Impacts of Occupational Cognitive Failure and Subjective Workload on Patient Safety Incidents among Intensive Care Units Nurses

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Abstract

Background: Life-saving treatments and high-quality care techniques increase the opportunity for patient safety incidents in Intensive care unit. Aims: This descriptive correlation study aimed to determine the impacts of occupational cognitive failure and subjective workload on patient safety incidents among intensive care unit nurses. Methods and Material: One hundred seventy-six nurses working in intensive care units were included using census sampling. The data collection tools consisted of demographic and occupational data, standard questionnaires of subjective workload (NASA-TLX) and occupational cognitive failure (OCFQ), and a question about frequency of patient safety incidents. Data analysis was performed using Mann–Whitney and Kruskal–Wallis, Spearman rank correlation coefficient, and logistic regression tests. Results: Occupational cognitive failure (OR = 1.043), subjective workload in dimension of “performance” (OR = 0.982), age (OR = 0.947), and gender (OR = 3.726) were important predictive variables of patient safety incidents. Conclusions: Nursing mangers and policymakers can consider the factors identified for staffing nurses and development of patient safety programs.

Keywords: Medical error, nursing, patient safety, psychology, workload

Introduction

Patient safety incidents, if not controlled or prevented, lead to prolonged hospitalization, death, and disability and, in turn, impose high costs on the health system.¹ Hence, nowadays the patient safety is considered as one of the components of health care quality in hospital validation.² The incidents occur due to lack of attention, absent-mindedness, and error.³ On this basis, the error reporting has been accepted as a tool for improving patient safety quality.⁴ The incidents related to medical errors impose annually to hospitals a cost over $2 billion.⁵ The intensive unit is one of the most important units in the hospital, where patients are under the care and treatment of the best nurses and the most modern equipment. Life-saving treatments and high-quality care techniques increase the opportunity for patient safety incidents in this unit. On the other hand, the ailing patients admitted to intensive units that are usually afflicted with the organ dysfunction are very sensitive to safety incidents.⁶ Statistics show that 10% of patients are affected by various medical errors one way or another, while 75% of these incidents can be prevented by identifying predictive factors.⁷

Weak attention, absent-mindedness, and mental errors seem to be a major factor to occur incidents.⁸ In fact, the cognitive ability plays an important role in the error occurrence. The Occupational Cognitive Failure is a branch of failure that

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occurs in the workplace. Nowadays, the cognitive needs of the workplace have increased compared to physical needs, in other words, the subjective volume and workload has increased. The subjective workload involves the requirements imposed on the person during the work (physical, mental, time needs) to achieve a certain level of performance and factors associated with the outcome of the work (person’s performance, amount of effort, and level of frustration). High workload is a considerable stressor in all occupations and is one of the most important occupational stressful factors for nurses. Nurses who work in a high-tech complex environment, such as intensive care units, have a high degree of responsibility and low freedom of action. Because of the need to meet patient and family demands and engage in their emotional issues, in addition to the need for immediate decisions in specific situations, leads to a lot of physical and mental workload. Stress, in turn, causes some cognitive problems such as damages in concentration, processing information, decision-making, and performance. This could indirectly affect the patient’s safety, in addition to negative consequences for the nurses of the intensive care units.

Studies done in the field of cognitive failure and subjective workload have been performed mainly independently in industrial environments or in the entire hospital departments. Only one study has examined the relationship between these two variables. No study was found in the literature on the relationship between mental workload and cognitive failure with safety incidents. Therefore, due to the limitations of studies and the need to pay attention to factors related to patient safety incidents, this research was conducted to identify the impact of occupational cognitive failure and subjective workload on patient safety incidents among intensive care units nurses.

**MATERIALS AND METHODS**

This descriptive correlation study was conducted on nurses working in intensive care units (ICU, CCU, and dialysis) in 7 hospitals in north of Iran. On hundred seventy-six nurse participated using census sampling. The criteria for participation included having at least one year of work experience in the intensive care units, and care of at least one patient at a minimum of 6 hours per shift.

The patient safety incidents were evaluated by the question “Have you done any mistake or error in taking care of a patient during the past 6 months that could lead to an incident?” the responses were as “Never,” “How many times in the past 6 months,” “How many times in a month,” “How many times in a week,” and “More than once a day in the past 6 months.”

Nurses’ occupational cognitive failure during the past 6 months was assessed using the 30-item Occupational Cognitive Failure Questionnaire. The answering of the questions is based on a five-option Likert scale with a score range of one to five (never = 1, rarely = 2, moderate = 3, much = 4, and very much = 5). The range of scores earned is between 30 and 150. Gaining a higher score means more cognitive failure. Validity and reliability of the questionnaire were approved in a psychometric study. Cronbach’s alpha of the Questionnaire was 0.96 in this study.

NASA Task Load Index (TLX) was adopted for measuring subjective workload. NASA-TLX is a multidimensional method including 6 dimensions. The mental demand (the amount of mental activity for processing information such as decision-making, computing, etc.), the physical demand (the amount of physical activity required to do the things required in that shift), and the temporal demand (the time needed to do the necessary works in that shift) are related to the requirements imposed on the operator when performing tasks. The performance (satisfy the result of the work), the effort (the amount of effort, mentally and physically to reach the level of performance required), and the level of frustration (feeling insecure and depression and irritability by doing the job in this shift) are in relation to the outcome of the work. Each dimension has been presented as a line divided into 5 sections and bipolar descriptors at each end. At first, weight in each of the dimensions is determined to reveal the priority of those. The operator evaluates all dimensions by selecting in a paired form and in 15 different comparisons, and then, each dimension is scored 0-5.

Then, the operator scores each of dimensions from 1 to 100 based on his/her own working condition for determining of each dimension’s effect on the workload. At last, total score is calculated through the following formula: “Weighted Workload (WLW) is \( \sum (\text{rating} \times \text{weight})/15. \) The range of scores is from 1 to 100. The validity of NASA-TLX was confirmed in the study of Mohammadi et al. The reliability was confirmed in this research by the split half method with a correlation coefficient of 0.66.

Data were collected by self-report questionnaires on May 2018. The Ethics Committee of Guilan University of Medical Sciences approved this study (ethical code: IR.GUMS.REC.1396.498). The samples were informed the research goals and obtained informed consent. They were assured of the confidentiality and anonymity of their information. Self-report questionnaires were completed by the samples in the presence of the researcher and at the end of the shift. The Participation rate was 88%.

Data were analyzed with the software of SPSS version 21. Distribution of the variables was not normal using KS (Kolomogrover-Smirnov test) and Shapiro–Wilk test, and so, Mann–Whitney, Kruskal–Wallis, and spearman rank correlation coefficient were used. Logistic regression (Back Ward LR) was used to determine the factors predicting patient safety incidents. The non-error variable was considered zero and the error equal to 1. The significance level of the tests was considered 0.05.
RESULTS

Majority of the nurses were female, married, of bachelor’s degree, formal employment, and working shift [Table 1].

The majority of samples (56.3%) did not report an error during the past 6 months that resulted in injury to patient. 66 people (37.5%) reported an occurrence of error several times

Table 1: Patients’ characteristics (demographic and occupational variables)

| Variables       | Number (%) | Mean±SD | Variables       | Number (%) | Mean±SD |
|-----------------|------------|---------|-----------------|------------|---------|
| Age (year)      | 35.85±7.05 |         | Unit            | CCU        | 34 (19.3)|
| <30             | 36 (20.5)  |         | (Year)          | Dialysis   | 17 (9.7)|
| 31-40           | 103 (58.5) |         |                | ICU        | 125 (71.0)|
| >40             | 37 (21.0)  |         |                |            |         |
| Gender          |            |         | Employment Type |            |         |
| Female          | 164 (93.2) |         | Formal          | 113 (64.2) |
| Male            | 12 (6.8)   |         | Contractual     | 14 (8.0)   |
| Marital status  |            |         | limited period  | 29 (16.5)  |
| Unmarried       | 47 (26.7)  |         | Project-based   | 20 (11.4)  |
| Married         | 125 (71.0) |         | Work experience (year) | 12.21±7.06 |
| Divorced        | 4 (2.3)    |         |                |            |         |
| Widow           | 0 (0.0)    |         |                |            |         |
| Number of child | 1.43±0.60  |         |                |            |         |
| Without children| 82 (46.6)  |         | Overtime (h/Month) | 61.17±58.65 |
| 1               | 58 (33.0)  | < 30    | 37 (21.0)       |
| 2 and over      | 36 (20.5)  | 70-31   | 99 (56.3)       |
| Education level | 12.21±7.06 |         |                |            |         |
| BSc             | 163 (92.6) |         | Patients under care | 3.28±2.11 |
| MSc             | 13 (7.4)   |         |                |            |         |
| Mental crisis history | Yes | 41 (23.3) | 4-3 | 62 (35.2) |
| No              | 135 (76.7) |         | > 4            | 27 (15.3)  |
| Income (Rial/Month) | 58/65±61/17 |   |                |            |         |
| ≥2 million      | 111 (63.1) |         | Mornings       | 19 (10.8)  |
| 1               | 58 (33.0)  | < 30    | 87 (49.4)       |
| 2≤              | 11 (30.6)  | 22 (61.1)| 36 (100)       |
| Education level | 12.21±7.06 |         |                |            |         |
| BSc             | 89 (54.6)  |         | Patients under care | 3.28±2.11 |
| MSc             | 8 (76.9)   |         |                |            |         |
| Mental crisis history | Yes | 22 (53.7) | 4-3 | 62 (35.2) |
| No              | 77 (46.3)  |         |                |            |         |

Table 2: Distribution of patient safety incidents in terms of individual variables

| Variable | Categories | Have you Committed Mistakes or Error in Patient care During the past 6 months? | Never n (%) | Several times in past 6 months n (%) | Several times in a month n (%) | Several times in a week n (%) | Total n (%) | Ranking mean | P       |
|----------|------------|--------------------------------------------------------------------------------|--------------|--------------------------------------|--------------------------------|--------------------------------|--------------|-------------|---------|
| Gender   | F          | 94 (57.3)                                                                          | 60 (36.6)    | 7 (4.3)                              | 3 (1.8)                        | 164 (100)                    | 87.57        | 0.307*      |         |
|          | M          | 5 (41.7)                                                                           | 6 (50.0)     | 1 (8.3)                              | 0 (0.0)                        | 12 (100)                     | 101.21       |             |         |
| Age (year)| 30>        | 11 (30.6)                                                                          | 22 (61.1)    | 2 (5.6)                              | 1 (2.8)                        | 36 (100)                     | 110.53       |             | 0.003**    |
|          | 31-40      | 66 (64.1)                                                                          | 32 (31.1)    | 4 (3.9)                              | 1 (1.0)                        | 103 (100)                    | 81.49        |             |         |
|          | 40<        | 22 (59.5)                                                                          | 12 (32.4)    | 2 (5.4)                              | 1 (2.7)                        | 37 (100)                     | 116.51       |             |         |
| Marital status | Unmarried | 24 (51.1)                                                                          | 19 (40.4)    | 3 (6.4)                              | 1 (2.1)                        | 47 (100)                     | 93.64        |             |         |
|          | Married    | 74 (59.2)                                                                          | 44 (35.2)    | 5 (4.0)                              | 2 (1.6)                        | 125 (100)                    | 85.82        | 0.339**     |         |
|          | Divorced   | 1 (25.0)                                                                           | 3 (75.0)     | 0 (0.0)                              | 0 (0.0)                        | 4 (100)                      | 111.88       |             |         |
| Child number | 0         | 45 (54.9)                                                                          | 33 (40.2)    | 3 (3.7)                              | 1 (1.2)                        | 82 (100)                     | 89.10        |             |         |
|          | 1          | 37 (63.8)                                                                          | 17 (29.3)    | 4 (6.9)                              | 0 (0.0)                        | 58 (100)                     | 82.42        | 0.306**     |         |
|          | 2≤         | 17 (47.2)                                                                          | 16 (44.4)    | 1 (2.8)                              | 2 (5.6)                        | 36 (100)                     | 96.93        |             |         |
| Education | BSc        | 89 (54.6)                                                                          | 63 (38.7)    | 8 (4.9)                              | 3 (1.8)                        | 163 (100)                    | 90.05        | 0.103*      |         |
|          | MSc        | 10 (76.9)                                                                          | 3 (23.1)     | 0 (0.0)                              | 0 (0.0)                        | 13 (100)                     | 69.04        |             |         |
| Mental crisis history | Yes | 22 (53.7)                                                                          | 14 (34.1)    | 4 (9.8)                              | 1 (2.4)                        | 41 (100)                     | 89.18        | 0.791*      |         |
|          | No         | 77 (57.0)                                                                          | 52 (38.5)    | 4 (3.0)                              | 2 (1.5)                        | 135 (100)                    | 87.33        |             |         |

* Mann-Whitney test **Kruskal-Wallis test
in the past 6 months, 8 people (4.5%) several times in a month, and 3 people (1.7%) several times in a week. Only the age variable had a significant relationship ($P = 0.003$) with patient safety incidents [Tables 2 and 3].

The mean score of cognitive failure was $70.31 \pm 17.06$. Comparing samples in terms of individual and occupational variables, a significant difference was observed in the mean ranks of patient safety incidents in terms of age ($P = 0.023$). Spearman rank correlation test showed a significant correlation between the occupational cognitive failure and safety incidents ($r = 0.274$, $P = 0.001$).

The mean total score of subjective workload was $59.95 \pm 16.41$. Also, the mean scores of subjective workload were as following: the mental demand $43.63 \pm 26.80$, the physical demand $41.13 \pm 22.72$, the temporal demand dimension $29.65 \pm 19.51$, the dimension of performance $24.65 \pm 20.60$, dimension of effort $35.14 \pm 21.45$, and dimension of frustration $5.64 \pm 14.44$. There was a statistically significant difference in the mean total scores of workload in terms of the number of children ($P = 0.035$), work experience ($P = 0.045$), type of work shift ($P = 0.051$). There was no a significant correlation between the occupational workload and patient safety incidents ($P > 0.05$).

There was a significant positive correlation between cognitive failure and total workload ($r = 0.272$, $P = 0.001$) and its dimensions including the mental demand ($r = 0.170$, $P = 0.024$), the temporal demand ($r = 0.248$, $P = 0.001$), and the level of frustration ($r = 0.234$, $P = 0.002$).

Based on the Backward LR logistic regression model in the final model, the cognitive failure (OR = 1.043) and the subjective workload in subscale of “performance” (OR = 0.982), age (OR = 0.947), and gender (OR = 3.726) were predictive variables of patient safety incidents. In addition, subjective workload in subscales of “temporal demand” (OR = -0.984) and “frustration level” (OR = -0.974) were borderline predictive variables of patient safety incidents [Table 4].

**Discussion**

The results of this study showed age, gender, cognitive failure, and the subjective workload in area of performance, temporal demand, and frustration are important predictive factors of patient safety incidents.

The majority of nurses reported that they had no error during the past 6 months. However, it is significant that 43/7% of them had at least an error leading to safety incidents. A similar result was found in a study,[1] but in other study reported a higher error rate.[21] The error reporting system depends on the nurse’s perception of the error and the ability to detect it.[22] The obstacles to the honest reporting of error can be attributed to managerial, ethical, environmental factors of the fear of reporting implications.[23]

Cognitive failure was an important predictive factor of the patient safety incidents. The nurses with more error reporting had more cognitive failure. In line with this result, other studies and showed that with increasing in occupational cognitive failure increases the chance of occurrence of occupational incidents.[3,9] Meta-cognitive skills such as planning and monitoring can inversely predict cognitive failure.[24] Therefore, reinforcement of these skills and considering cognitive failure periodic assessments in nursing staff can help to improve patient safety and quality of care.

Age was an important predictive factor of patient safety incidents. As the age increased, the chance of an error decreased. This finding is consistent with the study of Park and Kim.[3] However, the results of the study of Saki et al. showed that there is no relationship between age and safety incidents.[25] It seems that people at a low age are in an uncertain employment position and job instability, which can be a factor in the occurrence of care errors. The instability of the job leads to a chance in the motivational situation of individuals that affects people’s knowledge and performance.[3]

The chance of occurrence of error decreased with the increase of subjective workload in subscales temporal demand, performance, and frustration. Bagheri et al. reported a relationship between workload and patient safety incidents.[18] Increasing temporal demand or limitation in the time needed to do work as a positive stressor can be resolved with increasing effort. This stress is a motivating factor in doing work.[26,27] Sharon also knew the tension of time did not relate to occupational accidents. [28] Due to subscales of performance and frustration, the results achieved in the final model were an unexpected finding. This result may be related to report 56.3% error over the past 6 months. Assuming an honestly report, it may be said that environmental tension, as long as it is not beyond the ability of the individual, will be a factor for motivation, stimulation, and energy.[23] In this study, in spite of high subjective workload and physical load, the nurses’ satisfaction with their performance was high. High experience and skill lead to optimal performance and prevent undesirable effects of perceived workload on nurses’ performance. Persons with job motivation and sense of hope have less cognitive errors than others.[17]

The results showed that gender the male nurses have a higher chance of error than female nurses. This finding is consistent with the study of Farsani et al.[29] Men are the breadwinners of the family, and usually have second job as a way of increasing their income. Therefore, this result may be due to the high level of mental and work concerns of male nurses that affects the incidence of safety incidents. However, in the study of Saki et al., the gender did not have any relation with nursing errors.[25]

**Limitations and future research**

The findings may not be a fully precise representation of actual safety incident reports. Considering the borderline chance of some dimensions of subjective workload in predicting safety incidents, more studies are recommended on the relationship between subjective workload and the patient safety incidents.
with more sample size and a more comprehensive patient safety questionnaire and longitudinal data.

**Conclusion**

The findings of the study showed that age, gender, cognitive failure, and subjective workload in the areas of performance, temporal demand, and frustration are predictive factors of patient safety incidents. Hence, the need to pay attention to the factors mentioned in the development of programs to maintain and improve the patient’s safety and, finally, to improve the quality of care. The periodic evaluations of employee’s cognitive status and workload, staffing in terms of distribution of age and gender in the intensive care units may help optimize the workforce in these units. Since the human factor is the most important factor in the occurrence of safety incidents, optimizing the workforce employed in the intensive care unit will have an important role in preventing and minimizing safety incidents.

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Conflicts of interest
There are no conflicts of interest.

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