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Factors Influencing Cumulative Fatigue Symptoms in Female Nurses Working in Two Shifts Rotation System in Japan

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Abstract

Background: This study aimed to clarify factors affecting cumulative fatigue in nurses working two-shift rotations system with 16-hour night time shifts.

Methods: A cross sectional design was employed; subjects were 96 nurses. The Cumulative Fatigue Symptoms Index (CFSI) was used to assess cumulative fatigue, and number of steps was counted as an objective measure/ index of physical activity. Data were collected over four days, which included a day shift, night shift, and day off a series of nursing shift. Participant characteristics such as their CFSI scores and years of experience were analyzed using a Mann-Whitney U or a Kruskal–Wallis test. In addition, logistic regression analysis was performed to examine the association between cumulative fatigue and potential contributing factors.

Results: Valid data were obtained from 96 female nurses. Cumulative fatigue was found to be related to having less than 5 years of clinical experience (OR = .22, 95% CI=.05-.92), subjective busyness of nigh-time shifts (OR = 3.12-3.69, 95% CI= 1.06-12.11), and the number of steps taken on one's day off (OR =.03, 95% CI= .10-.92). The subjective busyness in night shift work was an increasing risk factor of CFSI, and less than 5 years clinical experience and the numbers of steps of day off were lowering risk factors of CFSI.

Conclusion: Clinical experience less than 5 years, subjective busyness in night shift work, and the number of steps on a day off as a measure of physical activity were identified as factors associated with CFSI in nurses working in two-shift rotation system.

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Introduction

Working environment for nurses where fatigue tends to accumulate due to heavy workloads and characteristics of work [1]. According to "Night shift and shift work guidelines for nurses", the hospitals adapting two-shift rotation system were 57.4%and three-shift rotation system were 21.7%[2]. The two-shift rotation system was more common than the three-shift rotation system, and this has remained unchanged. In two-shift rotation system with 16-hour night shift, perception of relaxation, absence of commuting, and decrease in the number of patient-status communication during the night shift were cited as advantage, whereas long-time restraint was considered a disadvantage [3].Besides, it was difficult to incorporate exercise habits in the lifestyle of nurses working in two shifts, and there was concern about incident risks due to the influence of physical disorders caused by long working hours at nightshifts [4]. For nurses working in two-shift rotation system, it was difficult to recover from fatigue even after a day off, so that they were presumed in a state of cumulative fatigue. Thus, it was important to analyze fatigue in nurses working in two shifts through examining not only each shift duty but also the time period including the workflow up to the day off after night shift. Accordingly, since the Cumulative Fatigue Symptoms Index (CFSI) was suitable for measuring fatigue over a certain period and not just at a point in time [5]. As well as measurement of physical activity as an objective indicator was considered useful since the amount of activity tends to decrease in a person with chronic fatigue symptoms [6].

Therefore, regarding the factors influencing CFSI in nurses working in a two-shift system, in addition to age and years of experience, which have been considered in previous studies, this study also considers family status, duty status, and physical activity associated with each duty and aims to elucidate their associations with CFSI.

Materials & Method

1) Participants: Nurses working in the two-shift system in two A prefecture hospitals with more than 200 beds and general wards having a 7-to-1 patient–nurse ratio.

2) Survey period: Four days from April of 2012 to February of 2013; a total of 4 days including day shift, night shift (counted as 2 days since work was performed continuously from 16 o'clock to 10 o'clock the next morning), and day off were selected.

3) Survey items: Attributes surveyed were age, years of clinical

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experience, status of cohabiting family, status of cohabiting caregiver family, the presence or absence of cohabiting children, and exercise habits, and the degree of subjective busyness in a day and night shift and physical activity were measured. After each day or night shift ended, "not at all busy" to "extremely busy" responses were scored in a scale of 1 to 4 points representing subjective busyness. As objective indicators of physical activity, the number of steps in a day shift, night shift, and day off were analyzed. The physical activity meter (Actimarker ®,Panasonic) that was used to count steps. Accordingly, this study analyzed the number of steps, which is advocated as an important indicator of physical activity [7].

CFSI consists of 8 characteristic items from 3 aspects: mental aspect items of "depressive feelings,""anxiety," and "decreased vitality"; physical aspect items of "general fatigue,""chronic tiredness," and "physical disorders"; and social aspect items of "decreased willingness to work" and "irritability" [5].

4) Data analysis: Basic statistics were calculated for each variable concerning the attributes, physical activity, and CFSI Chi-squared and Mann-Whitney U test and Kruskal-Wall is test were conducted, and multiple comparisons were performed using the Steel method in order to analyze relationship between each attribute/variable and CFSI. The attribute/variable were allocated following groups: between high step-count group and low step-count group in physical activity based on the average value; between non-busy group and busy group based on subjective busyness; and five groups based on the age attribute from 20 years to 69 years; four groups based on years of clinical experience from less than 5 years to more than 20 years were created..To analyze factors associated with CFSI, a logistic regression analysis with binary data was performed using dummy variables by creating two (high and low) groups based on the average value of the characteristic items. To avoid collinearity, the age group having high correlation with years of clinical experience was excluded. IBM SPSS ver21 was used for all statistical analyses, and the significance level was less than 0.05.

6) Ethical considerations: A document outlining the research was sent to representatives of the medical institutions in advance, and consent was obtained by verbally explaining the content and method of research. The participants who consented were asked to register their names, since it was necessary to link the equipment used with the questionnaire responder, and the participants were anonymized in the analysis to protect privacy. It was adequately explained to the participants that they could choose to participate at their own discretion, and, even after consenting to the study, they could drop out any time expeditiously. The study was conducted with the approval of the General Research Ethics Review Committee of Nagasaki Prefectural University, with which the author was previously affiliated, as well as the Ethics Review Committees of the respective participating facilities.

Results

1) Outline of participants: Many of the participants were in the 20–39-year-old age group, accounting for about 70%. With respect to years of clinical experience, those with less than 10 years' experience accounted for more than 50%. As for family composition, cohabiting families accounted for 72.9%, and about 80% of the participants had no exercise habits (Table 1). Regarding physical activity, mean steps in a day shift, night shift, and day off were 8176, 14446, and 4488, respectively (Table 2).

	Attribute	n	%
Age group	20-29 Years	37	38.5
	30-39 Years	33	34.4
	40-49 Years	14	14.6
	50-59 Years	9	9.4
	60-69 Years	3	3.1
Years of clinical experience	Less tahn 5 years	32	32.3
	5 to 10 years	22	22.9
	10 to 20 years	22	22.9
	More than 20 years	20	20.8
Cohabiting family	Yes	70	72.9
	No	26	27.1
Cohabiting caregiver family	Yes	3	3.1
	No	93	96.9
Cohabiting children	Yes	23	23.7
	No	73	75.3
Exercise habit	Almost none	76	80.0
	2 to 3 days per week	16	16.8
	4 to 5 days per week	2	2.1
	Daily	1	1.1

Table 1: Outline of participants
N=96
Excluding non-responders

2) CFSI: Characteristic items related to physical, mental, and social aspects were analyzed. Five variables—presence or absence of cohabiting children, years of clinical experience, day shift work steps in physical activity, overtime hours in work status, and subjective busyness in night shift were found to be associated with CFSI (Table 2).

Among the five variables found to be associated with CFSI in unilabiate analysis, three variables years of clinical experience, subjective busyness in day shift and night shift showed a significant association with CFSI in logistic regression analysis ($p<0.05$for each). As for physical aspect items, the number of complaints regarding "physical disorders" was 0.3 times lower in the "low step-count in a day off" group than in the "high step-count in a day off" group (Odds: 0.30, 95%CI: 0.01–0.92,$p<0.05$),"general fatigue" was 3.5 times higher in the "subjective busyness night shift busy" group than in the "night shift non-busy" group(Odds: 3.50, 95%CI: 1.09–11.22, $p<0.05$), and even "chronic tiredness" was 3.1 times higher in the "subjective busyness night shift busy" group than in the "night shift non-busy" group (Odds: 3.12, 95%CI: 1.06–9.69, $p<0.05$). With respect to mental aspect items, "depressive feelings" was 0.2 times lower in "years of clinical experience—more than 20 years" group than in the "less than 5 years" group(Odds: 0.22, 95%CI: 0.05–0.92,$p<0.05$),"decreased vitality" was 3.7 times higher in the "subjective busyness—night shift busy" group than in the "night shift non-busy" group (Odds: 3.69, 95%CI: 1.12–12.11, $p<0.05$) (Table 3).

Discussion

Association between attributes and CFSI

The participants in this study presented high score of six of eight CFSI characteristic items in physical and mental aspect items, which

Item	Category		Physical aspects			Mental aspects			Social aspects	
			Physical disorders	General fatigue	Chronic tiredness	Anxiety	Depressive feelings	Decreased vitality	Irritability	Decreased willingness to work
Cohabiting family	Yes (n=69)		2.06	4.36	3.45	4.23	2.75	3.55	1.57	2.36
	No (n= 26)		2.08	3.92	3.73	5.04	3.00	3.23	1.50	2.85
Cohabiting caregiver family	Yes (n= 3)		2.67	3.00	1.67	4.00	2.33	1.33	0.67	1.33
	No (n = 92)		2.04	4.28	3.95	4.47	2.84	3.53	1.58	2.53
Cohabiting children	Yes (n= 23)		1.78	4.87	4.30	5.04	3.26	4.57	1.65	3.13
	No (n= 72)		2.15	4.04	3.28	4.26	2.68	3.11	1.51	2.29
Attribute Age group	20-29 years (n= 37)		1.95	4.00	3.92	4.08	3.19	3.38	1.78	2.14
	30-39 years (n = 33)		2.06	3.97	2.97	4.66	2.53	3.13	1.50	2.47
	40-49 years (n = 14)		1.93	4.71	3.86	4.71	2.14	3.21	1.07	2.14
	50-59 years (n= 9)		2.78	5.67	4.22	4.44	3.11	5.89	1.89	4.44
	60-69 years (n = 3)		2.33	5.33	2.00	7.69	4.67	4.00	0.33	4.00
Years of clinical experience	Less than 5 years (n= 32)		2.38	4.53	3.75	4.63	3.95	4.38	2.09	2.69
	5 to 10 years (n= 22)		1.68	3.45	3.27	3.55	2.32	1.86	1.05	1.77
	10 t0 22 years (n= 22)		1.73	3.95	3.50	5.68	2.50	3.36	1.50	2.64
	More than 20 years (n=20)		2.30	5.00	3.45	3.90	2.50	4.00	1.20	2.85
Physical activity volume	Day shift	Low step-count group (n=41)	2.09	4.42	3.07	4.07	2.62	3.31	1.36	2.29
		High step-count group (n=54)	2.02	4.10	3.92	4.82	3.00	3.65	1.69	2.69
	Night shift	Low step-count group (n=41)	2.31	4.45	3.95	5.07	3.07	3.79	1.33	2.55
		High step-count group (n=54)	1.85	4.09	3.19	4.00	2.63	3.26	1.69	2.46
	Day off	Low step-count group (n=34)	2.21	4.30	3.40	3.84	2.35	3.49	1.23	2.02
		High step-count group (n=39)	1.92	4.21	3.62	4.98	3.21	3.49	1.77	2.89
Work status	Day shift subjective busyness	Non-busy group (n=35)	1.57	3.97	3.51	3.77	2.40	3.06	1.17	1.89
		Busy group (n=61)	2.32	4.38	3.47	4.75	3.05	3.67	1.72	2.83
	Night shift subjective busyness	Non-busy group (n=33)	1.74	3.47	2.82	3.12	1.97	2.35	1.06	2.12
		Busy group (n=63)	2.23	4.68	3.90	5.21	3.29	4.11	1.79	2.71

Table 2: Association between CFSI and the variables.

N = 96

For age and clinical experience, after the Kruskal-Wallis test, the Steel method was used in multiple comparison, and, for the rest, either chi-squared test or Mann-Whitney U test was used

Day shift low step-count group: less than 8000 steps, high step-count group: more than 8000 steps

Night shift low step-count group: less than 14,000 steps, high step-count group: more than 14,000 steps

The subjective busyness in day and night shifts was categorized into non-busy (responses of "not busy at all–not busy") and busy (responses of "busy–very busy")

Average values are shown for comparison with the basic value of average complaint count. Non-responders have been excluded.

** significant at 1% level, * significant at 5% level.

indicated having high cumulative fatigue. Among the different age groups, scores for six out of eight CFSI characteristic items namely, three physical aspect items, one mental aspect item, and two social aspect items in the 50–59-year-old group and two mental aspect items in the 60–69-year-old group were the highest, and particularly in the 50–59-year-old group, a trend of a higher number of complaints was observed. It was presumed that the reason for the scores for the physical aspect item of "general fatigue" being higher in the 50–59- and 60–69-year-oldage groups was that the same work content was set for all nurses irrespective of age. The fact that nursing work content does not change based on age may have contributed to such results. Grouping the years of clinical experience in 5-year increments, such as less than 5 years and 5–10 years, helped reveal the differences due to CFSI, which were not clear from the age groups. In the mental aspect item of "decreased vitality," the scores were higher for the "years of clinical experience less than 5 years" group than for the "5–10 years" group. In congruence with a previous study that reported the CFSI complaint rate was high in people with 3–4 years' clinical experience [8], it can be said that the load and efforts to adapt to workplaces and duties are likely to be high at less than 5 years of clinical experience. Besides, Kikuchi et al. [9] reported that specific, abstract, and independent judgment ability in professional autonomy tends to strengthen around 3 years of clinical experience, may decline or stabilize during the 6 to 10 years period, and strengthens again after exceeding 10 years. The period of clinical experience less than 5 years is indeed a time when professional autonomy as a nurse improves and is likely an important time to influence subsequent career continuation. Nurses, who can continue to work until such a time, get accustomed to their workplace and develop stabilized professional autonomy, which most likely enables them to cope better without accumulating

		Physical disorders		General fatigue		Chronic tiredness		Anxiety		Depressive feelings		Decreased vitality		Imitability		Decreased willingness to work	
Item	Category	Odds ratio (95% CI)	P value	Odds ratio (95% CI)	P value	Odds ratio (95% CI)	P value	Odds ratio (95% CI)	P value	Odds ratio (95% CI)	P value	Odds ratio (95% CI)	P value	Odds ratio (95% CI)	P value	Odds ratio (95% CI)	P value
Years of clinical experience	Less than 5 years	1[References]		1[References]		1[References]		1[References]		1[References]		1[References]		1[References]		1[References]	
	5 to 10 years	0.54(0.13–2.19)	n.s	0.67(0.17–2.56)	n.s	1.05(0.27–4.03)	n.s	0.71(0.19–2.65)	n.s	0.33(0.08–1.27)	n.s	0.36(0.09–1.48)	n.s	0.41(.09–1.77)	n.s	0.48(0.11–2.07)	n.s
	10 to 20 years	0.27(0.06–1.16)	n.s	0.62(0.16–2.41)	n.s	0.61(0.15–2.39)	n.s	0.81(0.21–3.16)	n.s	0.37(0.09–1.44)	n.s	0.85(0.22–3.30)	n.s	0.56(.14–2.23)	n.s	0.81(0.20–3.25)	n.s
	More than 20 years	0.66(0.15–2.80)	n.s	1.62(0.41–6.42)	n.s	0.75(0.18–3.05)	n.s	0.64(0.16–2.51)	n.s	0.22(0.05–.92)	*	1.56(0.39–6.19)	n.s	0.44(.10–1.86)	n.s	0.78(0.20–3.02)	n.s
Physical activity volume	Day shift low step–count group	1[References]		1[References]		1[References]		1[References]		1[References]		1[References]		1[References]		1[References]	
	Day shift high step –count group	0.70(0.24–1.99)	n.s	0.88(0.32–2.44)	n.s	2.59(0.92–7.28)	n.s	1.82(0.66–5.00)	n.s	1.11(0.39–3.13)	n.s	0.94(0.33–2.65)	n.s	1.63(0.56–4.73)	n.s	1.26(0.44–3.61)	n.s
	Night shift low step–count group	1[References]		1[References]		1[References]		1[References]		1[References]		1[References]		1[References]		1[References]	
	Night shift high step–count group	0.58(0.19–1.71)	n.s	0.53(0.18–1.52)	n.s	0.86(0.30–2.48)	n.s	0.65(0.22–1.85)	n.s	0.58(0.20–1.66)	n.s	0.78(0.27–2.27)	n.s	1.56(0.52–4.64)	n.s	0.85(0.29–2.46)	n.s
	Day off low step–count group	1[References]		1[References]		1[References]		1[References]		1[References]		1[References]		1[References]		1[References]	
	Day off high step–count group	0.30(0.10–.92)	*	0.59(0.20–1.69)	n.s	0.46(0.16–1.35)	n.s	1.38(0.49–3.89)	n.s	1.02(0.36–2.92)	n.s	0.64(0.22–1.86)	n.s	0.69(0.23–2.06)	n.s	1.20(0.422–3.42)	n.s
Subjective busyness	Day shift non–busy group	1[References]		1[References]		1[References]		1[References]		1[References]		1[References]		1[References]		1[References]	
	Day shift busy group	2.09(0.64–1.74)	n.s	0.69(0.22–2.15)	n.s	1.30(0.42–3.90)	n.s	1.28(0.43–3.78)	n.s	1.28(0.42–3.80)	n.s	0.77(0.24–2.40)	n.s	1.94(0.60–6.27)	n.s	2.53(0.77–8.28)	n.s
	Night shift non–busy group	1[References]		1[References]		1[References]		1[References]		1[References]		1[References]		1[References]		1[References]	
	Night shift busy group	2.39(0.74–7.51)	n.s	3.50(1.09–11.22)	*	3.12(1.06–9.69)	*	3.00(0.99–9.05)	n.s	1.68(0.54–5.20)	n.s	3.69(1.12–12.11)	n.s	0.95(0.29–3.88)	*	1.18(0.31–3.80)	n.s

Table 3: Factors associated with CFSI.
Binomial logistic regression analysis using forced entry method was used
Analysis was performed by excluding the non-responders.
** significant at 1% level, * significant at 5% level, not significant shown as n.s

fatigue. In the 2012"Survey on night shifts and shift work in hospital nursing" [10], reported that 53% of20–24-year-old age group described the reasons of workplace anxiety was, "long working hours."For 20 to 24 years of age corresponds to 5 years of clinical experience who were same as the participants of the present study, two-shift system with long working hours leads to "decrease vitality" in mental aspect.

Furthermore, it was observed that nurses with children tend to exhibit higher "chronic tiredness" in the physical aspect. All participants in this study were female and since women experience life events such as marriage, childbirth, and child rearing, they often have to bear two or three burdens besides the workplace. According to Asanuma et al. [11],"chronic tiredness" was high in nurses over 30 years and in this age group, it was observed that in their private lives, they also had a burden associated with the growth of children; therefore, it was presumed that, as the busyness continued even after work, thus recovery from fatigue became difficult.

As for physical activity, the score for "chronic tiredness" was high in high step-count group in the day shift. Since work involving high physical strength, such as patient transfer, occurs more in the day shift than in the night shift [12], with increasing numbers of steps and physical activity in the day shift, a change in "chronic tiredness" of the physical aspect may have occurred. In the day off high step-count group, "chronic tiredness" of the physical aspect, "anxiety" and "depressive feelings" of the mental aspect, and the social aspect symptoms tended to be high, it was presumed that the day off were not likely to help participants recover from fatigue; on the contrary, they might have worsened the feelings of fatigue.

CFSI and associated factors

The results of binomial logistic regression analysis suggest that "years of clinical experience" associated with "depressive feelings";"number of steps in day off" associated with "physical disorders"; and "subjective busyness of night shift" associated with the three variables of "general fatigue,""chronic tiredness," and "decreased vitality" were CFSI-associated factors. Fatigue in nurses working in two shifts was susceptible to these three factors, and it was presumed that continued busyness in the night shift not only results in cumulative physical fatigue but also causes change in cumulative mental fatigue.

In a survey analyzing job quitting factors in female nurses [13], the night shift duty count (hours worked) was identified as a factor. Since subjective busyness in night shift was considered to reflect mental status, it was presumed that continued busyness in the night shift and increasing number of night shifts were caused cumulative fatigue which leading to quitting the job.

The association between physical activity and CFSI was analyzed based on the flow of duties in a day and night shift and day off. Since how one spends the day off depends largely on the individual, judging the activity based on step count alone was deemed difficult; however, the number of steps was an indicator [7] cited in the guideline and easily understandable, it was considered meaningful. The number of steps on a day off expressing physical activity was found to be a factor affecting CFSI. According to Ichie et al. [13], "fatigue could be alleviated by maintaining balance through adjustments in time and environment in daily living," and nurses might be able to alleviate fatigue by adjusting daily living habits. It was considered that the way of spending the day off might be associated with fatigue recovery in nurses working in shifts. In this study, as an indicator of how a day off was spent and physical activity were represented by step count. Accordingly, as the results of this study suggest that the number of steps in a day off affected recovery from fatigue after night shift, it could be considered as a representative indicator of activity in a day off. An appropriate level of activity on day offs based on the number of steps recommended to prevent cumulative fatigue in nurses working in two shifts since the results suggested that physical disorders decrease by increasing the number of steps on a day off.

One limitation of this study is that, in activities based on step count, the number of participants in day off was small compared to those in day and night shifts, resulting in a bias in the number of participants among the shifts, which necessitated appropriate consideration in interpreting the results. Thus, regarding the way of spending day offs, since it largely depends on the individual, and the participants in this study were not asked specifically about the ways they actually spend their day offs, no concrete recommendation could be developed.

Conclusion

Clinical experience less than 5 years, subjective busyness in night shift work, and the number of steps on a day off as a measure of physical activity were identified as factors associated with CFSI in nurses working in two-shift systems.

Accordingly, to prevent cumulative fatigue in nurses working in two-shift rotation systems, organizational measures, such as stress management in nurses with less than 5 years of clinical experience, duty adjustment that could reduce the subjective busyness in night shift, and recommendations regarding ways to spend day off based on physical activity measured in terms of steps, are desirable.

Competing Interests

This study is based on a paper presented at the 15th Japan Society for Health Care Management Conference held in June of 2013, The author declears that they have no competing interest exists.

Author Contributions

Narumi Ooshige, Tae Yamaguchi, Mitsuyo Nakashima, Kazuo Minematsu, and Noriaki Tsunawaki were responsible for the study conception and design and for critical revisions to the paper for important intellectual content. Narumi Ooshige and Tae Yamaguchi performed the data collection. Narumi Ooshige, Mitsuyo Nakashima, Kazuo Minematsu, and Noriaki Tsunawakei were responsible for the drafting of the manuscript and for statistical analysis of the data. Narumi Ooshige obtained funding and supervised the study.

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