Effects of a 7:1 Patient-to-Nurse Staffing Ratio on Nurses' Stressors, Accumulated Fatigue, and Intention to Continue Working

Hiroko Namba[1], Atsushi Koike[1], Takeko Wakabayashi[1]

Key Words :
nurse-patient ratio
job stress
fatigue
retention
hospital nursing services

ABSTRACT

This study aimed at verifying the effects of differences in patient-to-nurse staffing ratios on nurses. In total, 868 nurses were investigated in terms of peripheral tasks implemented, the Nursing Job Stressor Scale (NJSS), the self-Diagnosis Checklist for Workers' Accumulated Fatigue, and intention to continue working. Data was compared between the 7:1 and 10:1 groups and multiple regression analysis was conducted using each scale as the criterion variable and the patient-to-nurse staffing ratios as the explanatory variable. The results showed that compared to the 10:1 group, the 7:1 group had fewer transfer tasks among peripheral tasks, as well as significantly lower scores for "human environment at work" and "quantitative workload" on the NJSS as well as "assessment of subjective symptoms" on the accumulated fatigue scale. As for intention to continue working, the proportion of nurses who viewed their hospital as a good place to work was significantly higher in the 7:1 group. Multiple regression analysis showed that patient-to-nurse staffing ratios had a slight effect on intention to continue working. These results indicate that the characteristics of hospitals capable of implementing a 7:1 patient-to-nurse staffing ratio influence the nurses' work environment and the nurses themselves.

I. Introduction

Since the adoption of a stricter standard for the deployment of nurses due to the 2006 revision of the medical fee reimbursement system, a shortage of nurses has become a serious problem nationwide, and it has become particularly more difficult to secure nursing staff in rural areas. In this context, the introduction of nurse staffing with a patient-nurse ratio of 7:1 is expected to alleviate the shortage of nurses and promote environments that allow them to concentrate on nursing practice. However, some studies suggest that adoption of the 7:1 ratio does not necessarily improve their work environment (Ogushi and Kitaura, 2009a; Ozawa, Arai, Nagai, and Yoshizawa, 2009). Kadota (2007) pointed out that introduction of the 7:1 ratio based on the revised reimbursement system would increase, rather than reduce, their burden of related tasks. For nurses, being prevented from conducting daily tasks and nursing practice constitutes a factor determining turnover (Yamaguchi, Misawa, and Tahara, 2006). Therefore, it is significant to distinguish between nurse staffing and assigning nurses related tasks in terms of nursing management.

A large number of overseas studies suggest that, the higher the nurse-to-patient ratio, the more benefits the patients and nurses receive (Aiken, Clarke, and Douglas, 2002; IOM, 2006; Kramer and Schmalenberg, 1992; Rothberg, 2005). However, the relationship between a high nurse-to-patient ratio and its benefits has not been established; some studies suggested the possible positive effects of a high nurse-to-patient ratio on patient outcomes (Kanai, 2007; Yasukawa, 2008), but others reported no significant correlations between the nurse-to-patient ratio and numbers of medical accidents or adverse events (Ota, Oku, Koba, Yasui, and Ibe, 2006; Uchinuno, 2008). Most of these surveys were conducted prior to the 2006 revision of the reimbursement system. Few studies have been conducted to examine the relationship between nurse staffing and its outcomes following the revision, and most have only involved a single facility.

Although nurse staffing has become a serious medical policy-related issue in Japan, there have been few studies on the deployment of nurses and its outcomes. Furthermore, few analyses have been conducted to examine the relationship between nurse staffing and its benefits for nurses: how nurses are affected by different assignments. Therefore, it is significant, in terms of nursing management, to examine the effects of the introduction of the patient-nurse ratio of 7:1 due to the 2006 reimbursement revision on nurses in Japan.

The present study, which examined the relationships between differences in related tasks performed by nursing staff due to varying assignments, job stressors faced by them, the level of accumulated fatigue, and their intention to continue working, will promote discussions on appropriate nurse staffing to nurture a favorable work environment for nurses.

II. Purpose of the Study

The purpose of the study was to examine differences in the status of nursing-related tasks performed in health institutions with a patient-to-nurse ratio of 7:1 and 10:1, and discuss the influences of the differences on job stressors faced by nurses, the level of accumulated fatigue, and their motivation to continue working.

III. Operationally Defined Terms

1) Nurse staffing: The ratio of patients assigned to one nurse, which is determined according to the "basic hospitalization fees" based on the medical fee reimbursement system and submitted to the ministry.
2) Job stressor: Causes of work-related stress attributed to subjective requirements in the workplace, which can be assessed using the "scale for assessment of job stressors in clinical nurses" (Higashiguchi, Morikawa, Miura, Saijou, Tabata, and Nakagawa, 1998).
3) Level of accumulated fatigue: Level of physical and psychological fatigue in the previous month, which can be assessed using the "checklist for self-diagnosis of the level of accumulated fatigue in workers" developed by the health promotion division of the Japan Industrial Safety and Health Association.

1) *Mie Prefectural College of Nursing*

Corresponding author. Tel.: +81 59 233 5622; Fax: +81 59 233 5622.
E-mail address: hiroko.namba@mcn.ac.jp (H. Namba)

4) Intention to continue working: Intention to continue working as a nurse in a health institution.

5) Nursing-related tasks: Ten tasks listed by the Japanese Nursing Association (2001) as "related work" that they want to commission to professionals other than nurses (serving of meals, checking of leftover food, single-dose packaging of drugs, mixing of injectable drugs, drug inventory management, transfer of drugs, hygiene products, and specimen, bed-making, and ME maintenance and management).

IV. Research Methods

A. Subjects

Subjects of the study were full-time nurses (excluding those with experience of less than one year) working on general wards of 15 acute care hospitals with 200 or more beds for general patients in Prefecture A (excluding advanced treatment hospitals) that agreed to participate in the study.

B. Research methods

1. Survey methods

A self-completed anonymous questionnaire survey was conducted. The researcher asked the Department of Nursing of each hospital to distribute survey sheets and addressed envelopes to the subjects. Completed survey forms were sent back by the respondents by mail within three weeks. To collect data on the attributes of the hospitals, a "list of hospitals and clinics" (Life and Culture Division of Prefecture A) was referred to and the managers of the nursing departments were interviewed.

2. Survey period

Between April 22 and May 28, 2009

3. Data collection tools

1) Basic attributes: The survey items included the age, gender, type of job, experience as a nurse, job title, marital status, and whether or not the nurse had children.

2) Implementation of nursing-related tasks: The nurses were asked if they performed specific nursing-related tasks. Response options were: "I always perform the task", "I only perform the task on holidays/at night/in emergency situations", and "I do not perform the task / Other answers".

3) Job stressors: The "scale for assessment of job stressors in clinical nurses" developed by Higashiguchi et al. (1998) was used. The job stressor scale consists of seven factors as subscales and 33 items: Factor 1 (stressors related to personal relationships in the workplace) including seven items, Factor 2 (stressors related to roles as nurses) including five items, Factor 3 (stressors related to relationships with physicians and autonomy as nurses) including five items, Factor 4 (stressors related to the attitude toward death) including four items, Factor 5 (stressors related to the qualitative burden of work) including five items, Factor 6 (stressors related to the quantitative burden of work) including five items, Factor 7 (stressors related to relationships with patients) including two items. Five-grade subscales were used, and the total subscale score was divided by the number of items to calculate the mean subscale score. Its reliability and validity have been established by the developer (Higashiguchi et al., 1998).

4) Level of accumulated fatigue: The "checklist for self-diagnosis of the level of accumulated fatigue in workers" (accumulated fatigue scale), including 20 items, developed by the health promotion division of the Japan Industrial Safety and Health Association, was used to determine the level of fatigue. Using a seven-grade scale, the accumulated fatigue scale aims to determine the [level of burden at work] in a comprehensive manner, based on a combination of assessments of [subjective symptoms] in the previous month (13 items) and [working conditions] (7 items). Although the previous study employed another scale to determine the level of accumulated fatigue, the present study adopted the score for [burden at work] as the score for [accumulated fatigue]. Its reliability and validity have been established by Sasaki et al. (Sasaki, Iwasaki, Mouri, Hisanaga, and Shibata, 2005)

5) Intention to continue working: Based on the "analysis of the possibility to continue working", developed by Hirai, Ohara, Kinoshita, Oshima, and Kusakari (2003), four questions regarding the intention to continue working: "Do you think of this hospital as an excellent workplace in general?", "Do you think of yourself as a member of this hospital?", "Have you ever thought of leaving this hospital?", and "Do you hope to continue to work at this hospital?", as well as an additional question: "Are you planning to leave this hospital (in two years)?", were asked. Response options included "Yes", "I do not know", and "No".

4. Analysis methods

An unpaired t-test was conducted to compare the attributes (number of beds, mean bed occupancy rate, and mean hospitalization period) of 7:1 and 10:1 hospitals. A comparison was also conducted of the basic attributes of groups of nurses working at 7:1 and 10:1 hospitals and the status of implementing nursing-related tasks. To examine the attributes, χ^2 tests were conducted to compare category data, and unpaired t-tests were used to compare quantitative data, such as the number of years of experience. Using unpaired t-tests, job stressor and accumulated fatigue subscale scores were compared between the 7:1 and 10:1 groups. Nurses' intentions to continue working were examined using a χ^2 test.

Pearson's correlation coefficients were used to examine the relationships between nurse staffing and variables. To examine the influences of differences in nurse staffing on job stressors in nurses, the level of accumulated fatigue, and intention to continue working, a multi-regression analysis (stepwise procedure) was conducted between the 7:1 and 10:1 groups: job stressor scale and accumulated fatigue scores and the intention to continue working were criterion variables; explanatory variables included the attributes of facilities and individual nurses, including the deployment of nurses and status of implementing nursing-related tasks.

Prior to calculating the correlation coefficients and conducting a multi-regression analysis, the intention to continue working and status of implementing nursing-related tasks were converted into quantitative data, according to the following procedures: To determine the intention to continue working, a positive response was counted as one point and other responses were counted as zero points. The higher the score (between 0 and 5 points), the more strongly determined to continue working the nurse was. Regarding the implementation of nursing-related tasks, the response

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"I always conduct the task" was counted as one point and other responses were counted as zero points. The higher the score (between 0 and 10 points), the larger the number of nursing-related tasks implemented. Dummy variables were used to assess the following items: nurse staffing (7:1 nurse staffing=1, 10:1 nurse staffing=0), managerial position (managerial position=1, non-managerial position=0), marital status (married=1, unmarried/divorced/bereaved=0), and with or without children (with children=1, without children=0). In all tests, the significance level was "p<0.05". For statistical analysis of data, SPSS16.0 for Windows, statistical software, was used.

5. Ethical considerations

The present study was conducted with the approval of the research ethics committee of Mie Prefectural College of Nursing (Notification No. 083501).

The researcher visited hospitals at which the nurses work, and provided the managers of the nursing departments with oral and written explanations of the purpose of the survey, its methods, distribution of survey forms to the nurses, and ethical considerations to obtain their consent. For all subjects, a document stating the anonymity of the survey, its purpose and significance, that participation in the survey must be based on the nurse's own free will, that nurses would never be disadvantaged because of their refusal to participate, that survey data and results would be processed in a manner to prevent individual nurses from being identified prior to their publication, and that returning a completed form would be regarded as consent to the study was attached to the survey form. The subjects were asked to complete the form, put it in an envelope, and send it back by mail.

Although the survey forms used in the study had code numbers indicating the hospitals and wards where the respondents worked, the code numbers were only used to identify the hospitals at the time of data analysis. Information to identify the hospitals was handled only by the researcher and promptly discarded following the completion of the study.

V. Results

A total of 1,342 responses were collected from 2,213 subjects (response rate: 60.6%). Of the 1,342 responses, 919 were selected as valid responses (valid response rate: 68.5%), completely excluding overlapping and defective data, and responses from 868 nurses were analyzed in the present survey.

1. Attributes of surveyed facilities

Table 1 shows the attributes of surveyed facilities. Ten 7:1 and five 10:1 hospitals cooperated in the present survey. The mean numbers of beds for general patients in 7:1 and 10:1 hospitals were 356.8 ± 157.6 and 322.2 ± 87.8, respectively. The mean bed occupancy rates for 7:1 and 10:1 hospitals were 78.4 ± 10.8 and 82.6 ± 7.2%, respectively. The mean hospitalization periods for 7:1 and 10:1 hospitals were 14.1 ± 1.7 and 16.3 ± 3.4 days, respectively.

2. Basic attributes of subjects

Table 2 shows the basic attributes of the subjects. The 7:1 and 10:1 groups included 625 and 243 nurses, respectively (a total of 868). The mean age was 33.7 ± 9.0 years old (33.6 ± 9.2 for the 7:1 group and 33.9 ± 8.3 for the 10:1 group). The mean period of experience as nurses was 11.4 ± 8.5 years (11.3 ± 8.7 for the 7:1 group and 11.6 ± 8.1 for the 10:1 group). There were no significant differences in the basic attributes of subjects between the two groups.

3. Status of implementing nursing-related tasks

Table 3 shows the status of implementing nursing-related tasks according to the pattern of nurse staffing. A significantly larger number of nurses in the 7:1 group conducted the tasks of single-dose-packaging ($\chi^2_{(2)}$=11.6, p<0.01) and bed-making ($\chi^2_{(2)}$=12.62, p<0.01) on a regular basis, compared to nurses in the 10:1 group. On the other hand, a significantly larger number of 7:1 hospital nurses conducted the following three tasks: serving meals ($\chi^2_{(2)}$=9.86, p<0.01), transfer of drugs ($\chi^2_{(2)}$=14.42, p<0.001), transfer of hygiene materials ($\chi^2_{(2)}$=21.39, p<0.001)

4. Differences in nurse staffing and their relationships with the levels of job stressors, accumulated fatigue, and intention to continue working

Table 4 shows mean job stressor and accumulated fatigue

Table 1. Attributes of surveyed facilities

Number of hospitals (number of wards)	7:1 hospitals	10:1 hospitals	Total
	10 (67)	5 (30)	15 (97)
Mean number of beds for general patients[*1] ± SD (beds)	356.8±157.6	322.2±87.8	345.3±135.8
Mean bed occupancy rate ± SD (%)	78.4±10.8	82.6±7.2	79.8±9.7
Mean hospitalization period ± SD (days)	14.8±1.7	16.3±3.4	15.3±2.4
Organizations that established health care facilities[*2] (number of facilities)	Public health care institutions (8) Social insurance-related organizations (1) Health care corporations (1)	Public health care institutions (3) Social insurance-related organizations (1) Health care corporations (1)	Public health care institutions (11) Social insurance-related organizations (2) Health care corporations (2)
Population of the area (city) ± SD (number of people)	165,407.5±87,199.3	154,016.6±17,545.9	161,610.5±94,163.3

[Note] All are hospitals that have adopted the DPC (diagnostic procedure combination)-based calculation system
[*1]: Number of beds as reported to the ministry
[*2]: Organizations that established health care facilities were classified according to a large classification by the Ministry of Health, Labour, and Welfare as part of its survey of medical facilities.

Table 2. Basic attributes of subjects

Attribute	Classification	Total N=868		7:1 hospitals N=625		10:1 hospitals N=243		t or χ^2 value
		N	%	N	%	N	%	
1. Mean age[*1] ± SD		33.7± 9.0		33.6±9.2		33.9±8.3		t =-0.52 n.s.
2. Age categories[*2]	20s	351	40.4	264	42.2	87	35.8	χ^2=7.68n.s.
	30s	293	33.8	198	31.7	95	39.1	
	40s	165	19	115	18.4	50	20.6	
	50s or older	59	6.8	48	7.7	11	4.5	
3. Gender[*2]	Male	17	2	12	1.9	5	2.1	χ^2=0.17n.s.
	Female	851	98	613	98.1	238	98	
4. Mean number of years of experience as nurses[*1] ± SD		11.4±8.5		11.3±8.7		11.6±8.1		t =-0.49n.s.
5. Managerial position[*2]	None	733	84.5	532	85.1	201	82.7	χ^2=1.93n.s.
	Chief/Vice head nurse	98	11.3	70	11.2	28	11.5	
	Head nurse	37	4.3	23	3.7	114	5.8	
6. Marital status[*2]	Unmarried	445	51.3	326	52.2	119	49	χ^2=1.13n.s.
	Married	394	45.4	280	44.8	114	46.9	
	Divorced/Bereaved	29	3.3	19	3	10	4.1	
7. With or without children[*2]	With children	326	37.6	223	35.7	103	42.4	χ^2=3.36n.s.
	No children	542	62.4	402	64.3	140	57.6	

[Note] [*1]: t test [*2]: χ^2 test

Table 3. Nurse staffing and the status of implementing nursing-related tasks

Items	Status of implementation	Total		7:1 hospitals		10:1 hospitals		χ^2 value
		N	%	N	%	N	%	
Serving of meals	Task conducted on a regular basis	570	65.7	392	62.7	178	73.3	9.86**
	On holidays/at night/in emergency situations	221	25.5	392	62.7	52	21.4	
	Task not conducted/Others	77	8.9	169	27	13	5.4	
Checking of leftovers	Task conducted on a regular basis	614	70.7	64	10.2	185	76.1	4.75n.s.
	On holidays/at night/in emergency situations	144	16.6	429	68.6	33	13.6	
	Task not conducted/Others	110	12.7	111	17.8	25	10.3	
Single-dose packaging of drugs	Task conducted on a regular basis	612	70.5	85	13.6	156	64.2	11.6**
	On holidays/at night/in emergency situations	132	15.2	456	73	53	21.8	
	Task not conducted/Others	124	14.3	79	12.6	34	14	
Mixing	Task conducted on a regular basis	740	85.3	90	14.4	209	86	5.87n.s.
	On holidays/at night/in emergency situations	68	7.8	531	85	12	4.9	
	Task not conducted/Others	60	6.9	56	9	22	9.1	
Drug inventory management	Task conducted on a regular basis	257	29.6	38	6.1	83	34.2	4.47n.s.
	On holidays/at night/in emergency situations	306	35.3	174	27.8	86	35.4	
	Task not conducted/Others	305	35.1	231	37	74	30.5	
Transfer of drugs	Task conducted on a regular basis	152	17.5	91	14.6	61	25.1	14.42***
	On holidays/at night/in emergency situations	498	57.4	366	58.6	132	54.3	
	Task not conducted/Others	218	25.1	168	26.9	50	20.6	
Transfer of hygiene materials	Task conducted on a regular basis	61	7	34	5.4	27	11.1	21.39***
	On holidays/at night/in emergency situations	408	47	276	44.2	132	54.3	
	Task not conducted/Others	399	46	315	50.4	84	34.6	
Transfer of specimens	Task conducted on a regular basis	158	18.2	103	16.5	55	22.6	4.54n.s.
	On holidays/at night/in emergency situations	620	71.4	457	73.1	163	67.1	
	Task not conducted/Others	90	10.4	65	10.4	25	10.3	
Bed-making	Task conducted on a regular basis	359	41.4	278	44.5	81	33.3	12.62**
	On holidays/at night/in emergency situations	406	46.8	269	43	137	56.4	
	Task not conducted/Others	103	11.9	78	12.5	25	10.3	
ME maintenance and inspections	Task conducted on a regular basis	246	28.3	181	29	65	26.8	0.54n.s.
	On holidays/at night/in emergency situations	193	22.2	136	21.8	57	23.5	
	Task not conducted/Others	429	49.4	308	49.3	121	49.8	

[Note] χ^2 test ***:p< 0.001 **:p< 0.01

scores and SDs, as well as Cronbach's alpha coefficients.

a. Nurse staffing and job stressors (Figure 1)

The job stressor score was 2.86 ± 0.52 points for the 7:1 group and 2.84 ± 0.51 points for the 10:1 group; there was no

significant difference between the two groups. Mean scores on job stressor-related subscales were compared between the two groups. Mean scores for <stressors related to personal relationships in the workplace> ($t_{(866)}$=-2.38, p<0.05) and <stressors related to the workload> ($t_{(866)}$=-2.00, p<0.05) received by the 7:1 group were significantly lower. There

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were no significant differences in other job stressor-related subscale scores between the two groups. In both groups, the score for <stressors related to the attitude toward death> was the lowest and the score for <stressors related to the workload> was the highest. Cronbach's α in the job stressor scale was between 0.62 and 0.83.

b. Nurse staffing and the level of accumulated fatigue (Figure 2)

Mean scores for [subjective symptom assessment], [work condition assessment], and [the workload] were compared between the two groups. The 7:1 group received a significantly higher score for [subjective symptom assessment] ($t_{(866)}$=-2.43, p<0.05). No significant differences were noted in other items between the two groups. Cronbach's α in the accumulated fatigue scale was between 0.74 and 0.88.

c. Nurse staffing and the intention to continue working

Table 5 shows the intention to continue working according to the pattern of nurse staffing. To the question: "Do you think of this hospital as an excellent workplace in general?", a larger number of nurses in the 7:1 group answered "Yes" than those in the 10:1 group ($\chi^2_{(2)}$=15.27, p<0.001). There were no significant differences in other items between the two groups.

5. The influence of nurse staffing on dependent variables

a. Relationship between nurse staffing and dependent variables

Table 6 shows Pearson's correlation coefficients. Although there was a significant correlation between nurse staffing and the intention to continue working (r=0.072, p<0.05), it was not significantly correlated with the levels of job stressors, accumulated fatigue, and nursing-related tasks. Nurse staffing was significantly correlated with the number of beds for general patients (r=0.286, p<0.001), mean bed occupancy rate (r=-0.158, p<0.001), and mean hospitalization period (number of days) (r=-0.133, p<0.001).

Although nursing-related tasks were not significantly correlated with nurse staffing, they were significantly correlated with the level of job stressors (r=0.120, p<0.01), accumulated fatigue (r=0.135, p<0.01), and intention to continue working (r=-0.94, p<0.01). There were also significant correlations between the levels of job stressors, accumulated fatigue, and intention to continue working.

Figure 3 shows the relationships between the attributes of health institutions, including nurse staffing and nursing-related tasks, the levels of job stressors, accumulated fatigue, and intention to continue working. The variables were plotted assuming that nurse staffing and other attributes of institutions were associated with the levels of job stressors

Table 4. Job stressor and accumulated fatigue subscale scores, SD, and reliability analysis

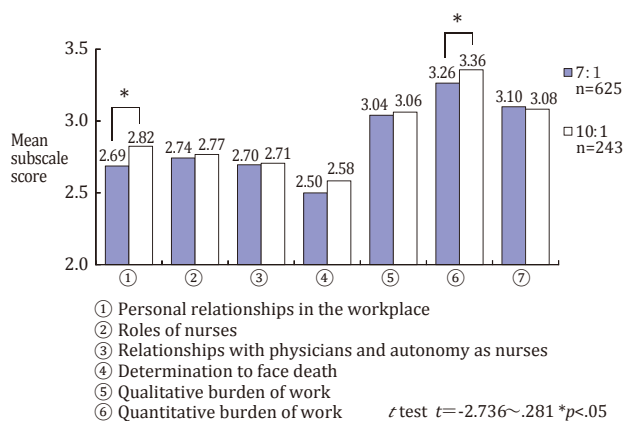| Survey scale and subscale items (number of items)	Total	7:1 hospitals	10:1 hospitals	Cronbach's alpha coefficient
Scales for assessment of job stressors in clinical nurses (33)	2.86±.52	2.84±.52	2.90±.51	–
Personal relationships in the workplace (7)	2.73±.77	2.69±.78	2.82±.73	0.82
Roles of nurses (5)	2.75±.65	2.74±.6	2.77±.65	0.82
Relationships with physicians and autonomy as nurses (5)	2.70±.80	2.70±.79	2.71±.84	0.82
Determination to face death (4)	2.52±.76	2.50±.76	2.58±.76	0.62
Qualitative burden of work (5)	3.05±.66	3.04±.68	3.06±.62	0.8
Quantitative burden of work (5)	3.29±.61	3.26±.61	3.36±.60	0.83
Relationships with patients (2)	3.09±.79	3.10±.78	3.08±.83	0.74
Checklist for self-analysis of the level of accumulated fatigue in employees (20)	4.36±2.15	4.29±2.2	4.56±2.1	–
Assessment of the workload (level of accumulated fatigue)				
Assessment of subjective symptoms (13)	15.21±8.73	14.76±8.62	16.36±8.94	0.88
Assessment of working conditions (7)	5.81±3.70	5.72±3.67	6.04±3.78	0.74

① Personal relationships in the workplace
② Roles of nurses
③ Relationships with physicians and autonomy as nurses
④ Determination to face death
⑤ Qualitative burden of work
⑥ Quantitative burden of work
t test t=-2.736~.281 *p<.05

Figure 1. Job stressor scale scores

① Workload
② Assessment of subjective symptoms
③ Assessment of working conditions
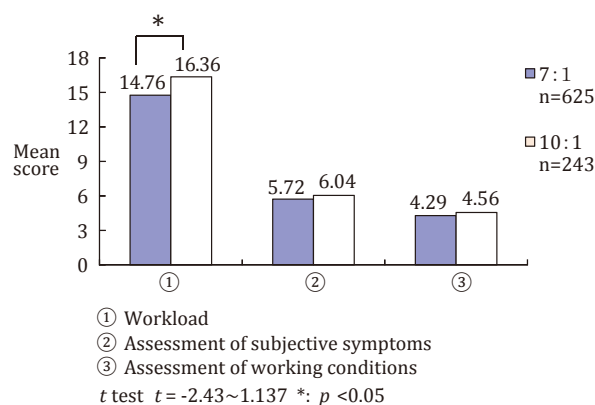t test t = -2.43~1.137 *: p <0.05

Figure 2. Accumulated fatigue scale scores

**Table 5. Differences in the intention to continue working depending on the nurse staffing ratio**

Items	Answer	7:1 hospitals		10:1 hospitals		χ^2 value
		N	%	N	%	
Do you think of this hospital as an excellent workplace in general?	Yes	272	43.5	71	29.2	15.27
	I do not know	274	43.8	130	53.5	
	No	79	12.6	42	17.3	***
Do you think of yourself as a member of this hospital?	Yes	498	79.7	194	79.8	
	I do not know	118	18.9	45	18.5	0.062
	No	9	1.4	4	1.6	n.s.
Have you ever thought of leaving this hospital?	Yes	469	75	207	85.2	
	I do not know	88	14.1	21	8.6	4.747
	No	68	10.9	15	6.2	n.s.
Do you hope to continue working at this hospital?	Yes	254	40.6	84	34.6	
	I do not know	295	47.2	119	49	4.521
	No	76	12.2	40	16.5	n.s.
Are you planning to leave this hospital (in two years)?	Yes	81	13	39	16	
	I do not know	352	56.3	122	50.2	2.913
	No	192	30.7	82	33.7	n.s.

***: p< 0.001

Table 6. Pearson's correlation coefficients between the attributes of facilities and individual nurses and dependent variables (Total N=868)

	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12	-13
(1) Nurse staffing [1]	1												
(2) Number of beds for general patients	.286***	1											
(3) Mean bed occupancy rate	-.158***	0.05	1										
(4) Mean hospitalization period	-.133***	-.652***	0.054	1									
(5) Implementation of nursing-related tasks [2]	-0.053	-.189***	0	.234***	1								
(6) Age	-0.017	0.005	-.108**	0.026	-.107**	1							
(7) Number of years of experience as nurses	-0.016	0.023	-.083*	0.017	-.109**	.938***	1						
(8) Managerial post [3]	-0.03	-0.018	0.019	-0.01	-.245***	.478***	.501***	1					
(9) Marital status	-0.019	-0.064	-0.019	.078*	-.092**	.444***	.443***	.222***	1				
(10) With or without children [5]	-0.062	-0.051	-0.038	.091**	-.069*	.574***	.545***	.278***	.693***	1			
(11) Job stressors	-0.051	0.008	-.069*	-0.006	.120***	.088**	.080*	0.053	0.041	0.057	1		
(12) Level of accumulated fatigue	-0.56	0.013	0.04	-0.049	.135***	-0.008	-0.001	-0.017	-0.04	-0.048	.429**	1	
(13) Intention to continue working [6]	.072*	.080*	.094**	-0.002	-.094**	.188***	.175***	.217***	.120***	.181***	-.144***	-.291***	1

[Note] 1)The 7:1 nurse staffing: 1, the10: 1 nurse staffing: 0　2) The total was calculated by counting the answer "I always perform the task" as one point and other answers as zero points and summing up the scores for ten task-related questions.　3) managerial position: 1, non-managerial position: 0　4) married: 1, unmarried/divorced/bereaved: 0　5) With children: 1, without children: 0　6) The total was calculated by counting an answer that expressed an intention to continue working as one point and other answers as zero points. ***: $p< 0.001$ **: $p< 0.01$ *: $p< 0.05$
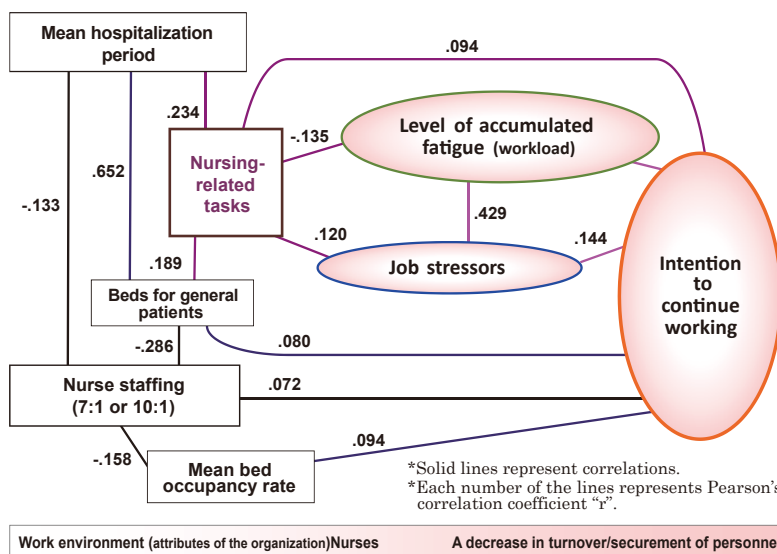
Figure 3. Relationships between the attributes of health institutions, including nurse staffing and scale items

and accumulated fatigue in nurses and their intention to continue working, and that they contributed to the recruitment of nurses and a decrease in the turnover rate.

b. Influences of nurse staffing

Table 7 and Figures 4 and 5 show the results of the multi-regression analysis based on the patterns of nurse staffing. In both 7:1 and 10:1 groups, an increase in the burden of nursing-related tasks increased the levels of job stressors (β=0.090 and $p<0.05$ for the 7:1 group, β=0.233 and $p<0.01$ for the 10:1 group) and accumulated fatigue (β=0.126 and $p<0.01$ for the 7:1 group, β=0.179 and $p<0.01$ for the 10:1 group). In both groups, nurses in a managerial post (β=0.197 and $p<0.01$ for the 7:1 group, β=0.146 and $p<0.05$ for the 10:1 group) and those with children (β=0.134 and $p<0.01$ for the 7:1 group, β=0.143 and $p<0.05$ for the 10:1 group) more strongly hoped to continue working.

In the 7:1 group, the higher the mean bed occupancy rate, the greater the intention to continue working (β=0.119 and $p<0.01$) and accumulated fatigue (β=0.081 and $p<0.05$), and the shorter the mean duration of hospitalization, the greater the intention to continue working (β=-0.81, $p<0.05$) and accumulated fatigue (β=-0.121 and $p<0.01$).

In the 10:1 group, the higher the age, the higher the level of job stressors (β=-0.216, $p<0.01$), which is not in line with the 7:1 group.

VI. Discussion

1. Differences in the characteristics of health care facilities due to varying nurse staffing

The attributes of health care facilities selected for the present survey, including the number of beds per ward, mean hospitalization period (number of days), and bed occupancy rate, were in line with those of 7:1 and 10:1 hospitals selected as the subjects of the "survey regarding 7:1 basic hospitalization fee hospitals" (Ministry of Health, Labour, and Welfare, 2009a) conducted by the Central Social Insurance Medical Council. Therefore, 7:1 and 10:1 groups, selected as the subjects of the present study, are considered to represent groups of nurses from registered 7:1 and 10:1 hospitals in Japan, respectively.

No significant differences were noted in the attributes of 7:1 and 10:1 hospitals. All health care facilities that consented to cooperate in the survey had adopted the DPC (diagnostic procedure combination) system, and efforts to shorten the mean hospitalization period and differentiate their functions were already in progress. On the other hand, as the 7:1 hospitals had to satisfy a criterion for 7:1 nurse staffing, a mean hospitalization period of 19 days or shorter, they had a greater incentive to shorten the duration of hospitalization than the 10:1 hospitals, instead of increasing the bed occupancy rate. Therefore, an extension of the mean duration of hospitalization increased job stressors and the level of accumulated fatigue in the 7:1 group.

A significantly larger number of nursing-related tasks, transfer and other tasks not involving direct contact with patients in particular, were performed by the 10:1 group. When hospitals introduced 7:1 nurse staffing and newly recruited nurses, most of them are reported to have reviewed nursing tasks, including their commission to other professionals (Kurosawa, 2008; Takehisa, 2008) - the majority of transfer and other tasks not directly related to patients were commissioned to other professionals and commissioned staff. A shortage of nurses attributed to the adoption of 7:1 nurse staffing may inappropriately increase salaries for nurses, their salaries as a percentage of the total personnel expenditure, and eventually the budget for recruiting other staff. For this reason, it has been pointed out that the adoption of 7:1 nurse staffing may increase the burden of nursing-related tasks performed by nurses (Sumida, 2007). However, according to the results of the present study, the numbers of staff other than nurses and the burden of related tasks performed by nurses were maintained.

Although bed-making was assigned to commissioned staff and assistant nurses in most hospitals, regardless of the nurse staffing ratio, most nurses in the 7:1 group performed the task on a regular basis. Different from other nursing-related tasks, bed-baking directly influences the lives of patients. The 7:1 hospitals presumably provided appropriate nursing care intervention, including the exchange of sheets on a regular and as-required basis.

Table 7. Effects of nurse staffing on the levels of job stressors, accumulated fatigue, and intention to continue working

	Job stressors			Level of accumulated fatigue			Intention to continue working [1]		
	Total	7:1	10:1	Total	7:1	10:1	Total	7:1	10:1
Nurse staffing [2]		–	–		–	–	.104**	–	–
Mean bed occupancy rate					.081*		.112**	.119**	
Mean hospitalization period		-.081*		-.085*	-.121**				
Nursing-related tasks [3]	.131***	.090*	.233***	.155***	.126**	.179**			
Age	.102**		.216**						
Managerial or non-managerial post [4]							.179***	.197***	.146*
With or without children [5]							.142***	.134**	.143*
Adjusted R²	0.023	0.016	0.084	0.023	0.024	0.028	0.078	0.081	0.043
F value	11.011 ***	4.335 ***	12.144 ***	11.172 ***	6.194 ***	7.916 ***	19.371 ***	19.432 ***	6.374 **

[Note] 1. The values represent significant differences in the standardized regression coefficient "β"
　　2. The numbers of beds for general patients, years of experience as nurses, and marital status are not expressed in the table because they were not adopted as criterion variables.
　　　　1) The total was calculated by counting an answer that expressed the intention to continue working as one point and other answers as zero points.　2) The 7: 1 nurse staffing : 1, the 10:1 nurse staffing: 0　3) The total was calculated by counting the answer "I always perform the task" as one point and other answers as zero points and summing up the scores in ten task-related questions.
　　　　4) Managerial post: 1, non-managerial post: 0　5) With children: 1, without children: 0
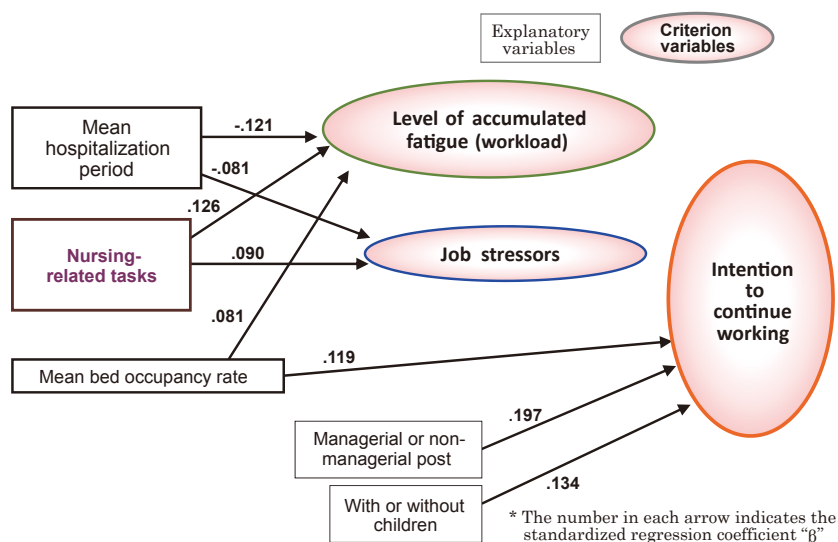　　　***: $p< 0.001$　**: $p< 0.01$　*: $p< 0.05$

Figure 4. Effects of the attributes of facilities and individual nurses on scale items in the 7:1 group
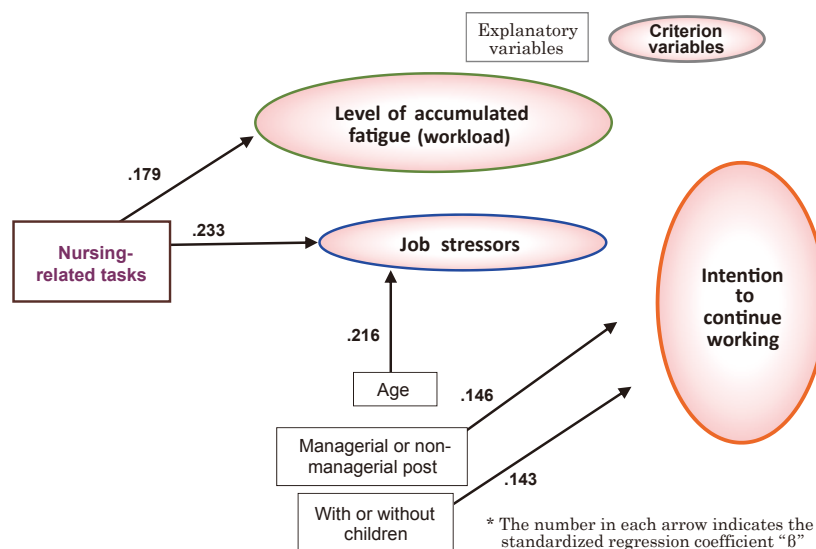

Figure 5. Effects of the attributes of facilities and individual nurses on scale items in the 10:1 group

These results suggested that the 7:1 group could afford to spend more time providing nursing care, compared to the 10:1 group, because they were exempt from transfer and other chores. Yamaguchi et al. (2006) stated that, when nurses are unable to fulfill their primary duties (or unable to provide adequate care services), it has negative effects on the sense of satisfaction with the job and their commitment to it, leading to a high turnover rate. When performing nursing-related tasks, the transfer of patients in particular, nurses cannot take advantage of their expertise because they do not directly come into contact with patients. Therefore, nursing-related tasks, which were performed by a significantly larger number of nurses in the 10:1 group, may have increased job stress in nurses and even reduced their motivation to continue working.

2. Differences in the characteristics of dependent variables due to varying nurse staffing

a. Differences in the characteristics of job stressors due to varying nurse staffing

The 7:1 group received significantly lower mean scores for <stressors related to personal relationships at work> and <stressors related to the workload> than the 10:1 group. <Stressors related to personal relationships at work> is a subscale item to determine scores for stressors related to interpersonal relationships in the workplace, social support provided by seniors and colleagues, and differences in their attitudes toward work. The introduction of 7:1 nurse staffing is considered to have alleviated the shortage of nurses and reduced the "stressors related to personal relationships at work".

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<Stressors related to the workload> is a subscale item to determine scores for stressors related to the workload placed on nurses. Nurses are in charge of different numbers of patients depending on the patient-nurse ratio. In addition to this, the 10:1 group had to conduct a larger number of nursing-related tasks than the 7:1 group, which is assumed to have caused a larger number of stressors.

Shimazu (2004) stated that, in work settings in which a large workload is placed on a nurse, stress responses are more effectively reduced by achieving a sense of satisfaction at work rather than reducing the workload. As nurses in the 10:1 group were involved in a number of nursing-related tasks, transfer in particular, it is necessary to help promote their sense of satisfaction with work. Prior to the survey, other stressors in the 7:1 group had been expected to be fewer compared to the 10:1 group because the former provided quality care for fewer patients, although no significant differences were noted between the two groups. The 2008 revision of reimbursement fees included new criteria for 7:1 nurse staffing: the mean hospitalization period of 19 days or shorter; determination of the level at which a patient is in need of nursing care, and a specified number of inpatients who have satisfied the requirements. In other words, the 7:1 group was required to promote the earlier discharge of more seriously ill patients, compared to the 10:1 group. Therefore, nurses in the 7:1 group did not recognize the positive effects of 7:1 nursing staff on relationships with patients and the quality of tasks conducted, although they were in charge of fewer patients.

There were no significant differences in the following job stressor-related subscale scores between the two groups: <stressors related to roles as nurses>, <stressors related to relationships with physicians and autonomy as nurses>, <stressors related to the attitude toward death>, <stressors related to the qualitative burden of work>, and <stressors related to relationships with patients>; these subscale items are presumably not affected by nurse staffing. Nurses may consider that qualitative items, such as the roles of nurses and their relationships with physicians, are not associated with the deployment of a sufficient number of nurses.

b. Differences in the characteristics of the level of accumulated fatigue due to varying nurse staffing

The 7:1 group received a lower "subjective symptom assessment" score than the 10:1 group; nurses in the 7:1 group did not have a strong feeling of fatigue as a physical symptom. No significant differences were noted in [working conditions] and [burden at work] depending on the pattern of nurse staffing, and even nurses at 7:1 hospitals, in which the shortage of nurses was considered to be less serious, felt burdened while working. This was presumably because the 7:1 hospitals were required to facilitate the discharge of seriously ill patients in the acute phase and nurses had a busy schedule to fulfill the criteria for 7:1 nurse staffing, although a larger number of nurses are deployed in 7:1 compared to 10:1 hospitals.

c. Differences in the characteristics of the intention to continue working due to varying nurse staffing

To the question: "Do you think of this hospital as an excellent workplace in general?", a larger number of nurses in the 7:1 group answered "Yes" than those in the 10:1 group. Nurses had presumably received increasingly higher recognition from other health professionals, directly experienced by nurses themselves, since the hospital as a whole was determined to secure the required number of nurses in response to the introduction of 7:1 nurse staffing.

A number of previous studies suggested the relationship between psychological stress and burnout syndrome experienced by nurses, as well as a correlation between burnout and the intention to quit their job (Tsukamoto and Nomura, 2007). The present study also revealed significant correlations between the intention to continue working and variables; their intention was influenced by job stressors and the level of accumulated fatigue.

3. Relationships between differences in nurse staffing, job stressors, and the levels of accumulated fatigue and intention to continue working

The correlation coefficients were calculated and a multi-regression analysis was conducted. The results suggested that nurse staffing was associated with the intention to continue working, and nursing-related tasks, which were influenced by differences in the deployment of nurses, affected job stressors, the levels of accumulated fatigue, and intention to continue working. The mean hospitalization period and bed occupancy rate for 7:1 hospitals were associated with the levels of job stressors and intention to continue working in the 7:1 group in a characteristic manner. This means that the attributes of hospitals that could afford to deploy nurses with a patient-to-nurse ratio of 7:1, rather than the number of nurses itself, may have positively influenced job stressors, the level of accumulated fatigue, and intention to continue working. To become qualified for 7:1 nurse staffing, a hospital is required to exert a collective effort. These attitudes of hospitals are assumed to influence nurses.

Ashish, Orav, Zheng, and Epstein (2008) examined factors related to the results of nurses' assessments of hospitals including items experienced by patients. Their study suggested that a hospital's characteristics that contribute to a high nurse-patient ratio may be associated with patients' favorable experiences, and presented evidence that a hospital can not only provide quality clinical care, but also help patients have favorable experiences. The results - nurses' intention to continue working is affected by nurse staffing and the status of implementing nursing-related tasks, suggest that these factors may also influence patients' satisfaction and management costs as well as nurses. Under the current reimbursement system and policy of curbing medical expenditure, "7:1 nurse staffing" is a life-or-death managerial decision. It is important for nursing managers to consider nurse staffing from the viewpoints of reducing the turnover of nurses they are in charge of, patients' assessments, and the viability of the hospital, in addition to increasing the basic hospitalization fee. They are also required to present the positive effects of the adoption of 7:1 nurse staffing using subjective data.

It should also be noted that factors including the age and job title of a nurse and whether or not he/she had children affected the intention to continue working, which is in line with the results of previous studies (Hirai et al., 2003; Nakanishi, Tsuge, and Futatsumori, 2007; Ohara, Maruguchi, Nishio, Tanaka, and Hirai, 2004). As most nurses are female,

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the turnover rate is significantly influenced by marriage, childbirth, and other major life events. To secure the required number of quality nurses, it is necessary to not only improve nurse staffing and the assignment of nursing-related tasks, but also implement nursing management while taking into consideration the backgrounds of individual nurses.

VII. Conclusion

1. The levels of job stressors and accumulated fatigue in nurses of the 7:1 group were lower compared to the 10:1 group, and the intention to continue working was greater.

2. In 7:1 hospitals, the longer the hospitalization period, or the higher the mean bed occupancy rate, the lower the levels of accumulated fatigue and intention to continue working.

3. The status of implementing nursing-related tasks, which varied depending on the pattern of nurse staffing, affected the levels of job stressors and accumulated fatigue and their intention to continue working.

4. Characteristics of hospitals qualified for 7:1 nurse staffing may have influenced the levels of job stressors and accumulated fatigue in nurses and their intention to continue work in a positive manner.

VIII. Future Challenges

The present study adopted the levels of job stressors, accumulated fatigue, and intention to continue working as indices of nurses' task performance affected by nurse staffing. These variables are considered to be significantly influenced by the characteristics of an organization and its individual employees (Inaoka, 1992; Masamura, Kakeda, Ichihara, Okuda, Tanida, Yoshihara, 2006). Regarding the implementation of nursing-related tasks, tasks assigned to nurses vary depending on the scale of the hospital or according to the criteria. Further examinations should be conducted on the influences of factors other than nurse staffing, such as the characteristics of an organization and its individual employees.

Although the present study discussed nurse staffing based on the criteria for basic hospitalization fees, questions have been raised about the fact that medical fees are determined by the number of nurses, and not by the newly established standard of 7:1 nurse staffing, as a result of a political initiative or the skills of nurses and quality of care (Ogushi, Kitaura, 2009b; Yasukawa, 2005; Yasukawa, 2008). Further studies should be conducted to help implement proper nurse staffing while taking into account the skills of nurses, nurse-to-practical nurse ratio, and rate of assistant nurse deployment.

Acknowledgment

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