



## Original Article

## Impacts of Job Stress and Cognitive Failure on Patient Safety Incidents among Hospital Nurses

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## ABSTRACT

**Background:** This study aimed to identify the impacts of job stress and cognitive failure on patient safety incidents among hospital nurses in Korea.**Methods:** The study included 279 nurses who worked for at least 6 months in five general hospitals in Korea. Data were collected with self-administered questionnaires designed to measure job stress, cognitive failure, and patient safety incidents.**Results:** This study showed that 27.9% of the participants had experienced patient safety incidents in the past 6 months. Factors affecting incidents were found to be shift work [odds ratio (OR) = 6.85], cognitive failure (OR = 2.92), lacking job autonomy (OR = 0.97), and job instability (OR = 1.02).**Conclusion:** Patient safety incidents were affected by shift work, cognitive failure, and job stress. Many countermeasures to reduce the incidents caused by shift work, and plans to reduce job stress to reduce the workers' cognitive failure are required. In addition, there is a necessity to reduce job instability and clearly define the scope and authority for duties that are directly related to the patient's safety.

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## 1. Introduction

In modern society, duties at a hospital organization are changing even more intricately with continued advancement in therapeutic skills in a departmentalized organization, patients frequently coming in and out of hospital, and demands for the best possible service.

Nurses, forming the majority of hospital personnel, are not only forced to be always personable based on hospital policy, putting customer satisfaction first, but they are also expected to provide high-quality nursing service. They need to put in many hours to learn ever-changing medical techniques; duties include dealing with nursing clients and hospital staff in other occupations, and they are the guardians of patients for the greatest amount of time during treatment. Such characteristics of duty can increase a nurse's job stress and cause them to have higher levels of stress than other occupations [1].

Job stress has an effect on a person's well-being, including cognitive, psychological, physiological, and behavioral aspects. In

highly stressful conditions, stress occupies the brain's memory of an task [2], leading to a lowered mental concentration [3]. Chronic stress causes damage to the cerebral structures such as hippocampus which can be accompanied by difficulties in cognitive functions [4]. These can increase error rates in duties and lead to an accident [2].

Usually, accidents occur as a result of lack of selective attention, mental error, or wrong cognition/attention such as distraction [5], whereas patient safety incidents in a hospital include all kinds of errors, mistakes, and accidents occurring in a hospital.

Referring to the mechanism of stress that increases the danger of accidents, Reason [6] maintains that stress factors affect a person's pattern of cognition, increasing the ratio of absentmindedness and simultaneously resulting in the performance of an improper strategy in dealing with a stressful situation. Such a situation is called cognitive failure, an example of which might be being unable to remember the name of a familiar person instantly, or making an error such as throwing a piece of candy into a wastebasket and putting its wrapper in one's mouth [7]. These

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kinds of acts occur in performing well-practiced tasks that hardly need careful attention, such as paying for an item and then leaving the shop carrying the bag that contains it [8].

Nurses are considered to carry higher job stress compared with other occupations, and thus have a high likelihood for cognitive failure, which may lead to patient safety incidents. However, studies on cognitive failure so far [2,9–14] have been chiefly on manufacturing or railway workers, college students, and general office workers, except for a single study regarding Swiss nurses [15].

Therefore, this study aims to examine the level of job stress and cognitive failure among hospital nurses and analyze their impacts on patient safety incidents for future use as basic data in promoting the safety of patients.

## 2. Materials and methods

### 2.1. Study design

This is a descriptive correlation study attempting to grasp the level of job stress, cognitive failure, and patient safety incidents among hospital nurses and to verify the predictor variables of incidents.

### 2.2. Sample and setting

The participants of this study are nurses working in five general hospitals located in Daejeon and Chungcheong provinces in Korea and with over 6 months of clinical experience, which was sampled by convenience from each hospital.

Participant numbers were calculated using G\*Power 3.1.3, which is a sample-size estimating program. The minimum sample size required was calculated as 261 people, considering a significance level of 0.05, effect size of 0.10, and power of 0.8 for inclusion of 28 independent variables. After a total of 300 copies of questionnaire were handed out considering wastage rates, 299 copies were collected, of which a total of 279 copies were used for analysis after excluding inappropriate ones. The response rate was 99.7%.

### 2.3. Instruments

#### 2.3.1. Job stress

Job stress was measured through the Short Form of the Korean Occupational Stress Scale (SF-KOSS) developed by Chang et al [16] by inclusion of the “physical environment” sphere for KOSS.

The subarea of this tool was composed of eight areas and it included 27 question items: physical environment ( $n = 3$ ), job demand ( $n = 4$ ), lack of job autonomy ( $n = 4$ ), relational conflict ( $n = 3$ ), job instability ( $n = 2$ ), organizational system ( $n = 4$ ), improper reward ( $n = 3$ ), and work culture ( $n = 4$ ). For each item, job stress was measured on a Likert 4-point scale with the following equivalents: strongly disagree (1), disagree (2), agree (3), and strongly agree (4) in inverse conversion for positive items. Job stress points were calculated by converting them into 100 full marks by subarea, with higher scores signifying more job stress. Cronbach  $\alpha$  of SF-KOSS was 0.84 in this study.

#### 2.3.2. Cognitive failure

For cognitive failure, the Workplace Cognitive Failure Scale developed by Wallace and Chen [11] was used. After obtaining permission to use the scale from J. Crag Wallace in advance through an e-mail, this research team translated it into Korean. The scale was used in this study after it was reviewed for expression and translation by a professor currently teaching English at a college.

The subarea of this tool is composed of three areas (15 items), including memory ( $n = 5$ ), attention ( $n = 5$ ), and action ( $n = 5$ ). Memory refers to failure to remember a familiar duty and related information, whereas attention refers to failure to focus one's attention on a duty. Action refers to failure to perform proper acts in the way they are intended and suited for a purpose in a person's engagement. Each item is evaluated on a Likert 5-point scale as follows: “Nothing” (1), “Rare” (2), “Sometimes” (3), “Often” (4), and “Very frequent” (5), with a higher point meaning higher failure of cognition. In this study, Cronbach  $\alpha$  for this tool was 0.90.

### 2.4. Patient safety incidents

Out of the question items for patient safety incidents translated by Kim et al [17] from the questionnaire on the Hospital Survey on Patient Safety Culture developed by the Agency for Healthcare Research and Quality in the United States, the first item on frequently reported incidents was used for the answer choices for this study. The question inquired whether one made a mistake that could harm the patient in the past 6 months. The modified answer choices were composed of “Never,” “Several times in 6 months,” “Several times in a month,” “Several times in a week,” and “More than once in a day.”

### 2.5. Personality type

Personality was also measured because the researcher thought the participant's personality can have an effect on cognitive failure and incidents. Personality was measured using the Heart-Type A scale adapted by Chang and Kang [18] from the questionnaire for behavioral type developed by Girdano et al [19]. This tool comprises 10 items with a Likert scale including the responses “Always so” (4), “Often so” (3), “Not so” (2), and “Never so” (1). By summing the marks for each item, a total of 24 marks or over was designated an A-type personality and 23 marks or under a B-type personality. Cronbach  $\alpha$  of the scale was 0.77 in the study.

### 2.6. Data-collection procedures

Data were collected through a self-administered survey from August 23 to September 25, 2011, under approval from the Institutional Review Board (Eulji University) in July 2011 (EU 11-27).

For the purpose of data collection, the researcher visited the nursing section of the target hospital and explained the purpose of the study, received permission, and then conducted the survey through persons in charge of each ward. The questionnaire explained the purpose of the study and stated the participant's rights, with no use for collected data other than the study purpose, and that the data was handled anonymously. Participants in the study were asked for a prior written consent with signature.

### 2.7. Data analysis

Data were analyzed using PASW Statistics 18. The participants' general characteristics, job stress, cognitive failure, and yes or no incidents were analyzed with descriptive statistics including frequency, percentage, mean, standard deviation, etc. To determine the correlation between the participants' general characteristics and incidents, the Chi-square test was performed. The difference in job stress and cognitive failure between the incident group and the no incident group was analyzed using a  $t$  test. The correlation among job stress, cognitive failure, and incidents was analyzed using Pearson correlation coefficients. To analyze the factors influencing incidents, multivariate logistic regression analysis was performed.

**Table 1**  
Patient safety incidents (N = 279)

	Response	n	%
Did you make a mistake that could harm a patient in the past 6 months	Never	201	72.1
	Several times in 6 months	69	24.7
	Several times in a month	7	2.5
	Several times in a week	2	0.7
	More than once in a day	0	0

### 3. Results

#### 3.1. General characteristics of participants

Table 1 shows the participants' ratio of experiencing patient safety incidents. The question about doing harm to patients by mistake in the past 6 months was answered with "Never" (72.1%), "Once in 6 months" (24.7%), "Once in a month" (2.5%), and "More than once in a day" (0%).

The general characteristics of the participants are shown in Table 2. A total of 97.5% of them were female, most (50.9%) were in their 20s, with their average age being 31.3 years ( $\pm 7.3$ ). The majority was unmarried (59.2%) and 56.1% had religion. For personality type, 62.7% were Type A and 37.3% were Type B. For clinical experience, most (37.3%) had over 10 years' experience and a mean duration of 9.0 ( $\pm 8.6$ ) service years. With regard to position, most were registered general nurses (78.9%), with 75.3% of them working shift duty.

To investigate the relation between participants' general characteristics and incidents, the Chi-square test was performed by classifying participants into those who had experienced incidents and those who had not in the past 6 months (Table 2). This yes or no experience of incidents showed a statistically significant relation with the participant's age, marital status, clinic years, position, and shift of duty. As for age, participants in their 20s who had experienced incidents (37.3%) outnumbered those in their 40s (20.9%) or

30s (17.1%). Further, more incidents were found among unmarried (34.1%) compared with married (19.5%) individuals. As for clinical experience, participants with less than 3 years' experience (50.0%) were shown to be involved in more incidents than other groups, whereas general nurses had a higher rate of incidents (31.4%) than participants acting as a charge nurse or a head nurse. In addition, the incident rate was shown to be higher among participants with a shift duty instead of a fixed duty.

Experience of incidents showed no statistically significant relations as to gender, religion, education, and ward in duty or personality type.

#### 3.2. Comparison of all variables between the incident group and the no incident group

Levels of job stress and cognitive failure were compared between the incident group and the no incident group (Table 3). Among the subareas of job stress, the only one showing a statistically significant difference was job instability between the incident group (46.37) and the no incident group (39.55) out of a score of 100.

As to cognitive failure, both subareas and total score showed a significant difference; that is, in all subareas an incident group showed higher marks compared with a no incident group.

#### 3.3. Correlation among job stress, cognitive failure, and patient safety incidents

Table 4 shows the results of analyzing correlations among job stress, cognitive failure, and incidents. Incidents correlate significantly with such subareas for job stress as job stability ( $r = 0.143$ ), relational conflict ( $r = 0.118$ ), and total score of job stress ( $r = 0.217$ ), as well as such subareas for cognitive failure as memory ( $r = 0.217$ ), attention ( $r = 0.266$ ), action ( $r = 0.230$ ), and total score of cognitive failure ( $r = 0.275$ ).

**Table 2**  
Differences in patient safety incidents according to participant characteristics

Variables	Category	n (%)	Incident group (n = 78)	No incident group (n = 201)	$\chi^2$	p
			n (%)	n (%)		
Gender	F	272 (97.5)	77 (28.3)	195 (71.7)	0.75	0.384
	M	7 (2.5)	1 (14.3)	6 (85.7)		
Age (y)	20–29	142 (50.9)	53 (37.3)	89 (62.7)	13.12	0.001
	30–39	94 (33.7)	16 (17.1)	78 (83.0)		
	$\geq 40$	43 (15.4)	9 (20.9)	34 (79.1)		
Marital status	Married	113 (40.8)	22 (19.5)	91 (80.5)	7.34	0.007
	Unmarried	164 (59.2)	56 (34.1)	108 (65.9)		
Religion	Have	156 (56.1)	37 (23.7)	119 (76.3)	2.79	0.094
	None	122 (43.9)	40 (32.8)	82 (67.2)		
Educational status	College and associate degree	124 (44.4)	39 (31.5)	85 (68.5)	2.30	0.316
	Bachelor's degree	85 (30.5)	24 (28.2)	61 (71.8)		
	Graduate school	70 (25.1)	15 (21.4)	55 (78.6)		
Clinical experience (y)	$< 3$	54 (19.4)	27 (50.0)	27 (50.5)	18.15	$< 0.001$
	3–5	51 (18.3)	14 (27.5)	37 (72.5)		
	5–10	70 (25.1)	19 (27.1)	51 (72.9)		
	$\geq 10$	104 (37.3)	18 (17.3)	86 (82.7)		
Job position	Staff nurse	220 (78.9)	69 (31.4)	151 (68.6)	7.440	0.024
	Charge nurse	28 (10.0)	3 (10.7)	25 (89.3)		
	Head nurse	31 (11.1)	6 (19.4)	25 (80.6)		
Shift duty	Shift duty	210 (75.3)	69 (32.9)	141 (67.1)	11.278	0.001
	Fixed duty	69 (24.7)	9 (13.0)	60 (87.0)		
Ward	General ward	195 (69.9)	61 (31.3)	134 (68.7)	4.633	0.201
	Operating room	22 (7.9)	3 (13.6)	19 (86.4)		
	Critical care unit	29 (10.4)	7 (24.1)	22 (75.9)		
	Others	33 (11.8)	7 (21.2)	26 (78.8)		
Personality type	A type	175 (62.7)	51 (29.1)	124 (70.9)	0.330	0.566
	B type	104 (37.3)	27 (26.0)	77 (74.0)		

**Table 3**  
Differences in predictor variables by incident group

Variables	Incident group (n = 78)	No incident group (n = 201)	<i>t</i>	<i>p</i>
	M (SD)	M (SD)		
Job stress (total)	51.04 (9.80)	48.95 (9.04)	-1.69	0.092
Job demand	70.62 (16.92)	70.07 (18.09)	-0.23	0.816
Physical environment	56.55 (14.68)	53.57 (15.47)	-1.47	0.143
Organizational system	54.17 (15.93)	52.78 (14.94)	-0.68	0.495
Improper reward	53.70 (17.12)	52.68 (16.27)	-0.46	0.643
Lack of job autonomy	46.47 (10.62)	48.22 (13.87)	1.00	0.317
Work culture	44.66 (16.34)	41.63 (15.06)	-1.47	0.142
Job instability	46.37 (18.74)	39.55 (18.14)	-2.79	0.006
Relational conflict	35.75 (13.12)	33.11 (11.49)	-1.66	0.099
Cognitive failure (total)	2.03 (0.48)	1.80 (0.44)	-3.78	<0.001
Memory	2.18 (0.50)	1.98 (0.52)	-2.84	0.005
Attention	2.10 (0.57)	1.85 (0.55)	-3.32	0.001
Action	1.80 (0.54)	1.56 (0.48)	-3.60	<0.001

M, mean; SD, standard deviation.

### 3.4. Predictors of incidents

Table 5 shows the results of multivariate logistic regression using the dependent variables of the participants experiencing patient safety incidents and the independent variables of age, marital status, education, clinical experience, job position, shift in duty (general characteristics), subareas of job stress, and cognitive failure.

Variables that have a significant effect on incidents turned out to be shift in duty, cognitive failure, lack of job autonomy, and job instability as a subarea of job stress. As to shift in duty, the odds ratio (OR) on ones for shift duty was 6.85 [confidence interval (CI): 1.72–27.21], which is significantly higher than that for fixed duty. The OR for cognitive failure was 2.92 (CI: 1.44–5.81), meaning that the higher the cognitive failure, the higher the rate of incidents. The OR for lack of job autonomy was 0.97 (CI: 0.94–0.99), whereas that for job instability was 1.02 (CI: 1.01–1.04), revealing that as job autonomy and job instability become higher, the ratios of incidents are also higher.

## 4. Discussion

Of the hospital nurses who participated in this study, 72.1% responded that they had never made an error causing harm to patients in the past 6 months. The remaining 27.9% of all those who experienced patient safety incidents were divided as follows: “Once in 6 months” (24.7%), “Once in a month” (2.5%), “Once in a week” (0.7%), and “More than once in a day” (none). It is hard to apply this result for hospital nurses in general, but it still has significance in the sense of a general understanding of the current condition of patient safety incidents among Korea’s hospital nurses. Considering their occupation deals with the life of patients, this is not to be overlooked; rather, it calls on the development of preventive solutions for the safety of patients.

In this study, variables that have a significant effect on incidents are shift work, cognitive failure, job instability, and lack of job autonomy.

Shift workers showed a 6.97 times (CI: 1.73–27.93) higher possibility of experiencing such incidents compared with those with fixed working hours. This agrees with results of previous studies [20,21], which reported a significantly higher rate of accidents in shift workers than in nonshift workers in manufacturing industries. Shift work is considered to influence the worker’s health and the safety of those who depend on her (or him) in both the short and long term by adversely affecting cycles of physiological rhythm and activity. This necessitates more research on plans and their application to practice to reduce the incident rates of shift workers. For this purpose, Rosa et al [22] proposes devising a schedule to adopt physiological rhythm quickly, adjust rest/sleep schedules as well as outside stimuli such as illumination, negotiation, and improving physical activity for overcoming fatigue.

The OR of cognitive failure turned out to be 2.96 (CI: 1.48–25.92), meaning that the higher the cognitive failure, the higher the rate of patient safety incidents. This result agreed with previous studies [2,23], which reported a significant correlation between cognitive failure and accidents. Melamed et al [24] maintained that a confusing environment for one’s job or work tends to distract a worker, which causes her/him less attention to danger clues, subsequently increasing the rates of accidents. This means that an effort to reduce cognitive failure should be preceded by finding a plan to lower job stress. Actually, at a scene in a ward, it can easily

**Table 4**  
Correlations between job stress, cognitive failure and patient safety incidents

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Job demand	1	—	—	—	—	—	—	—	—	—	—	—	—	—
Physical environment	0.50*	1	—	—	—	—	—	—	—	—	—	—	—	—
Organizational system	0.30*	0.40*	1	—	—	—	—	—	—	—	—	—	—	—
Improper reward	0.31*	0.37*	0.64*	1	—	—	—	—	—	—	—	—	—	—
Lack of job autonomy	0.09	0.15†	0.28*	0.35*	1	—	—	—	—	—	—	—	—	—
Work culture	0.18‡	0.24*	0.32*	0.21*	0.10	1	—	—	—	—	—	—	—	—
Job instability	0.31*	0.36*	0.26*	0.13‡	0.01	0.40*	1	—	—	—	—	—	—	—
Relational conflict	0.08	0.07	0.25*	0.23*	0.14‡	0.26*	0.19‡	1	—	—	—	—	—	—
Job stress (total)	0.62*	0.67*	0.72*	0.68*	0.41*	0.57*	0.59*	0.43*	1	—	—	—	—	—
Memory	0.06	0.16‡	0.11	0.17‡	0.11	0.05	0.04	0.05	0.16‡	1	—	—	—	—
Attention	0.11	0.17‡	0.15‡	0.14‡	0.13‡	0.14‡	0.03	0.12‡	0.21*	0.65*	1	—	—	—
Action	0.05	0.20‡	0.10	0.08	0.08	0.21‡	0.13‡	0.13‡	0.20*	0.59*	0.60*	1	—	—
Cognitive failure (total)	0.08	0.20*	0.14‡	0.15‡	0.12‡	0.15‡	0.07	0.12‡	0.86*	0.88*	0.84*	0.22*	1	—
Patient safety incidents (yes or no)	0.01	0.08	0.04	0.03	-0.06	0.09	0.17‡	0.09	0.10	0.17‡	0.20‡	0.21*	0.22‡	1

A, job demand; B, physical environment; C, organizational system; D, improper reward; E, lack of job autonomy; F, work culture; G, job instability; H, relational conflict; I, job stress; J, memory; K, attention; L, action; M, cognitive failure; N, patient safety incidents.

\*  $p < 0.001$ .†  $p < 0.01$ .‡  $p < 0.05$ .



**Table 5**  
Multivariate logistic regression: predictors of patient safety incidents

Variables	Category	Patient safety incidents odds ratio (95% CI)
Age (y)	20–29	1
	30–39	0.55 (0.19–1.60)
	≥ 40	1.32 (0.26–6.75)
Marital Status	Married	1
	Unmarried	0.91 (0.41–2.00)
Clinical experience (y)	<3	1
	3–5	0.44 (0.18–1.07)
	5–10	0.52 (0.21–1.29)
	≥ 10	0.54 (0.13–2.21)
Job position	Staff nurse	1
	Charge nurse	0.44 (0.10–1.83)
	Head nurse	2.10 (0.31–14.16)
Shift duty	Shift duty	6.85 (1.72–27.21)*
	Fixed duty	1
Job demand		0.98 (0.96–1.01)
Physical environment		1.01 (0.98–1.03)
Organizational system		0.99 (0.97–1.02)
Improper reward		0.99 (0.97–1.02)
Lack of job autonomy		0.97 (0.94–0.99)*
Work culture		1.00 (0.98–1.02)
Job instability		1.02 (1.01–1.04)*
Relational conflict		1.02 (0.99–1.04)
Cognitive failure		2.92 (1.47–5.81)*

CI, confidence interval.

\*  $p < 0.05$ .

occur that even on the way to a patient for a nursing treatment such as medication, a nurse can forget about this task after taking care of another job if a phone rings in the ward or if she/he receives a request from another patient or guardian. Therefore, it is necessary to coordinate lack of manpower and excess workload, among others. Another point is that cognitive failure is not only affected by a state such as job stress, but also it can be caused by a personal trait. Thus, in selecting a nurse who should function under an important duty to deal with a patient's life, persons with strong negative traits should be excluded or managed with special attention. Moreover, nurses inclined toward cognitive failure should themselves continually take care with their repetitive tasks to reduce mistakes, for example by making notes.

This study showed that in the subarea of job stress, job instability and lack of job autonomy are significant predictors of patient safety incidents. This result partially concurs with a previous study [2], which reported that as job stress increases, the accident rate becomes higher and the possibility to engage in safe actions becomes lower.

In this study, the OR of job instability on patient safety incidents was 1.02 (CI: 1.01–1.04), meaning that the higher the job instability is, the higher the incident rate is. Job instability relates to the stability of one's occupation or job, including an opportunity for finding jobs or employment instability. Such job instability brings change to a person's emotional state and this can change his/her cognition and performance [25] and increase the rates of incidents. This is why we must work on plans for lowering job instability, which is felt by the worker, in order to reduce accidents involving patients. Job instability can show differences according to employment status, but as this study had no specific questions on workers' employment status, it is impossible to verify whether or not this result actually means a difference between regular and irregular workers. In further studies, it is necessary to investigate and analyze the addition of such question items.

The OR of lack of job autonomy was 0.97 (CI: 0.94–0.99) in this study, showing that as job autonomy is lower, rates of possible incidents are lower. Lack of job autonomy means the level of

authority for decision making and using discretion on one's job, which shows that incident rates are lower among people with less authority for decision making. Because such a result denotes that those who are in charge of a limited given duty experience lower incidents of accidents, it is necessary to define clearly the responsibility, authority, and scope for very important duties directly related to the life of patients in a ward.

In this study, regression analysis was performed with a single dependent variable of incidents. Of job stress factors, only job instability and lack of job autonomy are found to be factors having a significant effect on accidents. However, factors showing a significant correlation with cognitive failure turn out to be physical environment, lack of job autonomy, relational conflict, organizational system, improper reward, work culture, etc., all of which are subareas of job stress. This suggests that job stress factors can have an indirect effect on accidents through cognitive failure. Thus, future research will need to cover structural equation modeling to examine the direct and indirect effects of job stress on accidents by way of cognitive failure.

In conclusion, this study was aimed at exploring the impact of hospital nurses' job stress and cognitive failure on patient safety incidents and ultimately using the result as basic data for preventing and managing patient safety incidents. This study showed that 27.9% of the participants had experienced such incidents in the past 6 months. Factors affecting incidents were found to be shift work, cognitive failure, job instability, and lack of job autonomy. Therefore, what we need to prepare is many countermeasures to reduce patient safety incidents caused by shift workers and plans to reduce job stress to reduce workers' cognitive failure. Further, it is necessary to reduce job instability and clearly define the scope and authority for duties that are directly related to patient safety.

## Conflicts of interest

The authors declare that they have no conflicts of interest to declare.

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