usually comes with fatigue. Working in a state of fatigue can result to work-related injuries such as

needlestick, back, shoulder and neck pain (Trinkoff *et al*., 2007). Work-related fatigue in nurses occurs as a result of heavy workload, long hours of shift work and inadequate staff ratios (Smith-Miller *et al*., 2014). This usually comes with implications, including disrupting natural circadian rhythms, leading to sleep disruption, sleep deprivation, and placing nurses at high risk of developing acute or chronic fatigue that will result into medical errors, decrease in performance, reduced mental acuity, and social problems (Geiger-Brown *et al*., 2012; Kunert *et al*., 2007; Rogers, 2008). Another good example of implications of fatigue is driving in a drowsy state. This will put both nurses and members of public at risk of accident and in the eventuality of having accident injury or death occurs (Crummy *et al*., 2008). Therefore, work-related fatigue become a major concern for nurses working in the hospital and has subsequently contributed to poor results such as reduced performance and mental acuity, and an increase in errors (Steege *et al*., 2015).

Addressing the problems of work-related fatigue in nurses would have to be in multidimensional nature. Given that different nursing organisations have proposed guidelines for managing fatigue and improving safety in the workplace such as the one submitted by American nurses association (Caruso *et al*., 2017). The most critical step in combating nurse fatigue and mitigating its effects is the introduction of organisational strategies and policies to minimise fatigue and encourage safe workplace practises. Such strategies and policies should include campaign awareness on preventable causes of fatigue, strategic breaks during work, napping during night shift, and monitoring and implementing these strategies (Smith-Miller *et al*., 2016; Steege *et al*., 2015). Additionally, researchers have shown the benefit of caffeine, melatonin administration, therapy using bright light/goggles and sunglasses as countermeasures in the fight against fatigue in nurses (Caldwell *et al*., 2008; Liira *et al*., 2010; McLellan *et al*., 2019). The goal of these countermeasures strategies is to minimise the effect of sleep deprivation and misalignment of the circadian rhythm (Caldwell *et al*., 2008). Given that different studies employed different strategies in managing fatigue among nurses, the aim of this review is to determine the effective methods of managing work-related fatigue in nurses working a hospital setting.

Aims and Objectives: The literature review aims at examining the most effective risk management strategies to handling nursing fatigue. As such, it seeks to determine the effective methods of managing work-related fatigue among nurses working in a hospital setting

METHODS

Study design: The review was performed on the basis PRISMA (Prepared Reporting Items for Systematic Reviews and Meta-Analyses)'s guidelines (Moher *et al*., 2009). In this review, the populations were nurses working in different departments and units in the hospitals. Our intervention is found in the studies conducted on the management/interventions of work-related fatigue in nurses working in the hospitals. The comparators were group of nurses that serves as controls by having fatigue measures taken before and after the administration of the intervention. The outcome measure was found in the studies that had fatigue as one of the outcome measures either by self-assessment using different fatigue measurement questionnaires or physiological measurement such melatonin and body temperature.

Literature search strategy

Search term: PubMed database was searched for potential studies on management of fatigue among hospital nurses using keyword terms such fatigue, nurses, shift work, night work, sleep, napping, workload, fatigue intervention, management. These terms were joined by "AND" or "OR" and searched in the database to get the potential articles for inclusion into our review. There was no filter for date of publication but, only articles written in English language were chosen. References of the potential articles was also screened to get more studies that fulfil our inclusion criteria. The articles were then screened by title and abstract followed by full text screening before data extraction and synthesis.

Study selection

Selection criteria

***Inclusion criteria*:** the inclusion criteria for this review were as follows:

Studies on adult Nurses working in the hospital settings

- Studies covering physical, mental and emotional fatigue
- Studies evaluating management of fatigue in nurses
- All type of interventional (cross sectional, cohort or case-control, randomised and nonrandomised control trials) studies with control or without participants

***Exclusion criteria*:** the exclusion criteria for this study were found below:

- Studies on other clinical workers
- Studies evaluating patients instead of nurses
- Interventional studies that were not evaluating fatigue

Target subjects: These are nurses working in the hospital ecosystem.

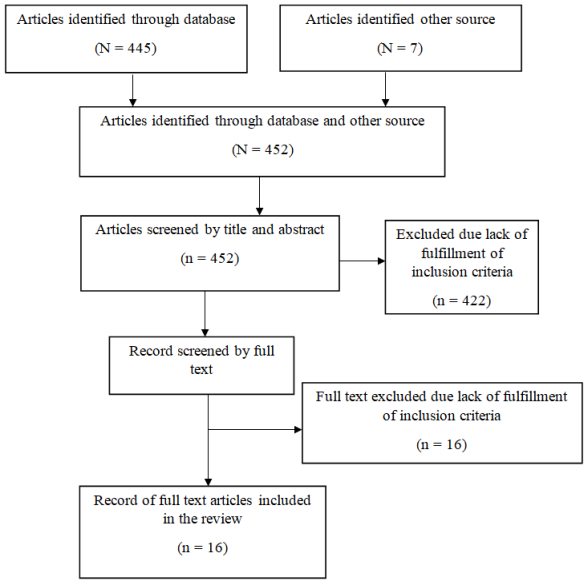
Data extraction: Data extracted included demographic information such as Author, year of publication, number of subject/controls, study design, aim of the study, type of intervention, measures, results, and limitation

Quality assessment: Downs and Black check list for randomised and non-randomised interventional studies (Downs & Black, 1998) was used to determine the quality of the included studies in which the scoring was later modified by changing the total scores from 31 to 28 (Hooper et al., 2008).

The check list comprises of six items to be graded during the assessment including reporting, external validity, bias, confounding and power. Moreover, based on the total scores earned by the study, it is graded in the form of excellent (26-28), good (20-25), fair (15-19) or poor (≤14).

RESULTS

Search outcome: As shown in figure 1, the literature search through the database produced 445 articles while hand search of the references from the search articles yielded 7 more articles making a total of 452 articles. After screening by title and abstract, the remaining articles were 32. About 422 articles that did not fulfil our inclusion criteria were excluded at this stage. Upon going through the full text articles, 16 more articles were excluded again due to noncompliance with our inclusion criteria leaving us with a total of 16 articles to be included in our quality and risk of bias assessment. Interestingly, all the 16 articles passed the assessment test, hence, 16 articles were used for the synthesis of the review.



Characteristics of studies included: As can be observed from table (1), out of the 16 included studies, 5 studies were conducted in European countries. Of the 5 studies from Europe, three were conducted in Italy (Costa *et al*., 1995; Costa *et al*., 1993; Costa *et al*., 1997); another two carried out in Norway (Eldevik *et al*., 2013; Flo *et al*., 2014) and lasty one was conducted in UK(Iskera-golec *et al*., 1996). Also, we have identified five studies conducted in Asia. Two of the studies were conducted in Japan (Fukuda *et al*., 1999; Takahashi *et al*., 1999) with two and one study carried out in Korea (Han *et al*., 2014; Yoon & Song, 2002) and Israel (Zion & Shochat, 2019) respectively. Moreover, four studies were performed in America; three of them from USA (Petrov *et al*., 2014; Scott *et al*., 2010; Smith-Coggins *et al*., 2006) and Brazil (Palermo *et al*., 2015). Lastly, only one study conducted in Australia met our inclusion criteria Winwood *et al*. (2006).

In terms of study design, six studies employed napping/sleeping intervention for fatigue management (Fukuda *et al*., 1999; Palermo *et al*., 2015; Petrov *et al*., 2014; Smith-Coggins *et al*., 2006; Takahashi *et al*., 1999; Zion & Shochat, 2019). However, out of these studies, Fukuda *et al*. (1999), Petrov *et al*. (2014) and Zion and Shochat (2019) used quasi-experiment design, Takahashi *et al*. (1999) used cohort interventional design, Smith-Coggins *et al*. (2006) used randomised control trial and lastly cross sectional study design was utilized by (Palermo *et al*., 2015). Three of the included studies by Eldevik *et al*. (2013), Flo *et al*. (2014) and Iskera-golec *et al*. (1996) explored the effect of regulation of shift work pattern in the management of fatigue. One of the study employed cohort study design (Flo *et al*., 2014) whereas the other two used quasi-experimental (Iskera-golec *et al*., 1996) and quasi-survey (Eldevik *et al*., 2013) designs respectively. In addition, three of our included studies used regulation of light exposure as an intervention for fatigue, and both of them were quasi-experimental design in nature (Costa *et al*., 1995; Costa *et al*., 1997). Additionally, two studies evaluated the effect of workload on fatigue using quasi-survey (Han *et al*., 2014) and quasi-experimental (Fukuda *et al*., 1999) study design. Finally, one quasi-experimental study by Yoon and Song (2002) evaluated the effect of melatonin on fatigue, one study evaluated the effect of family support on nurses fatigue (Winwood *et al*., 2006) and another prospective interventional study conducted by Scott *et al*. (2010).

Quality of studies included: Result of the assessment of the methodological quality of the included studies was conducted based on the check list by Downs and Black (1998). Seven (Eldevik *et al*., 2013; Palermo *et al*., 2015; Petrov *et al*., 2014; Scott *et al*., 2010; Smith-Coggins *et al*., 2006; Winwood *et al*., 2006; Yoon & Song, 2002) and nine (Costa *et al*., 1995; Costa *et al*., 1993; Costa *et al*., 1997; Flo *et al*., 2014; Fukuda *et al*., 1999; Han *et al*., 2014; Iskera-golec *et al*., 1996; Takahashi *et al*., 1999; Zion & Shochat, 2019) of our included studies had good and fair quality of the methodology (table 3). Nevertheless, looking at the scores for individual component of the check list, reporting got 100% for all the studies. Furthermore, 80% of the studies had good external validity, while scores for bias ranges between 4-7 which good, the confounding was also above average. However, only 38% of the studies reported the power of their studies, meaning the rest 62% of the studies did not provide adequate information about sampling method or they did not report the actual *P* value of the result of the main outcome of their studies. In summary, the quality of the included studies is above average and hence all of them were included in synthesis.

Effective risk management: With regards to the effective risk management or intervention of fatigue, there is a bit of heterogeneity in the approaches. Different studies used different methods to reduce the negative impact of fatigue on nurses. These interventional approaches targeted improvement of sleep quality, adaptation of night shift and reduction of workload to mitigate the consequences of acute and chronic fatigue. For the management of fatigue using sleeping/napping, reduced fatigue were reported after 30 minutes (Zion & Shochat, 2019), 40 minutes (Smith-Coggins *et al*., 2006), 2-3 hours (Fukuda *et al*., 1999; Palermo *et al*., 2015) of napping. One study reported increased level of fatigue after 2 hour of napping during night shift, this increment was later found to decline and comes back to pre-napping state(Takahashi *et al*., 1999). A study by Petrov *et al*. (2014) found no difference between group of nurses that undergo different strategies of sleeping /napping and the control. These results suggest that while conducting studies regarding management of fatigue optimization of sleep/napping duration and timing is necessary. For management of fatigue through the regulation of light exposure during night shift, the two studies included in our review did not find significant difference between nurses exposed to bright light during night shift (Costa *et al*., 1995; Costa *et al*., 1997). However, Costa *et al*. (1995) made mention of improved symptoms of fatigue even though the improvement was not statistically significant. Contrary to the two studies, Costa *et al*. (1993) reported significant reduction

Table 1. Characteristics of included studies

Author and year	Country	Subjects (% female)	Research objective	Research design	Conclusion	Limitation
Costa et al 1993	Italy	15 (100)	To determine if tolerance to night shift can be facilitated by exposure to bright light	This is a quasi-experimental design to evaluate the interventional effect of light exposure on tolerance to night shift	The result indicated reduced fatigue after exposure to bright light during night shift.	It would be important to tailor the use of bright light during night work according to whether circadian rhythms are recommended to be changed or not.
Costa et al 1995	Italy	15 (100)	To test the effect of exposure to bright light on some psychophysical conditions, such as fatigue during night shift	This is a Quasi-experimental design that test bright light exposure against normal light	The bright light intervention during night shift improved the fatigue condition of the nurses, however, the result was not statistically significant.	It would be important to tailor the use of bright light during night work according to whether circadian rhythms are recommended to be changed or not.
Costa et al 1997	Italy	5 (80)	To examine whether bright light exposure could be used as a potential method for shift workers to improve night work tolerance.	This is a Quasi-experimental design that test the effect of wearing light visor versus not-wearing it during night shift	The result did not produce a significant difference in terms of fatigue management between days of night shift with and without wearing the light visor	The very small sample size may have affected the result.
Eldevik et al 2013	Norway	1990 (90.4)	The research was to determine whether insomnia, extreme sleepiness, excessive fatigue, anxiety, depression, and shift work disorder were correlated with quick returns among shift employees.	This is a Quasi-survey design that test the effect of quick return to night shift on fatigue and related symptoms	The result indicated an association between quick return to night shift and fatigue among nurses	Since the result was based on self-assessment report, some biases may exist
Flo et al 2014	Norway	1224 (90.3)	To analyse if, at 1-year follow-up, the number of work shifts spaced by less than 11 hours (quick returns) at baseline could predict health concerns in nurses.	This is a longitudinal study assessing the relationship between quick returns and future health problems such as pathological fatigue.	The decline in the amount of quick returns from 1 year to the next was associated with a reduced risk of pathological fatigue.	The study design did not include assessment before participation and that more than a single follow up will increase the strength of the study. Since the study used self-reporting questionnaires, recall bias may exis.t
Fukuda et al 1999	Japan	20 (NA)	To evaluate the nursing workload related to a 2-shift 16-h night shift and a 3-shift 8-h night and evening shifts through four questionnaires and four physiological and behavioural assessments.	This is a Quasi-experimental design to test the effects of workload and napping on physiological and behavioural measures during night shift	The result showed that decreased workload, 2 hours of napping and a day off reduced the nurses' level of fatigue, heart rate and physical activities significantly in 16 hours shift.	Self-assessment often comes with bias.
Han et al 2014	Korea	80 (100)	To examine the relationship of work and non-work variables with acute and chronic fatigue and inter-shift recovery among 12-hour shift hospital nurses	This is a quasi-survey study that evaluated the relationship between work and non-work variables, and fatigue and its recovery.	The result indicated that both acute and chronic fatigue plus the inter-shift recovery were significantly related to workload and social support from working environment. Also, shift rotation has significant relationship with acute fatigue.	Sample size and self -reporting were the limitations of this study

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Iskera-golec et al 1996	UK	126 (NA)	To compare health, sleep, psychological and social well-being indicators, job satisfaction and ICU nurses' burnout on 12-and 8-h shifts.	This is a Quasi-experimental design comparing the effect of two shift patterns.	In comparison with 8 hours shift, 12 hours shift nurses reported more chronic fatigue, cognitive anxiety, sleep disturbance and emotional exhaustion even in the presence of an increased number of the rest days. The long-term health effects of working various shift job lengths did not vary significantly. Nurses working longer hours, however, registered lower social and domestic disturbance, possibly because they had more days off in a row.	Factors that lead to inefficiency of the rest days in to bring down the level of fatigue 12 hours shift need to be investigated
Palermo et al 2015	Brazil	1940 (84.7)	To examine the association between napping time during the night shift and nurse recovery after work	This is Cross-sectional epidemiological on the relationship between duration napping and recovery from short term effects of fatigue.	Higher level of recovery was seen in nurses that napped between 2-3 hours during night shift.	The model used for the analysis of short-term recovery needs to be replicated in another study since this was the first time of its usage in Brazil.
Petrov et al 2014	USA	214 (100)	To examine the off-shift sleep strategies of nightshift nurses, and to evaluate the relationship between the sleep strategies and adaptation to shift work.	This is a quasi-survey study design to evaluate the relationship between the sleep strategies and adaptation to shift work.	There is no significant difference between sleep/napping strategies and sleep quality or fatigue	Self-assessment often comes with bias.
Scott et al 2010	USA	47 (NA)	To Evaluate the effectiveness of a nurse fatigue countermeasure programme (FCMPN) to minimise fatigue and errors in patient care	This is pre-post-test interventional study design called fatigue countermeasures program for nurses (FCMPN)	The programme helped in minimising fatigue, improve sleep and reduced error	Using convenient sampling in this study limits the generalizability of the result.
Smith-Coggins et al 2006	USA	49 (67.3)	To investigate whether a 40-minute nap chance in doctors and nurses working 12-hour night shifts at 3 AM will boost cognitive and psychomotor performance.	This is a randomized control trial to determine the effect of napping on cognitive and psychomotor performance	At 7:00 am, the group that underwent napping reported less fatigue, less sleepiness, less performance lapses, less dangerous driving (simulated) and more vigour. However, at 4:00 am, the nurses performed poorly on memory recall test.	The limitations of this study were related to efficiency of the driving simulator. Also, effect of caffeine was not evaluated, instead, its usage was banned during the study.
Takahashi et al 1999	Japan	20 (100)	To analyse the impact on subjective symptoms (Fatigue, sleepiness, and dullness) of both timing and duration of the 2-hour napping among the 16-hour shift nurses	This is a cohort study design with 2 hours Napping intervention on nurses undergoing 16 hours shift	The findings show that immediately after napping, sleepiness, fatigue, and dullness increased relative to pre-nap. Sleepiness significantly reduced subsequently, and other symptoms returned to pre-nap values. The timing of the nap is not important. As nap time rose (> 1.5 h), post-nap fatigue lasted longer.	2-hour napping is lengthy for this type of study and it may lead to sleep inertia which will lead to more fatigue.
Winwood et al 2006	Australia	846 (100)	To examine the relationship between age, domestic responsibilities and recovery from shift work related fatigue and the evolution of maladaptive health outcomes among full-time working female nurses	This is a cross sectional study design to determine the effect of age and domestic responsibility on recovery from shift work related fatigue	Their findings showed that being part of a family structure for full-time shift work nurses would potentially be protective against the development of maladaptive fatigue.	The use of purposive sampling method in this study limits the generalizability of the result.
Yoon and Song, 2002	Korea	12 (100)	To determine the effect of melatonin administration on night shift adaptation and to see if this effect is enhanced by attenuating morning sunlight exposure	This is a Quasi-experimental design evaluating melatonin and sunlight treatment for night shift	Melatonin had a marginal advantage in enhancing workers' adaptation to night shifts, and its effect was not strengthened by attenuation of morning sun exposure.	Some parameters that are core measures for circadian rhythm such as body temperature, phase shift value have not been evaluated.
Zion and Shochat, 2019	Israel	119 (100)	To evaluate the effectiveness of a 30-min nap and its relationship during an 8-hr night shift with individual factors of sleepiness and cognition.	This is a Quasi-experimental design that examines the beneficial effect of napping on night shift.	A scheduled nap can provide a helpful countermeasure over and above interpersonal differences against the adverse effects of night-time shift work in female nurses.	Confounding effect of sleep inertia has not been considered in the study design.

Table 2. Measurement of fatigue

Author and year	Measure	comments
Flo *et al* 2014	Chalder fatigue scale	Established questionnaire
Costa *et al* (1993); Costa *et al* (1995); Costa *et al* (1997); Eldevik *et al* 2013	Fatigue scale	Established questionnaire
Fukuda *et al* 1999; Takahashi *et al* 1999	Fatigue symptom questionnaire	Established questionnaire
Yoon and Song, 2002; Smith-Coggins *et al* 2006	Profile of mood state	Established questionnaire
Iskera-golec *et al* 1996	Maslach born out inventory	Established questionnaire
Palermo *et al* 2015	Need for recovery scale	Established questionnaire
Han *et al* 2014; Winwood *et al* 2006	Occupational Fatigue Exhaustion Recovery scale (OFER)	Established questionnaire
Scott *et al* 2010	Fatigue countermeasures program for nurses (FCMPN)	Designed programme
Petrov *et al* 2014	Standard shift work index	It is a questionnaire designed for shift work, but has a component for measurement of chronic fatigue
Zion and Shochat, 2019	Questionnaire developed by the Author	The questionnaire was validated

Table 3. Assessment of the methodological quality for randomized and non-randomized studies

Study ID	Reporting (10)*	External validity (3)*	Bias (7)*	Confounding (6)*	Power (1)*	Total (28)*
Costa *et al* 1993	8	1	5	3	0	17
Costa *et al* 1995	7	1	5	3	0	15
Costa *et al* 1997	6	1	5	3	0	15
Eldevik *et al* 2013	8	3	5	4	1	21
Flo *et al* 2014	8	3	5	3	0	19
Fukuda *et al* 1999	7	3	5	4	0	19
Han *et al* 2014	7	3	4	4	1	19
Iskera-golec *et al* 1996	8	3	4	4	0	19
Palermo *et al* 2015	9	3	5	4	0	21
Petrov *et al* 2014	10	3	5	4	1	23
Scott *et al* 2010	9	3	5	3	1	21
Smith-Coggins *et al* 2006	10	3	7	5	0	25
Takahashi *et al* 1999	8	3	4	4	0	19
Winwood *et al* 2006	9	3	6	3	1	21
Yoon and Song, 2002	10	3	5	3	1	22
Zion and Shochat, 2019	8	3	5	3	0	19

in the level of fatigue after exposure to bright light during night shift. Overall, the result of light exposure during night shift may not be a best strategy for fatigue management in nurses. Additionally, some studies used regulation of shift pattern in the management of fatigue. Iskera-golec *et al*. (1996) indicated that nurses that undergo 12 hours of shift were more prone to chronic fatigue than those involved in 8-hour shift pattern. Also, reduction of quick return between shifts caused decline in level of fatigue (Eldevik *et al*., 2013; Flo *et al*., 2014; Han *et al*., 2014). The results from the studies that examine shift pattern on management of fatigue summarily showed that duration and frequency of night shift determine the effectiveness of fatigue management. Other studies reported different approaches to managing fatigue among nurses. For example, administration of melatonin during night shift have been reported to increases nurses' adaptation to night shift (Yoon & Song, 2002), which translates into fatigue reduction. Nurses on shift work and have family support have been reported to get protection against maladaptive fatigue (Winwood *et al*., 2006). Lastly, a strategic fatigue counter measures programme is one of the best methods of managing fatigue. This programme was able to minimise fatigue, improve quality of sleep and reduce errors during work (Scott *et al*., 2010).

Measurement of fatigue: Measurement of fatigue is done in either objective or subjective manner. The objective measurement involves measuring physiological parameters, such as reaction time and number of recorded errors during work.

On the other hand, subjective fatigue is measured mostly using questionnaires (De Vries *et al*., 2003). In our review, all the studies included, adopt the subjective method of fatigue measurement. Different type of questionnaires that directly or indirectly measure fatigue were used table 2. The questionnaire that measure fatigue directly are usually design to answer questions related tiredness, exhaustion, burn out, mood state and recovery (Costa *et al*., 1995; Costa *et al*., 1993; Costa *et al*., 1997; Eldevik *et al*., 2013; Flo *et al*., 2014; Fukuda *et al*., 1999; Han *et al*., 2014; Iskera-golec *et al*., 1996; Palermo *et al*., 2015; Scott *et al*., 2010; Smith-Coggins *et al*., 2006; Takahashi *et al*., 1999; Winwood *et al*., 2006; Yoon & Song, 2002). Contrarily, questionnaires that measure fatigue indirectly are usually designed for other purposes like shift work but have some questions allocated for fatigue (Petrov *et al*., 2014; Zion & Shochat, 2019).

DISCUSSION

To achieve effective management of fatigue among nurses' different strategies have been put in place. From the result of our review, three major interventions used in managing fatigue targeted improvement of sleep/napping, adaptation of shift work (especially the night shift). If we take sleep/napping intervention, we will observe that this intervention can only be effective when timing and duration of the napping is determined carefully.The effectiveness of this intervention have been reported when nurses napped for 30-40 minutes

during their night shift (Smith-Coggins *et al*., 2006; Zion & Shochat, 2019). This result is comparable with others studies that reported napping during short breaks at night improved the nurses' mood, regain their energy and be more concentrated (Arora *et al*., 2006; Fallis *et al*., 2011). even though other studies reported beneficial effect of 2-3 hours of napping (Fukuda *et al*., 1999; Palermo *et al*., 2015), however, napping for longer duration during night shift may result into more tiredness and sleep inertia (Takahashi *et al*., 1999). Furthermore, the timing of the choice of the timing of the napping is also necessary. Two types of napping timing strategy have reported as prophylactic (Bonnet, 1991) and restorative napping (Purnell *et al*., 2002). Both Smith-Coggins *et al*. (2006) and (Zion & Shochat, 2019) found early morning napping between 3am to 4 am to be useful in reducing fatigue. The early morning sleep have been shown to be effective because this time of the body temperature is in its lowest level (Fallis *et al*., 2011). Therefore, sleep/ napping intervention for night shift nurses could be more beneficial for fatigue management if it is conducted during the early morning and for a short duration depending on the individual difference.

From the result of the studies include in our review, management of fatigue in nurses by regulating exposure to bright light during and after night did not produce a significant result (Costa *et al*., 1995; Costa *et al*., 1997). Though Costa *et al*. (1993) reported significantly reduced level of fatigue after exposure to bright light, the result did not rhythm with the shift in circadian rhythm parameters (such as change in body temperature and hormonal excretion) tested. The target of the bright light exposure is normally to change the biological clock of the nurses so as to adapt to the night shift (Duffy & Czeisler, 2009). It should be noted that the intensity of the light matters during light therapy for shift workers. Exposure to light of low intensity usually does not alter biological clock, and on contrary, bright light of high intensity can alter the circadian rhythm(Costa *et al*., 1995). However, altering of biological clock is desirable only if the night shift is not frequent. Hence, light therapy for night shift nurses should be tailored to match the shift pattern. In summary, bright light intervention for fatigue management in nurses can only work if the intervention is designed to alter biological clock of the participants.

In the management of fatigue by altering shift pattern, its effectiveness relies on the frequency and timing of the night shift. Our result indicated that the lower the frequency of the night shift, the lower the fatigue in nurses as demonstrated by (Eldevik *et al*., 2013; Flo *et al*., 2014; Han *et al*., 2014). Also, changing the shift pattern from 12 hours to 8 hours helps in reducing the effect of fatigue (Iskera-golec *et al*., 1996). It is reported that quick return to night shift has detrimental effect on health as it affects circadian rhythm of the shift worker. Studies show that a couple of days are needed in order to get rid of the detrimental effect of shift work on physical, mental and psychological fatigue (Bjorvatn *et al*., 1998; Gibbs *et al*., 2002). Moreover, because of the negative implications of night shift on both patient and nurses (Flo *et al*., 2012), it is recommended that suitable pattern of night shift should be use to avert the negative consequences of bad shift pattern. Work-related fatigue can also be managed using melatonin administration as indicated by (Yoon & Song, 2002). Melatonin administration in the morning have been shown to improve sleep during daytime and activity at night (Lewy & Sack, 1997). Thus, it can alter the biological clock. However, this effect of melatonin of daytime sleep is very minimal as it does not improve sleep quality in night shift workers (James *et al*., 1998; Sharkey *et al*., 2001). Therefore, melatonin administration alone may not be helpful in managing fatigue among nurses working in the hospital.

Most of the interventions mentioned above were tested in a cross-sectional study design. Therefore, validation of these results is needed in a longitudinal study design. Interestingly, one study that uses a well structure longitudinal design in line with fatigue risk management system. This study conducted by Scott *et al*. (2010) reported significant decline in fatigue, improvement in sleep quality and work accuracy. It was in form of mini programmed involving lectures and demonstrations for nurses about fatigue, sleep, circadian rhythm, and the complications of sleep deprivation. The study was among the preliminary studies targeted at managing fatigue among registered nurses working in hospitals which will help in reducing errors made by the nurses for their safety and that of their patients. Nevertheless, implementation of this kind of in our hospital is daunting task. The cooperation of both employers and employees is highly needed for such type of programme to thrive well. For example, adequate number of nursing staff, adequate spaces for napping, proper shift pattern and use of caffeine were some of the measures used in this type of countermeasures intervention for fatigue. Therefore, in actual hospital settings, it is not an easy task to run the programme of this nature considering manpower, infrastructure, and commitment from the employers.

Study Limitations and Conclusion

One of the limitations of this review is limiting our search to studies that had their outcome major as fatigue. Any study that did not measure fatigue after the intervention does not fulfil our inclusion criteria and was therefore excluded. This was done purposely to determine the interventions used in managing work-related fatigue among hospital nurses. Another limitation of this review is the exclusion of interventional studies conducted in nursing homes. A separate review can be done to determine best interventions for fatigue in nursing homes. The articles included in this review were those written in English. Therefore, other articles written in other languages will be missed here. In summary, the literature review has demonstrated that the solution to fatigue management in nurses working in the hospital should be multifactorial. Emphasis should be given on knowledge about healthy sleep, napping strategy, healthy shift pattern, and support from employers, co-workers, and family.

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