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ORIGINAL ARTICLE

Work-related fatigue among medical personnel in Taiwan

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Background/Purpose: Work-related fatigue among medical personnel is a major concern for patient safety, however heavy on-call duty is common in many hospitals. The purpose of this study was to investigate the prevalence of self-reported work-related fatigue and its associated factors.

Methods: A cross-sectional survey of 1833 participants was conducted in two hospitals in Taipei City, Taiwan, using a self-administered questionnaire. Participants reported their demographic characteristics, health-related behavior, health status and symptoms, and work-related fatigue during the past 3 months.

Results: The prevalence of work-related fatigue among the 1833 participants was 30.9%. Younger participants (20–29 years old) were more likely to report work-related fatigue than older participants (40–65 years old) [adjusted odds ratio (aOR) = 1.55, 95% confidence interval (CI) = 1.18–2.01]. Physicians, nurses, and medical technicians were more likely to report work-related fatigue symptoms than administrative personnel (aOR = 2.30, 95% CI = 1.57–2.79; aOR = 2.83, 95% CI = 1.87–3.99; and aOR = 2.01, 95% CI = 1.12–3.06, respectively). Those who drank coffee more than five times a week were more likely to report work-related fatigue than those who did not drink coffee at all (aOR = 2.53, 95% CI = 1.25–1.93). Participants with

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poor and very poor self-reported health were more likely to report work-related fatigue (aOR = 1.80, 95% CI = 1.26–2.38) than those who reported that their health was fair, good, or very good.
Conclusion: We identified factors associated with work-related fatigue among hospital workers in Taipei City. These findings can be applied toward on-the-job training and the development of preventive measures for occupational safety in general hospitals.

Introduction

Work-related fatigue is a common complaint encountered at the workplace. Prevalence has been reported to vary from <10% to >40%.[1–5] There is increasing recognition that fatigue is a risk factor for workplace injuries and illness,[6–12] with some studies mentioning fatigue as a predictor of sickness absence.[2,13,14] The most serious condition among work-related fatigue outcomes is "Karoshi", which is now considered to be a significant occupational hazard and is recognized as a legislative occupational disease in Japan, Korea, and Taiwan.[15] In Taiwan, healthcare professionals were ranked as the third most overworked, with those suffering from fatigue estimated to be at 2.1 times the risk of their non-fatigued co-workers to suffer from an occupational injury, and at 2.9 times the risk to be on leave for disability.[16]

In addition to their own personal safety, fatigue among employees in the service sector is also a major concern for their clients. This is especially the case for drivers and healthcare workers, who are responsible for the safety of those they provide services to. Previous studies investigating this association among medical personnel have linked fatigue with diminished professional performance, increases in medical errors, and reduced patient safety.[7,17–19]

While the causes of work-related fatigue among medical personnel include sleep deprivation, long work hours, and extended-duration work shifts,[8,20,21] perpetual healthcare staff shortages in Taiwan have made such work conditions difficult to avoid. This has contributed to the current situation, in which many trainees work >80 hours a week, and working 100 to 120 hours a week is not uncommon among residents and interns.[22,23]

Three nationwide random sampling surveys were conducted among the general population of Taiwan in 2010, 2011, and 2012. The results indicated that there is a growing trend in fatigue in the workplace, with the prevalence of fatigue growing from 27.5% in 2010, to 28.9% in 2011, and 33.2% in 2012.[24] However, to date, no study has investigated the prevalence of fatigue among healthcare professionals in Taiwan. On account of the hazards associated with fatigue among healthcare professionals, who represent an overworked and high risk group for fatigue themselves, this study set out to provide an estimate of the prevalence of fatigue in this population, as well as to better elucidate some of its associated factors.

Although there is no single standard method to measure fatigue, it has been demonstrated that single-item fatigue measures offer a valid way to assess daily fatigue.[25] This study, therefore, was designed as a pilot study utilizing a single-item work-related fatigue measure to investigate several potentially fatigue-associated factors among medical personnel in Taiwan.

Methods

Study design and settings

During 2004, a cross-sectional study with a purposive sampling strategy was conducted. We chose two city hospitals in Taipei City, Taiwan as the target study sites. One of these hospitals was a medical center hospital and one was a regional hospital. Both chosen hospitals had more than 800 beds. All of the employees in both hospitals were eligible to participate in the survey. Participation in this study was voluntary and written informed consent was obtained from all participants. The hard copy questionnaires were allocated to the department secretaries of both hospitals, who then distributed them to the employees through the departmental mail system. After completing their questionnaires, the employees were instructed to return them to their individual department mail boxes. The completed questionnaires were collected from the employees' mailboxes 1 week following their distribution. The response rate was 66.0% ($n = 2135$).

Thirty volunteers joined the questionnaire pre-test, and several clinical and public health experts were invited to validate the pre-test contents. We selected four major categories of medical personnel ($n = 1833$), including physicians, nurses, medical technicians and administrative personnel for data analysis. The medical technician category included pharmacists, medical examiners, medical radiological personnel, nutritionists, physiotherapists, and occupational therapists. This effectively excluded hospital blue collar workers such as personal care takers, housekeepers, and laborers.

Study measures

The survey instrument was a self-administered questionnaire designed by the research team. It included three major parts: demographic characteristics, health-related behavior, and self-rated health status and symptoms. We determined work-related fatigue by using a single item, measuring the frequency of its occurrence. Correlation patterns and multivariate analysis revealed a strong and significant association between the single-item measure and the other scale analysis.[3,25] In our study, the outcome variable "perceived work-related fatigue status" was evaluated by self-report over the preceding 3 months. The participants were asked "With what frequency have you felt fatigue over the past 3 months?" with the response options consisting of "never", "rarely", "sometimes",

"often", and "always" on a Likert-type five-point scale. The participants were also required to identify if their perceived fatigue was work-related. It was defined as positive when it was reported as occurring sometimes, often, or always. They were further asked "Do you feel there is a relationship between your job and the above-mentioned fatigue symptom?" with response options of "no relationship", "possibly related", "quite related" and "I don't know". Fatigue symptom was defined as work-related when it was reported as "possibly related" and "quite related" with their jobs.

The survey also included questions regarding demographic characteristics, like age, gender, education level, job category, and working experience in a hospital. The health-related behavior included questions about regular exercise, drinking coffee more than once a week, and current smoking status. Participants were asked "In the past 3 months, with what frequency have you exercised each week?" with response options of "none", "one to two times per week", and "more than three times per week". Participants were asked "Have you drunk coffee at least once per week over the course of the past 3 months?" with response options of "none", "one to four times per week", and "five to fourteen times per week". The participants were also asked "Have you smoked regularly over the past 3 months?" with response options of "yes" and "no".

The self-reported health status and symptoms included questions such as self-reported health, headache, concentration difficulties, and sleepiness. These symptoms were also described using a five-point scale. The above symptoms were defined as positive when they were reported as occurring sometimes, often, or always.

Statistical analyses

The outcome variable of interest was the dichotomous variable "having work-related fatigue symptom" and "not having work-related fatigue symptom". "Having work-related fatigue symptom" was considered positive when it was reported as occurring sometimes, often, and always. We computed the frequency distributions for all variables. Cronbach's alpha was used to determine the internal consistency of the various measures in 30 individuals ($\alpha = 0.79$, $p < 0.01$). We first analyzed potential predictive factors by bivariate analysis, followed by multivariate logistic regression (SPSS for Windows version 17.0; SPSS Inc., Chicago, IL, USA). Statistical significance was set when p was <0.05. The independent variables were selected in the final model if they were either statistically significant in bivariate analysis, or if they had been demonstrated elsewhere to be significant predictors. The statistical significance of each interaction term was tested in multivariate regression models and retained if p was <0.05. The OR and 95% CI were also calculated.

Results

Distribution of participants' characteristics and associated factors

A total of 2135 employees participated in this self-administered questionnaire survey, with a response rate of 66.0%. After excluding blue collar hospitals workers, a total of 1833 participants were selected for data analysis. The prevalence of experiencing worked-related fatigue symptoms was 30.9%. Among the study participants, 38.2% were staff younger than 30 years old, 27.7% were between 30 years old and 39 years old, and 34.1% were over 40 years old. The mean age of these participants was 35.6 years (SD = 11.0); 81.5% were female and 18.5% were male. Among the participants, 31.9% had university or higher level educations. Of the total study sample, 50.1% were nurses, 9.6% were physicians, 27.8% were administrative personnel, and 12.5% were medical technicians. Among them, 37.5% were junior staff with <3 years of working experience, 21.2% were staff with between 4 and 6 years of working experience, 11.2% were staff with 7—9 years of experience, and 30.1% were staff with >10 years of working experience. The average term of hospital employment was 8.4 years (SD = 7.1).

Among the study participants, 55.9% had not exercised regularly in the 3 months preceding the administration of the questionnaire; 38.2% had exercised one to two times per week, and only 5.9% had reported exercising more than three times per week. Of the total, 54.2% reported not consuming coffee, while 26.1% reported drinking coffee five to fourteen times per week. Only 8.3% of the participants were current smokers. Of the total study sample, 82.7% of the participants reported that their health was fair, good, or very good. Headache symptoms were noted among 49.3% of the participants, 38.5% had concentration difficulties, and 35.2% reported being sleepy (Table 1).

Self-reported work-related fatigue symptoms

Among the 1833 staff members analyzed in this study, 566 (30.9%) reported experiencing work-related fatigue in the 3 months preceding the administration of the questionnaire. In general, we found that several predictive factors (such as age, job category, working experience in a hospital, exercise, drinking coffee more than 5 times a week, being a current smoker, self-reported health, having headache symptoms, experiencing concentration difficulties and sleepiness) were associated with the prevalence of work-related fatigue symptoms in the univariate logistic regression model ($p < 0.05$, Table 1).

A high correlation was found between headache and concentration difficulties (r = 0.69), hence, the variable "headache" was excluded from the multivariate analysis, due to multicollinearity. Furthermore, the association between work-related fatigue symptoms and several associated variables was analyzed by multiple logistic regression (Table 2). The participants aged 20—29 years old reported a higher prevalence of work-related fatigue than those aged 40—65 years old (aOR = 1.55, 95% CI = 1.18—2.01). Physicians, nurses, and medical technicians had a higher prevalence of work-related fatigue symptoms than administrative personnel (aOR = 2.30, 95% CI = 1.57—2.79; aOR = 2.83, 95% CI = 1.87—3.99; and aOR = 2.01, 95% CI = 1.12—3.06, respectively). Those drinking coffee more than five times a week reported a higher prevalence of work-related fatigue symptoms (aOR = 2.53, 95% CI = 1.25—1.93) than those

Table 1 Participants' characteristics by having work-related fatigue symptoms.

Characteristics	Total, *n* (%)	Having work-related fatigue symptoms		Unadjusted OR (95% CI)	*p*
		Yes, *n* (%)	No, *n* (%)		
Total subjects	1833 (100.0)	566 (30.9)	1267 (69.1)		
Demographic factors					
Age (y)					
20–29	700 (38.2)	237 (41.9)	463 (36.5)	1.35 (1.07–1.71)	0.013
30–39	508 (27.7)	157 (27.7)	351 (27.7)	1.18 (0.91–1.52)	0.212
≥40	625 (34.1)	172 (30.4)	453 (35.8)	1.00	
Gender					
Female	1494 (81.5)	461 (81.4)	1033 (81.5)	1.01 (0.78–1.30)	0.967
Male	339 (18.5)	105 (18.6)	234 (18.5)	1.00	
Education					
Junior college or under	1249 (68.1)	379 (67.0)	870 (68.7)	1.08 (0.87–1.34)	0.498
University or graduate school	584 (31.9)	187 (33.0)	397 (31.3)	1.00	
Job category					
Physician	176 (9.6)	50 (8.8)	126 (9.9)	1.81 (1.27–2.57)	0.026
Nurse	919 (50.1)	341 (60.3)	157 (12.4)	2.33 (1.80–3.00)	<0.001
Medical technician	229 (12.5)	72 (12.7)	578 (45.6)	1.56 (1.06–2.32)	0.001
Administrative personnel	509 (27.8)	103 (18.2)	406 (32.1)	1.00	
Working years in the hospitals					
≤ 3	688 (37.5)	220 (38.9)	468 (36.9)	1.34 (1.05–1.72)	0.021
4–6	389 (21.2)	137 (24.2)	252 (19.9)	1.55 (1.17–2.06)	0.002
7–9	205 (11.2)	66 (11.7)	139 (11.0)	1.36 (0.96–1.92)	0.089
≥ 10	551 (30.1)	143 (25.2)	408 (32.2)	1.00	
Health-related behavior					
Exercise (≥30 min per session)					
None	1025 (55.9)	320 (56.5)	705 (55.6)	2.11 (1.30–3.41)	0.002
1–2 times per wk	700 (38.2)	224 (39.6)	476 (37.6)	2.09 (1.28–3.40)	0.003
≥ 3 times per wk	108 (5.9)	22 (3.9)	86 (6.8)	1.00	
Coffee consumption					
5–14 times per wk	478 (26.1)	162 (28.6)	320 (25.3)	2.80 (1.24–4.63)	<0.001
1–4 times per wk	362 (19.7)	135 (23.9)	223 (17.6)	1.63 (0.83–2.36)	0.072
None	993 (54.2)	269 (47.5)	724 (57.1)	1.00	
Current smoker					
Yes	152 (8.3)	27 (4.8)	125 (9.9)	1.68 (0.99–2.86)	0.057
No	1681 (91.7)	539 (95.2)	1142 (90.1)	1.00	
Health status and symptoms					
Self-reported health					
Poor/very poor	317 (17.3)	160 (28.3)	157 (12.4)	2.79 (2.18–3.57)	<0.001
Fair/good/very good	1516 (82.7)	406 (71.7)	1110 (87.6)	1.00	
Having headache symptom					
Sometimes/often/always	903 (49.3)	408 (72.1)	495 (39.1)	4.03 (3.25–5.00)	<0.001
None/seldom	930 (50.7)	158 (27.9)	772 (60.9)	1.00	
Concentration difficulties					
Sometimes/often/always	706 (38.5)	346 (61.1)	360 (28.4)	3.96 (3.22–4.88)	<0.001
None/seldom	1127 (61.5)	220 (38.9)	907 (71.6)	1.00	
Sleepiness					
Sometimes/often/always	645 (35.2)	325 (57.4)	320 (25.3)	3.99 (3.24–4.92)	<0.001
None/seldom	1188 (64.8)	241 (42.6)	947 (74.7)	1.00	

CI = confidence interval; OR = odds ratio.

who did not drink coffee. Participants with poor and very poor self-reported health were more likely to report work-related fatigue (aOR = 1.80, 95% CI = 1.26–2.38) than those with fair, good, or very good self-reported health. Those experiencing concentration difficulties (aOR = 2.43, 95% CI = 1.80–3.05) and sleepiness (aOR = 3.20, 95% CI = 2.30–3.83) were also more likely to report work-related fatigue when compared with those who did not note experiencing the above symptoms.

Table 2 Multiple logistic regression of having work-related fatigue symptoms.

Characteristics	Adjusted OR (95% CI)	*p*
Demographic factors		
Age (y)		
20–29	1.55 (1.18–2.01)	0.001
30–39	1.01 (0.73–1.33)	0.977
≥40	1.00	
Gender		
Female	1.09 (0.81–1.45)	0.567
Male	1.00	
Job category		
Physician	2.30 (1.57–2.79)	<0.001
Nurse	2.83 (1.87–3.99)	<0.001
Medical technician	2.01 (1.12–3.06)	0.002
Administrative personnel	1.00	
Health-related behavior		
Exercise (≥30 min per time)		
None	1.73 (0.99–2.97)	0.061
1–2 times per wk	1.46 (0.85–2.48)	0.178
≥ 3 times per wk	1.00	
Coffee consumption		
5–14 times per wk	2.53 (1.25–1.93)	<0.001
1–4 times per wk	1.80 (0.77–4.31)	0.192
None	1.00	
Health status and symptoms		
Self-reported health		
Poor/very poor	1.80 (1.26–2.38)	<0.001
Fair/good/very good	1.00	
Concentration difficulties		
Sometimes/often/always	2.43 (1.80–3.05)	<0.001
None/seldom	1.00	
Sleepiness		
Sometimes/often/always	3.20 (2.30–3.83)	<0.001
None/seldom	1.00	

CI = confidence interval; OR = odds ratio.

Discussion

In this study, we found 28.4% of physicians, 37.1% of nurses, 31.4% of medical technicians, and 20.2% of administrative personnel to experience fatigue. When compared with administrative personnel, the aOR for fatigue among physicians, nurses, and medical technicians was 2.30, 2.83, and 2.01, respectively. Both individuals with less professional experience and those with lower self-reported health were also significantly more likely to experience fatigue. Frequent sleepiness and concentration difficulties were significantly associated with self-reported work-related fatigue. Participants who consumed more coffee complained of more frequent fatigue occurrence than those who reported consuming less coffee. In particular, those who reported drinking coffee more than five times per week were more likely to report fatigue than those who never drank coffee.

Although it is difficult to present a unique definition of fatigue,[26] it has been defined as "an experience of tiredness, dislike of present activities, and unwillingness to continue".[3,27] In general, fatigue is considered to be related to physiological, subjective, and behavioral processes in response to excessive demands and insufficient recovery.[28] Therefore, a single-item subjective fatigue measure may be an alternative indicator of total fatigue.

The prevalence of work-related fatigue among healthcare professionals in our study (30.9%), was greater than the prevalence of work-related fatigue (22.0%) detected by a separate nationwide survey (n = 17,321) conducted by the Institute of Occupational Safety and Health (IOSH), investigating employees' perceptions regarding safety and health in the workplace.[29] As the IOSH survey was administered in the same year as the present study, and utilized a work-related fatigue item similar to the one used in the present investigation, it is very likely that the difference in the abovementioned figures represent a true disparity in work-related fatigue between healthcare professionals and other workers in Taiwan.

The prevalence of work-related fatigue in this study also fits within the range of values in the literature detected by prior studies conducted outside of Taiwan, which reported prevalence rates ranging from <10% to >40%.[1–5] Whereas the variance in the prevalence rates reported by previous studies was explained as largely stemming from methodological differences, like the instruments and cut-off points used,[1,9,30–32] there may be reason to believe that regional and cultural differences contribute to this variance. For example, the prevalence of fatigue has been noted to vary substantially from country to country. In Norway, the Netherlands, and the UK, fatigue was reported among 22%, 25%, and 38%, respectively, of the general population.[33–35] Although several similar investigations have been conducted in Taiwan, none have specifically targeted healthcare professionals.

In this study, physicians, nurses, and medical technicians had a higher prevalence of work-related fatigue than administrative personnel. One possible reason may involve the inclusion of overtime work hours and shift-work as a normal state of working for physicians, nurses, and other medical personnel. The importance of these results needs to be seen in light of the magnitude of the issue. In Taiwan, there are over 210,000 medical personnel.[36] Furthermore, 73% of Taiwanese physicians and 67% of Taiwanese nurses are either shift workers or are on-call at night.[37] According to Labor Standards Act Article 30 in Taiwan, a worker shall not have regular working time in excess of 8 hours a day and 84 hours every 2 weeks.[38] Physicians in Taiwanese teaching hospitals average over 80-hour workweeks[39] and are still expected to provide a high quality of medical services, despite heavy workloads. Resident overtime work hours, which result in sleep deprivation and fatigue, have become an important issue in many countries.[40] Sleep loss, interrupted sleep, and irregular sleep cycles are generally common for residents worldwide. Sleep deprivation leads to fatigue, which impairs mood as well as cognitive and performance skills; this results in diminished workplace performance, particularly for tasks that are dependent on a high level of vigilance, fine motor cooperation, or newly learned procedural skills.[11] Studies show that fatigue and sleepiness not only put patient safety at risk, but also increase the prevalence of traffic and needlestick accidents among health professionals themselves.[8,19] Thus, there are

calls from the USA, the UK, and European countries for reductions in resident work hours to reduce medical errors and promote patient and doctor safety.[41]

In this study, the participants who reported higher weekly coffee consumption also reported greater fatigue prevalence than those who drank less coffee. Other studies had suggested that excess caffeine ingestion not only reduces the brain's vitality, but also deepens fatigue.[42,43] Coffee is a widely consumed beverage that many adults drink regularly. It contains caffeine, which has stimulatory effects on the central nervous system. These effects are predominantly caused by an antagonistic action on adenosine receptors. Caffeine increases the levels of several neurotransmitters, like acetylcholine, dopamine, and serotonin. In daily life, caffeine is used to suppress feelings of fatigue. Between 15 and 45 minutes after coffee consumption, subjective feelings, like alertness, energy, and concentration often improve, and this effect can last from 4 to 6 hours.[44] Adenosine is important for sleeping, especially deep sleeping. Caffeine binds to adenosine receptors in the brain. The half-life of caffeine binding to adenosine receptors is about 6 hours; if a person consumes a large cup of coffee containing 200 mg of caffeine at 3:00 PM, then by 9:00 PM approximately 100 mg of that caffeine is still present *in vivo*. Medical personnel may be able to sleep, but will not reap the benefits of deep sleep. Hence, while caffeine can stall the hormone adenosine, causing short-term alertness, in the long-term it is responsible for accumulating sleep debt by interfering with sleep quality.[45,46] By contrast, however, it is also very likely that these results are an artifact of reverse causation. The cause and effect relationship is difficult to tease apart, as healthcare professionals who experience greater fatigue are more likely to drink more coffee to increase their alertness and battle their fatigue-related symptoms.

While this study did detect a significant relationship between exercise and fatigue in the univariate model, this association failed to achieve significance in the multivariate analysis. We feel that the most likely explanation for this phenomenon was the small number of individuals who exercised regularly and the consequent lack of statistical power.

On account of the lack of a standardized methodology to define fatigue, this pilot study also intended to build on previous research demonstrating the validity of single-item fatigue measures in assessing fatigue.[26] In our multivariate model, we demonstrated strong associations between the single-item fatigue measure used in this study and sleepiness (aOR = 3.20), concentration difficulties (aOR = 2.43), and self-reported health (aOR = 1.80). We feel that these findings demonstrate convergent validity between the single-item fatigue measure used in this study and other theoretically related concepts included in our analysis.

Limitations

The results of this study need to be viewed with regard to several limitations. First, the cross-sectional design of this study prevented us from interpreting a causal relationship between fatigue and the factors of interest. Second, this study did not utilize a validated fatigue measure, like the "Fatigue Assessment Scale", "Fatigue Scale", or "Need for Recovery Scale".[3] Third, we did not have access to work schedule records, but instead used seniority in the workplace as a proxy for working hours. This should stand as a reliable proxy, as greater seniority in Taiwanese hospitals is associated with more stable work hours. Fourth, one prior study conducted in Taiwan has demonstrated the prevalence of psychiatric morbidity to be high among medical personnel.[47] As this study was unable to adjust for psychiatric factors, it is possible that such factors had an influence on the associations detected in this pilot study. Therefore, future investigations on fatigue among medical personnel should be conducted that are cognizant of psychiatric factors. Fifth, the hospitals from which we sourced our study participants for this investigation were not randomly selected. This may have introduced a selection bias and hampered the extrapolation of these results to other hospitals. Therefore, future research aimed at building on the results of this pilot study should employ random sampling strategies, to achieve results with greater external validity. Finally, prior research has demonstrated that shift work and extended work hours are associated with poor health behavior, like an improper diet and excessive alcohol consumption.[48–50] These associations will need to be addressed in future investigations to better evaluate the magnitude of contribution that these factors have on fatigue among medical personnel.

Conclusion

This study found the prevalence of work-related fatigue symptoms among healthcare professionals to be 30.9%. With efforts aimed at combating the increases in medical errors and accidents associated with work-related fatigue among healthcare professionals, North American and European countries have begun to stipulate increasingly stringent regulations limiting the work hours of residents.[51,52] The results of this study highlight that fatigue among healthcare professionals is also a problem in Taiwan, and is a topic that warrants both future study and the consideration of policy intervention.

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