Accident Analysis and Prevention 126 (2019) 31–36

Contents lists available at ScienceDirect

Accident Analysis and Prevention

journal homepage: www.elsevier.com/locate/aap

Fatigue as a mediator of the relationship between quality of life and mental health problems in hospital nurses

Ahmad Bazazan[a], Iman Dianat[a,*], Zohreh Mombeini[b], Aydin Aynehchi[c], Mohammad Asghari Jafarabadi[d]

[a] Department of Occupational Health and Ergonomics, Faculty of Health, Tabriz University of Medical Sciences, Tabriz, Iran
[b] Department of Occupational Health, Jundishapur University of Medical Sciences, Ahvaz, Iran
[c] Student Research Committee, Tabriz University of Medical Sciences, Tabriz, Iran
[d] Tabriz Health Service Management Research Center, Tabriz University of Medical Sciences, Tabriz, Iran

ARTICLE INFO

Keywords:
Health care
Nursing
Mental disorders
Psychological distress
Mediation

ABSTRACT

The aims of this study were to investigate the relationships among quality of life (QoL), mental health problems and fatigue among hospital nurses, and to test whether fatigue and its multiple dimensions would mediate the effect of QoL on mental health problems. Data were collected using questionnaires (including the World Health Organization Quality of Life-BREF [WHOQOL-BREF], General Health Questionnaire [GHQ-12] and Multidimensional Fatigue Inventory [MFI-20] for evaluation of QoL, mental health problems and fatigue, respectively) from 990 Iranian hospital nurses, and analysed by generalized structural equation modelling (GSEM). The results indicated that QoL, mental health problems and fatigue were interrelated, and supported the direct and indirect (through fatigue) effects of QoL on mental health problems. All domains of the WHOQOL-BREF, and particularly physical (sleep problems), psychological (negative feelings) and environmental health (leisure activities) domains, were strongly related to the mental health status of the studied nurses. Fatigue and its multiple dimensions partially mediated the relationship between QoL and mental health problems. The results highlighted the importance of physical, psychological and environmental aspects of QoL and suggested the need for potential interventions to improve fatigue (particularly physical fatigue along with mental fatigue) and consequently mental health status of this working population. The findings have possible implications for nurses' health and patient safety outcomes.

1. Introduction

In almost all countries, nurses constitute the largest group of health care professionals. Working in a hospital or clinical setting, as a stressful environment, may impose a high level of physical and mental demands on this working population (Suzuki et al., 2004; Tzeng et al., 2009; Dianat et al., 2013; Suzuki et al., 2004). There is evidence that mental health problems are fairly common among nurses (Suzuki et al., 2004; Su et al., 2009), which may be attributed to working in mentally stressful work settings (e.g. direct contact with patients, role in quality of care, documented nurse shortages in health care settings, etc.) and to the need for developing new skills to cope with advances in medical care and technology (Suzuki et al., 2004; Parhizi et al., 2013).

Study on the quality of life (QoL) of health care workers in hospitals is also of particular interest. The World Health Organization Quality of Life Group (WHOQOL) defines QoL as: "individuals' perceptions of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns" (Group, 1998). According to this definition, the QoL is a complex concept that includes physical and psychological health, emotional well-being, and social functioning. From an occupational point of view, the QoL is important because it is almost impossible to consider living and working conditions as two separate concepts. This means that there may be multi-dimensional interactions between the living and working conditions that influence the health and well-being of the employees. This problem seems to be worsening with the increasing working demands in modern complex working systems. Additionally, the International Ergonomics Association (IEA) declares its mission as follows: "to elaborate and advance ergonomics science and practice, and to expand its scope of application and contribution to society to improve the quality of life". Thus, as it has been acknowledged, we need to improve our understanding of QoL to better

* Corresponding author.
E-mail addresses: bazazana@tbzmed.ac.ir (A. Bazazan), dianati@tbzmed.ac.ir (I. Dianat), z.mombeini@razip.com (Z. Mombeini), aynehchia@tbzmed.ac.ir (A. Aynehchi), asgharimo@tbzmed.ac.ir (M. Asghari Jafarabadi).

https://doi.org/10.1016/j.aap.2018.01.042
Received 2 August 2017; Received in revised form 31 January 2018; Accepted 31 January 2018
Available online 14 February 2018
0001-4575/

determine what it is we are trying to improve, or even to optimise, as a profession (Hancock and Drury, 2011). Some investigators have evaluated the associations of QoL with work ability (Sörensen et al., 2008), occupational stress (Hamaideh, 2011) and mental health problems (Tzeng et al., 2009) among different occupational groups including nurses.

Previous studies suggest that compared to other health care professionals, nurses may suffer from a higher level of fatigue (Hooper et al., 2010; Yoder, 2010; Geiger-Brown et al., 2012; Raftopoulos et al., 2012). Although there is no accepted definition of fatigue because of its complexity and multidimensional nature, fatigue is considered to be related to several physiological, psychological and behavioral processes in response to excessive demands with inadequate recovery (Aaronson et al., 1999; Shen et al., 2006). Occupational fatigue, including fatigue in nursing work, is frequently defined as a multidimensional construct and includes mental, physical and total fatigue (Barker and Nussbaum, 2011; Parhizi et al., 2013). A recent study in the United States suggests that hospital nurses may be exposed to higher levels of mental than physical fatigue (Barker and Nussbaum, 2011). Evidence suggests that fatigue has a significant impact on nurses' safety and health, performance, stress, absenteeism, burnout and job satisfaction (Bing Yip, 2001; Josten and Thierry, 2003; Garrett 2008; Parhizi et al., 2013). Fatigue in this working group has serious implications for patients' safety and health care quality (Gaba and Howard, 2002). Thus, better understanding of fatigue and its multiple dimensions and possible adverse consequences of high work demands of the nursing job is a valuable tool to develop guidelines and recommendations for improving the working conditions of nurses.

The occupation group of hospital nurses has a major impact on quality of care and patient safety. There is a lack of evidence in the literature concerning the relationships between QoL, mental health problems and fatigue among this working group. While earlier studies on mental health problems and fatigue have mostly focused on evaluation of the effects of organizational and job-related factors, little information is available on the relationship between these parameters and life outside work. In one of the few attempts to address this issue, Tzeng et al. (2009) evaluated the mental health status and QoL of health care workers in military hospitals in Taiwan and reported that mental health problems were associated with physical health domain of QoL in the studied workers in that environment. However, not much attention has been paid to the mediating role of fatigue and its multiple dimensions regarding the relationship between QoL and mental health problems. The findings from research in this area will help to better understand the role of aspects of life outside work as well as the impact of fatigue on mental health status of hospital nurses, which have significant implications for nurses' health and well-being and for patient outcomes.

1.1. Conceptual model

To examine the prediction that fatigue and its multiple dimensions would mediate the relationship between QoL and mental health problems, mediation model was tested with WHOQOL as the independent variable, GHQ–12 as the dependent variable, and MFI–20 as the mediator. A graphic presentation of this model is illustrated in Fig. 1. Mediation refers to a statistical method used to examine whether the relationship between an independent variable (e.g. QoL) and a dependent variable (e.g. mental health problems) is caused by a mediating variable (e.g. fatigue) (Baron and Kenny, 1986). For this, the independent variable should significantly predict both the dependent (path a) and mediator (path b) variables. The mediator should also significantly predict the dependent variable (path c). A fully mediated effect occurs when the relationship between the independent and dependent variables becomes null after controlling for the mediator (path á). If the path á is less significant than the path a, but still significantly different from zero (e.g. when the p-value is still $< .05$), the

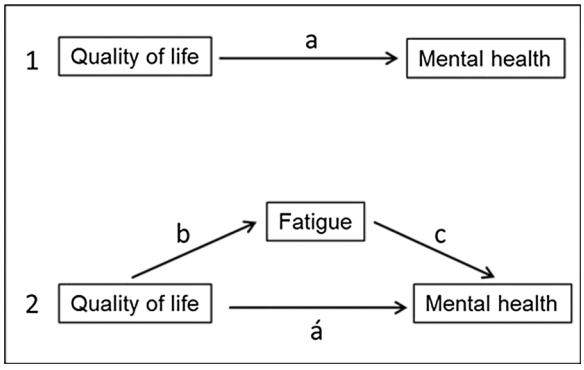

Fig. 1. Graphic representation of fatigue mediating the relationship between quality of life and mental health. Note: 1 shows the theoretical relationship between quality of life and mental health, while 2 shows the theoretical model where fatigue mediates the relationship between quality of life and mental health.

relationship is partially mediated (Preacher and Hayes, 2004, 2008). In other words, a fully mediated relationship occurs when the influence of the independent variable is fully transmitted via the mediator, while a partially mediated relationship occurs when the influence of the independent variable is transmitted both by a direct pathway (direct effect) and via the mediator variable (indirect effect).

1.2. Rationale

Based on the above mentioned background, this study was conducted to: 1) investigate the relationships among QoL, mental health problems and fatigue among a sample of hospital nurses in Iran, and 2) test whether fatigue and its multiple dimensions would mediate the effect of QoL on mental health problems. Fatigue was proposed to be the mechanism through which QoL would affect mental health problems, thus acting as the mediating variable.

2. Materials and methods

2.1. Study design, procedure and sample

This cross-sectional analytical study was conducted in seven large hospitals in Tehran, Iran. A questionnaire was used to collect data on demographic and job details as well as QoL, mental health status and fatigue in hospital nurses. All nurses working at least for one year with no physical disabilities or mental diseases, as determined by self-report, were asked to participate in the study. A total of 1450 questionnaires were distributed among eligible nurses, of which 990 (response rate = 68.2%) declared their agreement by completing and returning the questionnaires. The whole questionnaire took about 25 min to complete. The ethics committee of the Tabriz University of Medical Sciences reviewed and approved the study protocol. Each participating nurse signed a written informed consent form prior to the study.

2.2. Outcome mesurements

Mental health status was assessed using the 12-item General Health Questionnaire (GHQ–12), which is a valid and widely used screening instrument for predicting mental distress (Goldberg and Williams, 1988). Each item was rated on a scale (less than usual = 0, no more than usual = 0, rather more than usual = 1, or much more than usual = 1), and the total score ranged from 0 to 12. The threshold for cases classification (e.g. poor mental health) used in this present study was GHQ score of 4 or higher (Suzuki et al., 2004). The Farsi (Iranian language) version of the GHQ–12, with an established validity and reliability (Montazeri et al., 2003), was used in this study.

The demographic details including the participant's age, gender,

height, weight, educational level (graduate and post graduate) and marital status (married or single) as well as individual habits such exercise (no, yes) and smoking habits (no, yes) were also recorded. There were also items about their job including work experience (years), work schedule (8-h, 12-h and 24-h rotating shift or normal work day), type of hospital (general or private) and job satisfaction ('How much are you satisfied with your job? low, moderate or high').

The World Health Organization Quality of Life–BREF (WHOQOL–BREF), which is a 26-item revised version of the 100-item WHOQOL (Harper 1998), was used to measure QoL. This is a reliable and validated tool which has been used in previous studies to evaluate QoL among nurses (Su et al., 2009; Tzeng et al., 2009; Shao et al., 2010). It consists of 4 domains including physical health, psychological health, social relationships and environmental health. Each item is rated on a 5-point likert scale (from 1 = very poor/dissatisfied to 5 = very well/satisfied). All scores in this scale were transformed to reflect 4–20 for each domain, with higher scores indicating better QoL. The original version of WHOQOL–BREF, which has been translated and revised into Farsi and has an established validity and reliability was used in this study (Nedjat et al., 2008).

Finally, fatigue was measured using the 20-item Multidimensional Fatigue Inventory (MFI–20) (Smets et al., 1995). The MFI–20 is a reliable and validated tool widely used to evaluate fatigue in both general and working populations including health care workers (Schwarz et al., 2003; Lin et al., 2009; Mansour et al., 2010; Bazazan et al., 2014; Rasoulzadeh et al., 2015). A significant advantage of this tool is that it can measure multiple dimensions of fatigue. It consists of five subscales including general fatigue, physical fatigue, reduced motivation, mental fatigue and reduced activity. Each subscale contains four items (with a 5-point response format): two indicative for fatigue (where a high score shows a high fatigue level) and two contraindicative (where a high score shows low fatigue level). The score range for each subscale is from 4 to 20, with higher scores indicating higher fatigue. The English version of MFI–20 has been translated and revised into Farsi and has an established validity and reliability (Rasoulzadeh et al., 2015). This revised version was used in this study.

2.3. Data analysis

Statistical analysis of the data, including descriptive statistics, was performed using SPSS version 17 (SPSS Inc., Chicago, IL, USA) and Mplus version 6.12 (Mplus, Los Angeles, CA, USA) (Muthén and Muthén, 2011). The level of significance was set at $p < .05$. Demographic data and job characteristics of the study participants were presented as mean (standard deviation – SD), range and percentages. To establish the conditions necessary for testing mediation relationship, correlations between all variables were first calculated (Baron and Kenny, 1986). For this, Pearson's correlation coefficients were used to evaluate the relationships among QoL, mental health problems and fatigue. Using generalized structural equation modeling (GSEM), fatigue was examined as the mediator of the relation between QoL and mental health problems. Missing data were imputed by multiple imputation method utilizing fully conditional specification technique. GSEM with WLSMV (weighted least squares mean and variance adjusted) was then used to test the hypothesized model using the Mplus software. The fit of model was evaluated and confirmed by model fit indices including chi-square estimate with degrees of freedom, normed chi-square (equal to chi-square divided by its degree of freedom) (values < 5); root mean squared error of approximation (RMSEA) (values < .08) and its 95% CI; Tucker-Lewis index (TLI) (values > .9); comparative fit index (CFI) (values > .9).

Table 1
Demographic and job characteristics of the study population (n = 990).

Variables	
Gender (n, (%))	
Male	140 (14.1)
Female	850 (85.9)
Age (year)	
Mean ± SD	33.8 ± 6.3
Range	24–60
Height (Cm)	
Mean ± SD	164.3 ± 7.2
Range	144–188
Weight (kg)	
Mean ± SD	66.1 ± 10.1
Range	43–120
BMI (kg/m^2)	
Mean ± SD	24.4 ± 3.1
Range	16.0–37.5
Marital status (n (%))	
Single	277 (28.0)
Married	713 (72.0)
Education level (n (%))	
Undergraduate	923 (93.2)
Post graduate	67 (6.8)
Regularly exercise (n (%))	
Yes	902 (91.1)
No	88 (8.9)
Smoking (n (%))	
Yes	38 (3.8)
No	952 (96.2)
Job experience (year)	
Mean ± SD	9.3 ± 5.9
Range	1–32
Work schedule (n (%))	
8 h rotating shift	197 (19.9)
12 h rotating shift	479 (48.4)
24 h rotating shift	185 (18.7)
Work day	129 (13.0)
Type of hospital (n (%))	
General	699 (70.6)
Private	291 (29.4)
Job satisfaction (n (%))	
Low	214 (21.6)
Moderate	590 (59.6)
High	186 (18.8)

3. Results

3.1. Description of the study sample

Demographic and job details of the participating nurses are presented in Table 1. Most participants were females (85.9%), married (72.0%) and had been working in general hospitals (70.6%). The age and job experience of the participants ranged between 24–60 years (mean ± SD = 33.8 ± 6.3 years) and 1–32 years (mean ± SD = 9.3 ± 5.9 years), respectively. About half of the study participants (48.4%) had a 12-h rotating shift work. The level of job satisfaction among the participants was: low = 21.6%, moderate = 59.6% and high = 18.8%. Other demographic and job details of the study population can be found in Table 1.

3.2. Mental health status, QoL and fatigue

The mean score of the GHQ–12 was 2.37 (SD = 3.04; range = 0–12). The proportion in this study population above the cut-

Table 2
Pearson's correlation coefficients of the study variables and descriptive statistics.

Scale/Subscale	1)	2)	3)	4)	5)	6)	7)	8)	9)	10)	11)	12)
1) Overall QoL	–											
2) QoL–Physical health	0.515**	–										
3) QoL–Psychological health	0.614**	0.706**	–									
4) QoL–Social relationship	0.448**	0.508**	0.648**	–								
5) QoL–Environmental health	0.587**	0.652**	0.707**	0.583**	–							
6) Overall fatigue (MFI–20)	−0.439**	−.0711**	−0.689**	−0.532**	−0.524**	–						
7) Fatigue–General	−0.411**	−0.649**	−0.573**	−0.413**	−0.526**	0.727**	–					
8) Fatigue–Physical	−0.376**	−0.650**	−0.604**	−0.459**	−0.477**	0.819**	0.599**	–				
9) Fatigue–Reduced activity	−0.283**	−0.430**	−0.430**	−0.398**	−0.280**	0.728**	0.307**	0.454**	–			
10) Fatigue–Reduced motivation	−0.298**	−0.444**	−0.473**	−0.358**	−0.307**	0.757**	0.362**	0.460**	0.576**	–		
11) Fatigue–Mental	−0.369**	−0.572**	−0.580**	−0.426**	−0.435**	0.844**	0.518**	0.628**	0.512**	0.844**	–	
12) Mental health (GHQ–12)	−0.448**	−0.494**	−0.571**	−0.428**	−0.455**	0.545**	0.459**	0.473**	0.302**	0.496**	0.545**	–
Mean	3.38	13.24	13.18	13.53	12.08	50.53	12.77	10.16	9.04	8.84	9.74	2.37
(SD)	(0.80)	(2.55)	(2.55)	(2.73)	(2.47)	(12.85)	(3.39)	(3.47)	(3.25)	(2.93)	(3.50)	(3.04)

** Correlation is significant at the. 01 level (2-tailed).

off point (e.g. those with GHQ–12 ≥ 4, which were considered to be mentally in poor health) was 26.2%. The Cronbach's α for the GHQ was 0.89.

With regard to the WHOQOL–BREF domains, the social relationship (mean ± SD = 13.53 ± 2.73) and environmental health (mean ± SD = 12.08 ± 2.47) domains had the highest and lowest mean scores, respectively, among the study population (Table 2). The Cronbach's α for the WHOQOL–BREF domains were as follows: physical health (0.81), psychological health (0.81), social relationship (0.71) and environmental health (0.85).

The total fatigue score of the MFI was 50.53 (range = 20–100; SD = 12.85), with the general fatigue (mean ± SD = 12.77 ± 3.39) and reduced motivation (mean ± SD = 8.84 ± 2.93) being the subscales with the highest and lowest mean scores, respectively. The Cronbach's α for the MFI–20 and its subscales were as follows: total MFI (0.88), general fatigue (0.72), physical fatigue (0.73), reduced activity (0.71), reduced motivation (0.70) and mental fatigue (0.76).

3.3. Correlations among study variables

Table 2 shows correlations and descriptive statistics for all study variables. The results of Pearson correlation analyses indicated significant correlations between the QoL, mental health problems and fatigue. A negative correlation existed between QoL and mental health problems, and between QoL and fatigue, while there was a positive correlation between fatigue and mental health problems. All correlations were statistically significant, ranging from 0.280 to 0.844.

3.4. Mediating effect of fatigue and its subscales

The result of GSEM modelling showed good fit to the data: $\chi 2$ (26, N = 990) = 145.98, $p < .01$; TLI = 0.927, CFI = 0.958, RMSEA = 0.068. The structural model paths between QoL and mental health problems (e.g. direct effect of QoL on mental health problems) ($\beta = -0.39$, $p < .001$) and also between fatigue and mental health problems (e.g. indirect effect of QoL on mental health problems through fatigue (which in this case β is equal to the product of these two estimates – paths b and c: $-0.85 \times 0.36 = -0.30$, $p < .001$) were found to be statistically significant. These findings indicated that the composite total fatigue score partially mediated the relationship between QoL and mental health problems. Each of the fatigue subscales partially mediated this relationship, and details are shown in Fig. 2.

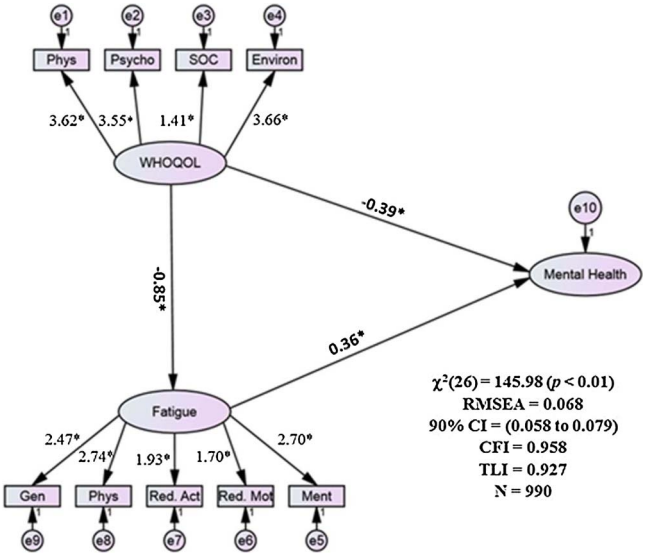

Fig. 2. Conceptual model of fatigue as a mediator of the relationship between quality of life and mental health problems. Note: Phys = Physical health; Psycho = Psychological health; Soc = Social relationship; Environ = Environmental health; Gen = General fatigue; Phys = Physical fatigue; Red. Act = Reduced activity; Red. Mot = Reduced motivation; Ment = Mental fatigue. *p < .01.

4. Discussion

The purpose of this present study was to investigate the relationships among QoL, mental health problems and fatigue in hospital nurses and to examine the mediating role of fatigue underlying the relationship between QoL and mental health problems. In line with the findings from other countries, fatigue, poor mental health and QoL were frequent among Iranian nurses. These findings would reflect the negative consequences of stressful and adverse working conditions of hospital nurses and highlight the potential for ergonomic interventions to reduce excessive job demands imposed on this group. The study also demonstrated that QoL, mental health problems and fatigue were interrelated and that fatigue was a mediator of the relationship between QoL and mental health problems in this working group. These findings highlight the importance of various aspects of QoL and fatigue in relation to mental health status of hospital nurses and suggest the need for potential ergonomic interventions to improve health and well-being of this working population.

As shown in this study, more than one-fourth (26.2%) of the study population had a GHQ–12 score above the cut-off point (≥4). These nurses were more likely to suffer from mental health problems than those scoring below the cut-off point. The results of a study conducted by Suzuki et al. (2004) among hospital nurses in Japan showed a much higher prevalence (68.8%) of mental health problems (GHQ–12 score ≥ 4) among their study sample. Additionally, a study conducted

by Su et al. (2009) among hospital nurses in Taiwan reported 42% of their respondents scored above the cut-off point of CHQ–12 (≥3), which is also much higher than our finding. The differences in mental health status of hospital nurses reported in these studies can be attributed to the differences in cultural backgrounds, clinical practices, or to the different methodologies used in selection of cut-off points of the GHQ. Nevertheless, the findings from these studies may reflect the poor and stressful working conditions of hospital nurses and highlight the importance of ergonomic interventions (e.g. measures to reduce fatigue, work load, work shift arrangements, etc.) to improve the mental health status of this working population.

One of the hypotheses of the study was that there would be a significant relationship between mental health problems and QoL in hospital nurses. The results supported this hypothesis, as QoL predicted mental health problems in this working group. According to the generalized structural equation modelling, all domains of the WHOQOL–BREF, and particularly physical (e.g. sleep problems) and psychological (e.g. negative feelings), and environmental health (e.g. leisure activities) domains, were strongly related to the mental health status of the studied nurses. These findings provide further evidence that, in addition to organizational and job-related factors, it might be useful to consider physical, psychological and environmental health aspects of life outside work as they may influence the nurses' health and well-being. This is, in part, consistent with the findings of Tzeng et al. (2009), who found that the mental health problems were only associated with physical health domain of QoL of health care workers in military hospitals in Taiwan. It is of interest to note that sleep problems were more problematic than other aspects of physical health domain of QoL in our study as they had the lowest mean score. This may be attributed to the fact that the majority of study subjects were shift-working nurses, and previous research has shown a significant association between shift work and poor sleep quality or disturbances in this occupation (De Martino et al., 2013; Lajoie et al., 2015). Leisure activities had the lowest mean score among environmental health domain of QoL in this study which may be explained by the fact that shift work has the potential to limit the employees' involvement in leisure and social activities, which can consequently lead to decreased QoL in this occupational group (Aalaa et al., 2012).

The results of this study also supported the hypothesis concerning the mediating role of fatigue in relation to mental health problems in the nurses under study. The findings supported the direct and indirect (e.g. through fatigue) effects of QoL on mental health problems. When fatigue was controlled, the strength of the relationship between the independent variable (QoL) and the dependent one (mental health problems) was reduced ($\beta = -0.39$ *vs.* $\beta = -0.30$), indicating that fatigue partially mediated the effect of QoL on mental health problems. In other words, at least part of this relationship appears to be mediated by fatigue. It is encouraging that even though QoL of hospital nurses predicts their mental health status, part of this relationship is explained by the presence of fatigue, which may possibly be modifiable to interventions. Thus, strategies and interventions to alleviate the adverse effects of fatigue as a modifiable determinant of mental health problems, has the potential for a notable impact on mental health status of hospital nurse, even if the underlying QoL conditions remain unchanged. Though these findings provide a basis for better understanding of the relationships between parameters under study, the findings would need to be validated in experimental (e.g. objective measures of fatigue) or longitudinal studies. Moreover, the addition of the fatigue as a mediating variable in this study did not cancel out the direct effect between QoL and mental health problems. This means that other factors may also be important in determining the relationship between these outcomes. Therefore, further studies testing other factors or mechanisms (such as stress, burnout, job satisfaction, etc.) that may mediate the relationship between QoL and mental health problems in this working group are needed to improve our understanding in this area.

The findings have possible implications for improving the mental health status of hospital nurses. The results highlight the importance of targeting fatigue as one possible approach in this regard. It was also hypothesized that all five dimensions of fatigue would mediate the relationship between mental health problems and QoL, with mental fatigue having the largest effect on this relationship. The GSEM results indicated that all fatigue dimensions (including general, physical, reduced activity, reduced motivation and mental fatigue) mediated the relationship between mental health problems and QoL. However, mental fatigue was not the strongest mediator of this relationship; rather, physical fatigue along with mental fatigue was the strongest mediator, while reduced motivation had a minimal effect on this relationship. This finding may also have practical implications for designing ergonomic interventions for health promotion of hospital nurses. It is interesting to note that the scores of the MFI–20 dimensions in this study showed that general fatigue and physical fatigue were more problematic than other dimensions of fatigue. This highlights the higher importance of physical aspect of fatigue, rather than particularly reduced motivation and reduced activity aspects. This result differs from the findings of Barker and Nussbaum (2011) who reported higher levels of mental fatigue than physical fatigue in hospital nurses in the United States. The higher levels of physical fatigue in our study may deserve particular attention given the relatively frequent and excessive levels of physical and biomechanical risks (such as poor working postures, manual patient transfer tasks, etc.) in nursing job, which can consequently lead to the development of musculoskeletal problems and occupational injuries (Bing Yip, 2001; Trinkoff et al., 2001; Abdollahzade et al., 2016). Thus, the implications for ergonomic practice may be to organize job activities, training programmes, etc. to reduce excessive physical demands, overexertion and poor working postures among this working population.

This is one of the largest studies of its kind which evaluates mental health status, fatigue and QoL and their relations and also extends the body of knowledge on this issue to include nurses in developing countries. The study has also the advantage of large sample size. However, as data were collected at a single time point, causality cannot be established. Further research may therefore be needed to replicate these findings using prospective longitudinal data. In addition, limitations regarding the generalizability of the findings may also need to be taken into account. However, as the majority of health care professionals (in both medical and mental health fields) experience or are exposed to a variety of stressful or excessive job demands in a hospital/clinical setting, the current findings, while specific to hospital nurses, may have significant implications for a diversity of health care professionals in a variety of fields. Additionally, a relatively low response rate in the present study may introduce a source of selection bias (e.g. the likelihood of bias from non-participation), and therefore care should be given when interpreting these results.

5. Conclusions

In conclusion, this is the first study that investigates the relationships between QoL, mental health problems, and fatigue in hospital nurses and also examines the mediating role of fatigue underlying the relationship between QoL and mental health problems. The findings indicated that QoL, mental health problems and fatigue are interrelated in this working population. The findings confirmed that QoL has indirect and direct effect on mental health problems through fatigue. Fatigue displayed a partially mediating effect on the relationship between QoL and mental health problems. The results highlighted the importance of physical, psychological and environmental aspects of QoL in this working population. The findings suggest the need for potential interventions to improve fatigue (particularly physical fatigue along with mental fatigue) and consequently mental health status of this working population. The present results have possible implications for both nurses (e.g. organization and allocation of work tasks) and

patients (e.g. quality of patient care and patient safety).

Funding

No fund was received for this study.

Competing interests

The authors declare that there is no conflict of interest.

Acknowledgements

We are grateful to all nurses for their cooperation during the collection of data.

References

Aalaa, M., Sanjari, M., Tootee, A., Mirzabeigi, G., Salemi, S., 2012. Assessment of quality of life of Iranian nurses. Nurs. Rep. 2 (1), 10.
Aaronson, L.S., Teel, C.S., Cassmeyer, V., Neuberger, G.B., Pallikkathayil, L., Pierce, J., Press, A.N., Williams, P.D., Wingate, A., 1999. Defining and measuring fatigue. Image: J. Nurs. Scholarsh. 31 (1), 45–50.
Abdollahzade, F., Mohammadi, F., Dianat, I., Asghari, E., Asghari-Jafarabadi, M., Sokhanvar, Z., 2016. Working posture and its predictors in hospital operating room nurses. Health Promot. Perspect. 6 (1), 17.
Barker, L.M., Nussbaum, M.A., 2011. Fatigue, performance and the work environment: a survey of registered nurses. J. Adv. Nurs. 67 (6), 1370–1382.
Baron, R.M., Kenny, D.A., 1986. The moderator–mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. J. Pers. Soc. Psychol. 51 (6), 1173.
Bazazan, A., Rasoulzadeh, Y., Dianat, I., Safaiyan, A., Mombeini, Z., Shiravand, E., 2014. Demographic factors and their relation to fatigue and mental disorders in 12-h petrochemical shift workers. Health Promot. Perspect. 4 (2), 165.
Bing Yip, Y., 2001. A study of work stress, patient handling activities and the risk of low back pain among nurses in Hong Kong. J. Adv. Nurs. 36 (6), 794–804.
De Martino, M.M.F., Abreu, A.C.B., Barbosa, M.F.D.S., Teixeira, J.E.M., 2013. The relationship between shift work and sleep patterns in nurses. Ciência saúde coletiva 18 (3), 763–768.
Dianat, I., Sedghi, A., Bagherzade, J., Jafarabadi, M.A., Stedmon, A.W., 2013. Objective and subjective assessments of lighting in a hospital setting: implications for health, safety and performance. Ergonomics 56 (10), 1535–1545.
Gaba, D.M., Howard, S.K., 2002. Fatigue among clinicians and the safety of patients. New Engl. J. Med. 347 (16), 1249–1255.
Garrett, C., 2008. The effect of nurse staffing patterns on medical errors and nurse burnout. AORN J. 87 (6), 1191–1204.
Geiger-Brown, J., Rogers, V.E., Trinkoff, A.M., Kane, R.L., Bausell, R.B., Scharf, S.M., 2012. Sleep, sleepiness, fatigue, and performance of 12-h-shift nurses. Chronobiol. Int. 29 (2), 211–219.
Goldberg, D., Williams, P., 1988. A User's Guide to the General Health Questionnaire. Nfer-nelson, Windsor Medical complications (if any) B 2.
Group, T.W., 1998. The world health organization quality of life assessment (whoqol): development and general psychometric properties. Soc. Sci. Med. 46 (12), 1569–1585.
Hamaideh, S.H., 2011. Occupational stress, social support, and quality of life among Jordanian mental health nurses. Issues Ment. Health Nurs. 33 (1), 15–23.
Hancock, P., Drury, C., 2011. Does human factors/ergonomics contribute to the quality of life? Theor. Issues Ergon. Sci. 12 (5), 416–426.
Harper, A., 1998. Development of the world health organisation whoqol-bref quality of life assessment. Psychol. Med. 28 (3), 551–558.
Hooper, C., Craig, J., Janvrin, D.R., Wetsel, M.A., Reimels, E., 2010. Compassion satisfaction, burnout, and compassion fatigue among emergency nurses compared with nurses in other selected inpatient specialties. J. Emerg. Nurs. 36 (5), 420–427.
Josten, E.J., Thierry, H., 2003. The effects of extended workdays on fatigue, health, performance and satisfaction in nursing. J. Adv. Nurs. 44 (6), 643–652.
Lajoie, P., Aronson, K., Day, A., Tranmer, J., 2015. A cross-sectional study of shift work, sleep quality and cardiometabolic risk in female hospital employees. BMJ Open 5 (3), e007327.
Lin, J.-M.S., Brimmer, D.J., Maloney, E.M., Nyarko, E., Belue, R., Reeves, W.C., 2009. Further validation of the multidimensional fatigue inventory in a us adult population sample. Popul. Health Metr. 7 (1), 1.
Mansour, A., Riad, W., Moussa, A., 2010. The occupational fatigue in anesthesiologists: illusion or real? Middle East J. Anaesthesiol. 20 (4), 529–534.
Montazeri, A., Harirchi, A.M., Shariati, M., Garmaroudi, G., Ebadi, M., Fateh, A., 2003. The 12-item general health questionnaire (ghq-12): translation and validation study of the Iranian version. Health Qual. Life Outcomes 1 (1), 1.
Muthén, L.K., Muthén, B.O., 2011. Mplus User's Guide, 6th ed. Muthén & Muthén, Los Angeles, CA.
Nedjat, S., Montazeri, A., Holakouie, K., Mohammad, K., Majdzadeh, R., 2008. Psychometric properties of the iranian interview-administered version of the World Health Organization's quality of life questionnaire (whoqol-bref): a population-based study. BMC Health Serv. Res. 8 (1), 1.
Parhizi, S., Steege, L.M., Pasupathy, K.S., 2013. Mining the relationships between psychosocial factors and fatigue dimensions among registered nurses. Int. J. Ind. Ergon. 43 (1), 82–90.
Preacher, K.J., Hayes, A.F., 2004. Spss and sas procedures for estimating indirect effects in simple mediation models. Behav. Res. Methods Instrum. Comput. 36 (4), 717–731.
Preacher, K.J., Hayes, A.F., 2008. Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behav. Res. Methods 40 (3), 879–891.
Raftopoulos, V., Charalambous, A., Talias, M., 2012. The factors associated with the burnout syndrome and fatigue in cypriot nurses: a census report. BMC Public Health 12 (1), 1.
Rasoulzadeh, Y., Bazazan, A., Safaiyan, A., Dianat, I., 2015. Fatigue and psychological distress: a case study among shift workers of an Iranian petrochemical plant, during 2013, in Bushehr. Iran. Red Crescent Med. J. 17 (10).
Schwarz, R., Krauss, O., Hinz, A., 2003. Fatigue in the general population. Oncol. Res. Treat. 26 (2), 140–144.
Shao, M.F., Chou, Y.C., Yeh, M.Y., Tzeng, W.C., 2010. Sleep quality and quality of life in female shift-working nurses. J. Adv. Nurs. 66 (7), 1565–1572.
Shen, J., Barbera, J., Shapiro, C.M., 2006. Distinguishing sleepiness and fatigue: focus on definition and measurement. Sleep Med. Rev. 10 (1), 63–76.
Smets, E., Garssen, B., Bonke, B.D., De Haes, J., 1995. The multidimensional fatigue inventory (mfi) psychometric qualities of an instrument to assess fatigue. J. Psychosom. Res. 39 (3), 315–325.
Sörensen, L.E., Pekkonen, M.M., Männikkö, K.H., Louhevaara, V.A., Smolander, J., Alén, M.J., 2008. Associations between work ability, health-related quality of life, physical activity and fitness among middle-aged men. Appl. Ergon. 39 (6), 786–791.
Su, J.A., Weng, H.H., Tsang, H.Y., Wu, J.L., 2009. Mental health and quality of life among doctors, nurses and other hospital staff. Stress Health 25 (5), 423–430.
Suzuki, K., Ohida, T., Kaneita, Y., Yokoyama, E., Miyake, T., Harano, S., Yagi, Y., Ibuka, E., Kaneko, A., Tsutsui, T., 2004. Mental health status, shift work, and occupational accidents among hospital nurses in Japan. J. Occup. Health 46 (6), 448–454.
Trinkoff, A.M., Storr, C.L., Lipscomb, J.A., 2001. Physically demanding work and inadequate sleep, pain medication use, and absenteeism in registered nurses. J. Occup. Environ. Med. 43 (4), 355–363.
Tzeng, D.-S., Chung, W.-C., Fan, P.-L., Lung, F.-W., Yang, C.-Y., 2009. Psychological morbidity, quality of life and their correlations among military health care workers in Taiwan. Ind. Health 47 (6), 626–634.
Yoder, E.A., 2010. Compassion fatigue in nurses. Appl. Nurs. Res. 23 (4), 191–197.