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Exploring the impact of 12-hour shifts on nurse fatigue in intensive care units

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ABSTRACT

Aim: To assess 12-h shift Intensive Care Unit (ICU) nurses' fatigue and identify the associated demographic factors.
Background: Literature reveals inconsistencies as to whether 12-h shifts decrease or increase nurse fatigue levels.
Methods: A cross-sectional survey of 67 ICU nurses working 12-h shifts was undertaken to determine their fatigue levels in two hospitals. The Occupational Fatigue Exhaustion/Recovery Scale (OFER), Spearman's correlation, ANOVA, *t*-tests, and Chi-Square were used for analyses.
Results: 57 out of 67 participants experienced low to moderate chronic fatigue; 36 of those exhibited low to moderate acute fatigue levels; 46 reported low to moderate inter-shift fatigue. Age ($\rho = 0.03$, $r^2 = -0.28$), number of family dependents ($\rho = 0.03$, $r^2 = -0.27$), and years of nursing experience ($\rho = 0.03$, $r^2 = -0.27$) were moderately negatively correlated with acute fatigue, while frequency of exercise per week ($\rho = 0.01$, $r^2 = -0.31$) was moderately negatively correlated with chronic fatigue. Hospital A had higher chronic fatigue levels than Hospital B. Age ($\rho < 0.01$), age group ($\rho = 0.03$), shift schedule ($\rho = 0.02$), and nursing experience ($\rho = 0.03$) were significantly related to the difference in chronic fatigue levels between the two hospitals.
Conclusions: More than half of the 12-h shift ICU nurses studied in both hospitals had low to moderate fatigue levels. Age, number of family dependents, years of nursing experience, and frequency of exercise per week were identified as key factors associated with fatigue. The difference in chronic fatigue levels between hospitals suggests that implementing more support for younger and/or less experienced nurses, better strategies for retaining more experienced nurses, and fewer rotating shifts could help reduce fatigue.

1. Background

Shift work has been found to disturb circadian rhythms, which led to sleep debt and increased fatigue levels, thereby impairing nurses' health and work performance (Barker & Nussbaum, 2011; Saksvik-Lehouillier, Bjorvatn, Hetland, et al., 2013). Sleep debt, also known as sleep deficit, refers to cumulatively insufficient sleep (American Sleep Association, 2019) that may lead to unhealthy physical or mental outcomes such as increased fatigue levels, weight gain, heart disease, or even memory loss (Harvard Medical School, 2007). Since 12-h shifts were introduced in the 1980's (predominately due to financial reasons), they have become the shift of choice for many nurses because of increased days off between shifts (National Nursing Research Unit, 2013). Studies found that long work hours exposed nurses to a higher risk of developing mental or physical fatigue and increased stress levels (Estryn-Béhar, Van der Heijden, et al., 2012; Hopcia, Dennerlein, Hashimoto, et al., 2012; Matheson, O'Brien, & Reid, 2014). Sleep debt, shift schedules, heavy workload, and lack of social support have been identified as key factors in association with 12-h shift nurse fatigue in literature.

Evidence has shown that increased fatigue levels during 12-h shifts were associated with sleep debt. A study surveyed 605 intensive care nurses in America and identified that nurses experienced sleep deprivation and insufficient inter-shift recovery (Scott, Arslanian-Engoren, & Engoren, 2014). Inter-shift refers to an interim period between consecutive shifts, and inter-shift recovery means the time taken by nurses to recuperate between work shifts (Winwood, Winefield, Dawson, et al., 2005). Insufficient inter-shift sleep and recovery increased the

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possibility of misjudgements, such as medication errors or incorrect clinical decisions, while nurses worked 12-h shifts (Scott et al., 2014). This finding was in line with the studies by Geiger-Brown and colleagues. In 2012, they studied the fatigue levels of 80 medical, surgical and critical care nurses working either day, night or inter-shifts over a three-day period in a large hospital. In 2014, they assessed the sleepiness of 40 nurses working 12-h night shifts over four weeks. These two studies concluded that a large sleep debt exacerbated the fatigue levels of nurses working 12-h shifts, endangering themselves and patients (Geiger-Brown, Rogers, Trinkoff, et al., 2012; Geiger-Brown, Wieroney, Blair, et al., 2014).

Evidence has also shown that nurses' fatigue levels were associated with shift schedules. Estryn-Béhar et al. analysed a large database, collated from 25,924 nurses in Europe in 2003 (Estryn-Béhar et al., 2012). The study found that, when compared to nurses working 8-h shifts, those working 12-h shifts exhibited higher burnout scores and lower index of work ability, which was mainly associated with shift schedules (Estryn-Béhar et al., 2012). Work ability is defined as an individual's ability to perform tasks and to meet the required skill and competency levels at work (Suleiman, 2017). Similarly, Han and colleagues studied 175 American full-time female 12-h shift nurses from medical, surgical and critical care units. The study found that nurses working variable and unpredictable shift patterns had higher fatigue levels, compared to those working regular fixed shifts (Han, Trinkoff, & Geiger-Brown, 2014).

More recent research has determined that increased fatigue levels were related to heavy workload. A study by Chen et al. monitored eight nurses' heart rates and recorded their 860 nursing activities during two consecutive 12-h shifts at a medical centre (Chen, Daraiseh, Davis, et al., 2014a). The study found heavy workloads that included bedside care, walking or standing, and manually handling patients were the main factors causing nurses' increased acute fatigue levels (Chen, Daraiseh, et al., 2014a). Furthermore, after conducting a cross-sectional survey on 130 nurses from three hospitals, Chen et al. concluded that younger nurses suffered higher acute fatigue levels due to increased work activities compared to older nurses after three consecutive 12-h day shifts (Chen, Davis, Daraiseh, et al., 2014b).

Previous studies have found that increased fatigue levels were related to lack of social support. A study surveyed 536 French nurses and healthcare assistants in Intensive Care Units (ICU) (Jones, Hocine, Salomon, et al., 2015). It identified that lack of social support increased staff stress levels, which worsened their fatigue and mitigated their work ability (Jones et al., 2015). Previous studies have also found that fatigue levels were linked to ethnicity. A study surveyed 18, 675 households and concluded that ethnicity was an important socio-demographic factor related to individuals' fatigue levels (Jason, Taylor, Kennedy, et al., 2000). However, there seems to be a sparsity of further current research related to nurse fatigue levels and ethnicity.

In contrast, some studies have identified that 12-h shifts reduced nurses' fatigue levels due to better quality downtime. A pilot study found that 8-h shifts, when compared to 12 h, showed an increase in commute times and number of days at work, and this exacerbated their fatigue levels (Martin, 2015). Another study surveyed 47 nurses working 12-h shifts in a post-anaesthesia care unit (PACU). The study found that nurses were able to sufficiently recover between shifts and did not suffer high fatigue levels (Hazzard, Johnson, Dordunoo, et al., 2013). Comparably, a study surveyed 805 nurses from 99 nursing units and concluded that nurses working 8-h shifts had more emotional exhaustion than those working 12-h shifts (Stone, Du, Cowell, et al., 2006). Similarly, other studies have reported improved quality time and reduced stress when undertaking 12-h shifts compared with 8-h shifts (Dwyer, Jamieson, Moxham, et al., 2007; Richardson, Turnock, Harris, et al., 2007).

Given these findings, it is clear that the impact of 12-h shifts on nurse fatigue is not consistent, this being supported by three recent systematic reviews. One review identified that there was not enough evidence to safely conclude whether 12-h shifts increased or decreased nurse fatigue (Harris, Sims, Parr, et al., 2015). The second review stated that nurse fatigue was associated with multiple factors comprising of work-related, personal, and organizational matters (Smith-Miller, Shaw-Kokot, Curro, et al., 2014). The third review concluded that 12-h shift nurses were at higher risk of making errors (Clendon & Gibbons, 2015).

The discussion above shows that literature on nurses working 12-h shifts has focused on studying the factors associated with fatigue, such as sleep debt, shift schedules, heavy workload, and lack of social support. Previously there has been a lack of research into whether nurses' fatigue is associated with key demographics in different clinical settings. Therefore, research is necessary to investigate the associations between nurse fatigue and important demographics. In New Zealand, it has been suggested that 12-h shifts should be discontinued due to the many risks and safety issues, such as medication errors and impaired nursing performance (Ferguson, 2013). This study aim was to assess the fatigue levels of 12-h shift ICU nurses and to identify any associated demographic factors. This could provide useful information on how to develop a supportive environment to reduce ICU nurse fatigue.

2. Research methods

2.1. Design

A cross-sectional survey was conducted on ICU nurses from two hospitals (Hospital A and Hospital B) in two different cities in New Zealand over three weeks during November 2015. The inclusion criteria for the study were (1) ICU registered nurse, (2) working 12-h shifts, and (3) working full-time (72 or 80 h fortnightly). The participants who worked at least three consecutive 12-h shifts per week provided more detailed information concerning the study's aim.

Hospital A and Hospital B are two of the largest tertiary teaching hospitals in New Zealand and provide specialised care to patients who are facing life-threatening situations, such as trauma, infection or major operations. There are 740 beds with around 8000 employees in Hospital A, and 670 beds with approximately 7850 staff in Hospital B. The ICU in Hospital A has 18 beds and specialises in caring for patients with severe burns and spinal injuries. The ICU in Hospital B has 16 beds and looks after critically unwell, injured, and post-cardiac surgical patients.

2.2. Sample

From the 112 distributed questionnaires, 85 were returned (76% response rate). A total of 18 of 85 respondents, who did not work full-time, were excluded from the study. Only 67 questionnaires (completed by 41 ICU nurses from Hospital A and 26 from Hospital B) met the inclusion criteria and were analysed in this study.

2.3. Instrumentation

This study used the validated Occupational Fatigue Exhaustion/Recovery (OFER) scale (Winwood et al., 2005) to assess the participants' fatigue levels. Unlike other measurement tools, the OFER scale differentiates between acute, chronic and inter-shift fatigue, which enables researchers to better understand fatigue levels of health workers. The validity and internal reliability of the OFER scale were initially tested on 770 nurses and then retested on 510 nurses in Australia in 2005 and 2006. The Crobach' alpha, at least 0.84, indicated that the OFER scale had a satisfied internal reliability, while the significant correlations between the scale and subscales revealed a strong construct validity (Winwood, Lushington, & Winefield, 2006a).

The OFER scale includes 15 statements using a 7-point Likert scale ranging from 0 (strongly disagree) to 6 (strongly agree). Of the 15 statements, the first five (1–5) assess participants' chronic fatigue and the next five (6–10) evaluate acute fatigue, while the final five (11–15)

determine inter-shift fatigue or recovery. The instrument uses the subscale scores of '0–25', '26–50', '51–75', and '76–100' to represent 'low', 'low/moderate', 'moderate/high', and 'high' fatigue levels respectively (Winwood et al., 2005).

The study assessed participants' chronic, acute, and inter-shift fatigue using the OFER scale, and an analysis of the OFER scores was used to identify the differences in fatigue levels in Hospital A and Hospital B. In addition, the study sought to explore any associations between demographic factors and fatigue. This was because the literature showed that the nurse fatigue levels were influenced by work-related, personal, and organizational factors (Harris et al., 2015). The demographic data collected included age, gender, relationship status, shift schedules (within a given month), ethnicity, number of family dependents, frequency of exercise per week, level of qualifications, and number of years of experience in general nursing, ICU and working 12-h shifts.

2.4. Procedures

The study was approved by the University of Auckland Human Participants Ethics Committee (UAHPEC) (reference number: 016043) and by participating hospitals. To recruit participants, an independent local investigator was nominated in each hospital to assist with advertising, distributing and collecting the research questionnaires. Participant information sheets were attached to the anonymous questionnaires. By completing and returning the questionnaires, participants were deemed to have consented to their information being used in the study. The research followed the ethical principles of veracity, justice, non-maleficence, beneficence and confidentiality (Moule & Goodman, 2014), and ensured that participants were not coerced into participating (Chater, 2011).

2.5. Analyses

Spearman's correlation was performed to identify the relationships between the three types of fatigue (chronic, acute, and inter-shift fatigue) and the demographic factors (age, age group, work hours fortnightly, number of family dependents, frequency of exercise per week, level of qualification, years of nursing experience, years of ICU experience, and years of working 12-h shifts). Analysis of variance (ANOVA) was used to identify any significant effects of the demographic factors (age, shift schedules in a typical month, frequency exercise per week, and years of nursing experience) on nurse fatigue.

T-tests and Chi-Square were used for comparisons between hospitals. Specifically, t-tests were carried out to determine the differences in the mean scores and counts for fatigue levels between two hospitals. They were also employed to compare the two hospitals' independent variables (age, years of nursing experience, years of ICU experience, and years of working 12-h shifts). Chi-Square tests were used for analysing independent variables (gender, relationship status, work hours fortnightly, shift schedules in a typical month, ethnicity, family dependents, frequency of exercise per week, and level of qualification) at the two hospitals. A p-value < 0.05 was the level of significance for this study. SPSS version 23 was used to analyse the collected data.

3. Results

The results were obtained after analysing a total of 67 returned questionnaires (41 from Hospital A and 26 from Hospital B). Baseline demographics for the 67 participants and comparisons between Hospital A and B (using t-tests and Chi-Square) are shown in Table 1. The following paragraphs report the 67 participants' demographic information, their fatigue levels and the associated factors from the total sample. The paragraphs also detail the differences in fatigue levels between the two hospitals and the related factors.

Table 1
Demographic information for Hospital A, B and the total sample.

Demographics		Hospital A	Hospital B	Hospital A + B	ρ value
Mean age (SD)		**35.7 (7.8)**	**42.1 (8.7)**	**38.0 (8.6)**	**< 0.01***
Number of participants N (%)		41 (61.2)	26 (38.8)	67 (100)	
*Age group	21-30 yrs	12 (30.0)	3 (13.0)	15 (23.8)	**0.03***
	31-40 yrs	17 (42.5)	8 (34.8)	25 (39.7)	
	41-50 yrs	8 (20.8)	7 (30.4)	15 (23.8)	
	51-60 yrs	3 (7.5)	5 (21.7)	8 (12.7)	
	Above 60 yrs	0	0	0	
Gender	Male	10 (25.0)	6 (23.1)	16 (23.9)	0.90
	Female	31 (75.0)	20 (76.9)	51 (76.1)	
Relationship status	Single	10 (23.7)	9 (39.1)	19 (30.7)	0.27
	Married	29 (76.3)	14 (60.9)	43 (69.4)	
Work hours fortnightly	80 h (FTE 1.0)	24 (58.5)	11 (42.3)	35 (52.2)	0.19
	72 h (FTE 0.9)	17 (41.5)	15 (57.7)	32 (47.8)	
*Shift schedules in a typical month	Mainly day shifts	5 (12.5)	8 (30.8)	13 (19.4)	**0.02***
	Mainly night shifts	6 (15.0)	8 (30.8)	14 (20.9)	
	Mixed day and night	30 (72.5)	10 (38.5)	40 (59.7)	
Ethnicity	European	14 (34.1)	19 (73.1)	33 (49.3)	0.05
	Maori	1 (2.5)	1 (3.9)	2 (3.0)	
	Pacific Islander	2 (5.0)	0	2 (3.0)	
	Chinese	3 (7.5)	1 (3.9)	4 (6.0)	
	South/East Asian	10 (25.0)	1 (3.9)	11 (16.4)	
	Indian	9 (22.5)	2 (7.7)	11 (16.4)	
	African	2 (2.5)	2 (7.7)	4 (6.0)	
	Middle Eastern	0	0	0	
Family dependents	0	22 (52.5)	13 (52.0)	35 (53.0)	0.55
	1	7 (15.5)	4 (16.0)	11 (16.7)	
	2	9 (22.5)	4 (16.0)	13 (19.7)	
	3	2 (5.0)	4 (16.0)	6 (9.1)	
	4	1 (2.5)	0	1 (1.5)	
Frequency of exercise per week	Never	2 (2.5)	0	2 (3.0)	0.51
	Occasionally	14(35.0)	6 (23.1)	20 (29.9)	
	Once	4 (10.0)	4 (15.4)	8 (11.9)	
	Twice	12 (30.0)	7 (26.9)	19 (28.4)	
	Three times or more	9 (22.5)	9 (34.6)	18 (26.9)	
Level of qualification	Bachelor/ Non-Bachelor	13 (32.5)	8 (30.8)	21 (31.3)	0.41
	PG. Certificate	13 (32.5)	9 (34.6)	22 (32.8)	
	PG. Diploma	14 (32.5)	9 (23.1)	20 (29.9)	
	Master's	1 (2.5)	3 (11.5)	4 (5.9)	
	PhD	0	0	0	
*Years of nursing experience	Below 2	1 (2.5)	0	1 (1.5)	**0.03***
	2 to 5	15 (12.5)	1 (3.9)	6 (9.0)	
	6 to 10	18 (45.0)	8 (30.8)	26 (38.8)	
	11 to 15	7 (17.5)	6 (23.1)	13 (19.4)	
	16 to 20	5 (10.0)	4 (15.4)	9 (13.4)	
	20 +	5 (12.5)	7 (26.9)	12 (17.9)	
Years of ICU experience	Below 2	5 (12.5)	1 (3.9)	6 (9.0)	0.13
	2 to 5	8 (20.0)	7 (26.9)	15 (22.4)	
	6–10	19 (47.5)	10 (38.5)	29 (43.3)	
	11 to 15	8 (17.5)	2 (7.7)	10 (14.9)	
	16 to 20	1 (2.5)	5 (19.2)	6 (9.0)	
	20 +	0	1 (3.9)	1(1.5)	
Years of working 12 h shifts	Below 2	1 (2.5)	1 (3.9)	2 (3.0)	0.56
	2 to 5	13 (32.5)	11 (42.3)	24 (35.8)	
	6–10	17 (42.5)	9 (34.6)	26 (38.8)	
	11 to 15	7 (15.0)	22 (7.7)	9 (13.4)	
	16 to 20	3 (7.5)	3 (11.5)	6 (9.0)	
	20 +	0	0	0	

3.1. Demographic information

The mean age and standard deviation (SD) for the 67 participants was 38 (SD ± 8.6) years old. The participants from Hospital B had a mean age of 42 (SD ± 8.7), which was six years higher than the Hospital A mean age of 36 (SD ± 7.8). For the total sample, 49% were European and the majority of the 26 Hospital B nurses were European (73%) compared with 34% European in Hospital A. Table 1 illustrates that the 'mixed of day and night' was the Hospital A nurses' favoured shift pattern (73% of the 41 participants). This type of shift pattern referred to nurses that worked three or four 12-h day shifts a week, followed by three or four 12-h night shifts during the following week. Table 1 also reveals that in hospital A 40% of the 41 nurses had more than ten years of nursing experience, compared with 65% of the 26 nurses from Hospital B.

3.2. Fatigue levels and the associated factors from the total sample (n = 67)

The mean OFER scores (± SD) were 27.0 (SD ± 22.9) (chronic fatigue), 49.9 (SD ± 12.2) (acute fatigue), and 46.4 (SD ± 10.5) (inter-shift fatigue). Table 2 shows the distribution of the fatigue levels (OFER scores) by number of ICU nurses out of 67 participants. It reveals that 57 of the 67 (85%) participants had 'low' and 'moderate/moderate' chronic fatigue levels, while 10 (15%) showed 'moderate/high' and 'high' chronic levels. A total of 36 of the 67 (54%) nurses reported having 'low' and 'low/moderate' acute fatigue levels, while 31 (46%) revealed having 'moderate/high' and 'high' acute fatigue levels. Table 2 also shows that 46 of the 67 (69%) participants described having 'low' and 'low/moderate' levels of inter-shift fatigue, and 21 (31%) exhibited 'moderate/high' inter-shift fatigue scores, while no one reported 'high' levels. Overall, the table shows that more than half of the 67 ICU nurses experienced low to moderate fatigue levels (chronic fatigue, acute fatigue and inter-shift fatigue) during 12-h shifts.

Spearman's correlation revealed that age ($\rho = 0.03$, $r^2 = -0.28$), number of family dependents ($\rho = 0.03$, $r^2 = -0.27$), years of nursing experience ($\rho = 0.03$, $r^2 = -0.27$) were moderately negatively correlated with acute fatigue. It also revealed that frequency of exercise per week ($\rho = 0.01$, $r^2 = -0.31$) was moderately negatively correlated with chronic fatigue. The results indicated that older or more experienced nurses exhibited lower levels of acute fatigue, while the participants who did exercise more often per week had lower levels of chronic fatigue. The results also showed that the participants with more family dependents had lower levels of acute fatigue, compared to those with less family dependents.

There was no statistically significant effect for any of the demographic factors (age, shift schedules, frequency exercise per week, and years of nursing experience) in relation to chronic fatigue, acute fatigue or inter-shift recovery using ANOVA test analysis (Table 3).

Table 2
Fatigue levels (OFER scores) for the total sample.

OFER scoring	0–25	26–50	51–75	76–100
Types of fatigue	(low) n (%)	(low/moderate) n (%)	(moderate/high) n (%)	(high) n (%)
Chronic fatigue	38 (57%)	19 (28%)	7 (10%)	3 (5%)
Acute fatigue	4 (6%)	32 (48%)	30 (45%)	1 (1%)
Inter-shift fatigue	4 (6%)	42 (63%)	21 (31%)	0

Note: OFER scores: '0–25' (low), '26–50' (low/moderate), '51–75' (moderate/high), and '76–100' (high).
n (%): OFER scores for fatigue categories by number of nurses (percentage).
Total ICU nurses $n = 67$.

3.3. Comparisons between hospitals

T-tests and Chi-Square were used for the comparisons between Hospital A and Hospital B. t-tests identified the differences in fatigue levels between hospitals. The results showed that participants from Hospital A had a statistically significantly higher level of chronic fatigue (Mean = 32.9) than those from Hospital B (Mean = 19.0) ($\rho = 0.02$). Participants from Hospital A had similar levels of acute fatigue (Mean = 51.6) to those from Hospital B (Mean = 47.2) ($\rho = 0.08$). Hospital A also had comparable levels of inter-shift fatigue (Mean = 48.4) to Hospital B (Mean = 43.2) ($\rho = 0.09$).

Using t-tests and Chi-Square, it was identified that 'age' ($\rho < 0.01$), 'age group' ($\rho = 0.03$), 'shift schedules in a typical month' ($\rho = 0.02$), and 'years of nursing experience' ($\rho = 0.03$) were statistically significant in relation to the difference in chronic fatigue levels between the two hospitals. Analysis of the following variables revealed non-significant findings when comparing the two hospitals: gender ($\rho = 0.90$), relationship status ($\rho = 0.27$), work hours fortnightly ($\rho = 0.19$), ethnicity ($\rho = 0.05$), family dependents ($\rho = 0.55$), frequency of exercise per week ($\rho = 0.51$), level of qualification ($\rho = 0.41$), years of ICU experience ($\rho = 0.13$), and years of working 12-h shifts ($\rho = 0.56$). These results are presented in Table 1.

In the specific groups, 'age', 'shift schedules in a typical month', and 'years of nursing experience', the study found significant differences between the chronic fatigue OFER scores in the two hospitals. Table 4 shows the chronic fatigue OFER scores and corresponding chronic fatigue levels from Hospital A and B. Specifically, in the 31–40 and 41–50 age groups, the study identified that the OFER scores were 29–39 (low/moderate chronic fatigue levels) in Hospital A, while the scores were 15–17 (low chronic fatigue levels) in Hospital B. It also revealed that the OFER scores for each type of shift schedule in Hospital A (29–41) (low/moderate chronic fatigue levels) was higher than in Hospital B (16–24) (low chronic fatigue levels). Additionally, it showed that the OFER score for each 'years of nursing experience' group in Hospital A (24–47) (low/moderate chronic fatigue levels) was higher than that of Hospital B (7–28) (low chronic fatigue levels).

4. Discussion

4.1. Fatigue levels for the total sample

The study showed that more than half of the ICU nurses studied had low to moderate fatigue levels, indicating that they coped well with 12-h shifts. This finding is consistent with the results from two studies, which concluded that nurses working 8-h shifts did not rest as well due to various reasons, such as having to travel more frequently to work, compared to when working 12-h shifts (Hazzard et al., 2013; Martin, 2015). The finding is also compatible with three studies, which reported that 12-h shift nurses were less tired and less stressed, enjoyed more restful sleep, exhibited better time-management, and showed higher quality of care, compared to those working 8-h shifts (Dwyer et al., 2007; Richardson et al., 2007; Stone et al., 2006).

The finding is inconsistent with two studies, which identified that 12-h shifts impaired nurses' performance, affected their general health, and increased fatigue levels (Barker & Nussbaum, 2011; Estryn-Béhar et al., 2012). The finding is also in contrast with Chen's studies (Chen, Daraiseh, et al., 2014a; Chen, Davis, et al., 2014b) and Geiger-Brown's studies (Geiger-Brown et al., 2012; Geiger-Brown et al., 2014). Chen et al. found that 12-h shifts decreased nurse activity due to increased fatigue, while Geiger-Brown et al. identified that the 12-h shift nurses experienced a larger sleep debt, which inevitably increased their fatigue levels.

The inconsistencies in the findings between the current study and others may be a result of varying sample sizes obtained, utilisation of different fatigue scales, and various study locations. For example, using the OFER scale to measure fatigue levels, the current study examined 67

Table 3
Fatigue levels and demographics for the total sample.

	Chronic fatigue					Acute fatigue					Inter-shift fatigue				
	Sum of square	df	Mean square	F	ρ value	Sum of square	df	Mean square	F	ρ value	Sum of square	df	Mean square	F	ρ value
Age	1363.23	3	454.41	0.87	0.46	546.55	3	182.18	1.43	0.25	394.78	3	131.59	1.17	0.33
Shift schedules in a typical month	595.61	2	297.81	0.56	0.58	119.86	2	59.93	0.39	0.68	107.39	2	53.69	0.48	0.62
Frequency exercise per week	4523.78	4	1130.94	2.34	0.07	295.35	4	73.83	0.48	0.75	147.52	4	36.88	0.32	0.86
Years of nursing experience	2156.22	4	539.05	1.03	0.40	860.59	4	215.15	1.49	0.22	900.23	4	225.05	2.19	0.08

ICU nurses at two large tertiary teaching hospitals in New Zealand, while Chen et al. studied 150 nurses from three acute care American hospitals (Chen, Davis, et al., 2014b), and Geiger-Brown et al. assessed 80 medical-surgical and ICU nurses from a large US hospital (Geiger-Brown et al., 2012). Additionally, the study by Barker and Nussbaum measured the fatigue levels of 745 American nurses from a variety of clinical settings by using four different types of fatigue scales (Swedish Occupational Fatigue Inventory, Fatigue-Related Symptoms Questionnaire, Fatigue Scale, and OFER) (Barker & Nussbaum, 2011).

4.2. Associated demographic factors for the total sample

The study found that 'age', 'years of nursing experience', 'frequency of exercise per week', and 'number of family dependents' were the key factors in relation to fatigue. Specifically, the study identified that the older or more experienced nurses had lower levels of acute fatigue, compared to the younger or less experienced nurses. This finding is supported by a study, which reported that younger nurses experienced higher fatigue levels than older nurses (Winwood, Winefield, & Lushington, 2006b). It is also in line with the conclusion from the study, which identified that older and more experienced nurses had better tolerance of acute fatigue due to their efficient work performance when compared to younger and/or less experienced nurses (Chen, Davis, et al., 2014b).

The study also identified that the nurses who exercised more often exhibited lower levels of chronic fatigue, compared to the nurses who exercised less. The finding indicated that exercise may have positively impacted on nurses mentally and physically, and this may have increased their performance when working 12-h shifts. This finding is supported by an exploratory study that surveyed 111 eldercare shift work nurses and found that lack of exercise, as a lifestyle factor, strongly contributed to chronic fatigue (Samaha, Lal, Samaha, et al., 2007).

Surprisingly, the study found that the nurses with more 'family dependents' had lower levels of acute fatigue, compared to those with fewer 'family dependents' or none. The explanation for this may be that participants with more family dependents might be older or experienced nurses. The research identified that older or experienced nurses had lower acute fatigue levels (as previously discussed). A further explanation might be that these nurses could have older dependents that look after their younger siblings. This could give the nurses peace of mind while at work, thus reducing stress, and subsequently lowering acute fatigue levels.

The above finding is supported by the study that analysed data collated from 25,924 European nurses in 2003. The study concluded that the nurses who did not have enough child care when at work were at high risk of work and family conflict (Estryn-Béhar et al., 2012), thus resulting in increased fatigue levels. Overall, it can be seen that the identified key demographic factors associated with nurse fatigue may provide managers with evidence to develop strategies to reduce nurse acute fatigue levels.

4.3. Differences in chronic fatigue levels between hospitals and associated factors

The study found that the mean chronic fatigue level in Hospital A was statistically significantly higher compared with that of Hospital B. 'Age', 'age group', 'shift schedules in a month', and 'years of nursing experience' were identified key factors that led to the difference in chronic fatigue levels between the two hospitals.

Specifically, the study found that Hospital B nurses' mean age was six year higher than Hospital A, and Hospital B had more participants from the 31 to 50-year-old age group than Hospital A. It also found that Hospital B fielded fewer nurses who worked 'mixed day and night

Table 4
OFER scores and chronic fatigue level comparisons between hospitals.

Demographics		Mean chronic fatigue OFER scores and chronic fatigue levels		
		Hospital A chronic fatigue levels (OFER scores)	Hospital B chronic fatigue levels (OFER scores)	Comparison between A and B (ρ value)
Mean chronic fatigue		Low/moderate (33)	Low (19)	0.02
Age group	21–30 yrs	Low/moderate (37)	Low/moderate (38)	0.03
	31–40 yrs	Low/moderate (29)	Low (17)	
	41–50 yrs	Low/moderate (39)	Low (15)	
	51–60 yrs	Low/moderate (27)	Low/moderate (26)	
Shift schedules in a typical month	Mainly day shifts	Low/moderate (29)	Low (16)	0.02
	Mainly night shifts	Low/moderate (41)	Low (24)	
	Mixed day and night	Low/moderate (32)	Low (18)	
Years of nursing experience	< 2 yrs	Low/moderate (37)	Low (0)	0.03
	2–5 yrs	Low/moderate (26)	Low (7)	
	6–10 yrs	Low/moderate (34)	Low/moderate (28)	
	11–15 yrs	Low (24)	Low (7)	
	16–20 yrs	Low/moderate (47)	Low (15)	
	> 20 yrs.	Low/moderate (33)	Low (25)	

Note: OFER scoring: low (0–25), low/moderate (26–50), moderate/high (51–75), and high (76–100).

shifts' and more nurses with at least 11 years nursing experience. In these specific groups, the study identified that Hospital B participants reported much lower chronic fatigue levels than those from Hospital A. Accordingly, this finding suggests that strategies need to be implemented to ensure more support for younger and/or less experienced nurses, enhance retention of senior staff, and reduce rotating shifts in order to lower chronic fatigue levels. This finding is consistent with another study, which found that as nursing experience increased, nurses coped better with the longer shift work hours (Bjorvatn, Dale, Hogstad-erikstein, et al., 2012). The finding is also in line with a study, which concluded that fewer rotating shifts meant nurses had more settled and routine schedules, thus decreasing their fatigue levels (Han et al., 2014). Overall, the findings in relation to these important demographic factors may be useful to managers to develop strategies to reduce nurse chronic fatigue levels.

4.4. Limitations

There are several limitations in this study. The small sample size reduces the generalisability of the findings as well as limiting the power to determine statistically significant results. This was due to study time constraints as well as New Zealand being a relatively small country and resource restrictions limiting the study to two large ICUs. However, using the OFER scale to measure fatigue may have increased the strength of the results as this scale has high reliability and validity (Winwood, Lushington, & Winefield, 2006a). The low number of subgroup participants, such as Maori or Pacific Islander, further affects the generalisability of results to ethnic minority groups.

The self-reporting questionnaire used in the study may have introduced bias due to some nurses' personal interests, such as wanting or not wanting to retain 12-h shifts influencing how they answered the questions. Additionally, the study was ICU-based, so the findings may not be applicable to other clinical areas. Future studies are needed with greater resources available to recruit a larger and more ethnically diverse study population to better explore the relationship between ethnicity and nurse fatigue. Finally, this study did not investigate the amount of years worked within the same organisation, which may have influenced fatigue.

5. Conclusion

This research was to help nurses in Intensive Care Units (ICU) recognise and understand the impact of 12-h shifts on their fatigue levels. This study found that the majority of ICU nurses in both hospitals had low/moderate fatigue levels, indicating they adapted to 12-h shifts well. It identified that age, family dependents, and years of nursing experience, were statistically significantly associated with nurse acute fatigue levels. In addition, the study identified that frequency of exercise per week was statistically significant in relation to nurse chronic fatigue levels. The statistically significant difference in chronic fatigue levels between the two hospitals suggests that some support should be established for younger and/or less experienced nurses. It also implies that nurses and managers should work together to provide nurses with improved shift schedules and retain senior nurses in the workforce to reduce chronic fatigue levels.

6. Implications for practice

The New Zealand Nurses Organisation (NZNO) is an association that represents New Zealand nurses and health workers, provides them with professional support, and seeks to improve their wellbeing (New Zealand Nurses Organization, 2015). The NZNO has limited 12-h shifts in some clinical areas in the multi-employer collective agreement due to identified risks and unsafe issues (New Zealand Nurses Organization, 2015). However, the current study found that more than half of nurses studied adapted to 12-h shifts well, implying that the 12-h shift system may be compatible with an ICU work setting. It also indicates that ICU nurses are able to recover sufficiently when working three consecutive 12-h shifts. The results suggest that the 12-h shift system may be an effective method to reduce nurse fatigue and improve inter-shift recovery for ICU nurses.

This study revealed that age and nursing experience are associated with acute fatigue levels. The results revealed that older nurses with more nursing experience had lower acute fatigue levels, when compared to younger nurses. Interestingly, prior research suggested that young and/or less experienced nurses should be supported by reducing their workload, working hours, and promoting teamwork to reduce their fatigue levels (Winwood, Winefield, & Lushington, 2006b). These strategies could help young nurses improve their work performance, which may help improve job satisfaction, thus increasing staff retention.

This study found that 'frequency of exercise per week' is associated with chronic fatigue. It highlights exercise as an important factor related to reducing nurses' chronic fatigue when working 12-h shifts. It also suggests that nurses should have sufficient days off after three or four consecutive 12-h shifts to enable them to integrate more exercise into their daily routine. This may help nurses develop a healthier life style to reduce stress reduction, thus decreasing their chronic fatigue levels (Samaha et al., 2007).

Furthermore, this study identified that 'number of family dependents' was associated with acute fatigue levels. The finding suggests that providing nurses with support, such as flexible work hours for childcare, could help reduce their acute fatigue levels. Additionally, the development of resilience education sessions may improve the ability of ICU nurses to better deal with their work and family conflicts (Mealer, Hodapp, Conrad, et al., 2017). This could also help ICU nurses working 12-h shifts develop coping skills and buffer stress, thus attenuating their fatigue levels.

The difference in chronic fatigue levels between the two hospitals shows that special attention should be paid to nurses' work schedules and retaining senior nurses in the ICU workforce. The study highlights that permanent 12-h day or night shifts are the most beneficial to ICU nurses. This is supported by previous research where fixed shift patterns can assist nurses to adapt to their shift schedules without interrupting their circadian rhythms (Han et al., 2014). The fixed shift patterns would ensure nurses have sufficient time to recuperate, thus helping reduce the risks of developing health problems, such as cardiovascular disease, gastrointestinal disturbances, cancer or hormonal disorders (Matheson et al., 2014). Improved shift schedules may also help retain senior nurses in the workplace. Mature and experienced nurses could work together with younger and/or less experienced nurses to lower fatigue levels, ensure safer practice, and ultimately improve nurse wellbeing.

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