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Original Paper

The Mental Workload and Its Correlated Factors in Nurses Working in Intensive Care Units

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Nurse, Intensive Care Unit (ICU), Mental workload

ABSTRACT

Introduction: One of the factors influencing the behavior and performance of nurses at the workplace is the mental workload. It is the amount of mental effort that a person uses during doing his or her task.

Objective: The current study aimed at evaluating the mental workload and its related factors in the Intensive Care Unit (ICU) affiliated to medical and educational centers of Guilan University of Medical Sciences.

Materials and Methods: The current analytical and cross-sectional study was conducted in 2015 on 105 nurses working in ICUs of educational and medical centers affiliated to Guilan University of Medical Sciences in Rasht, Iran using National Aeronautics and Space Administration-Task Load Index (NASA-TLX). This tool measures mental workload on the whole and separately under six subscales of mental demand, physical demand, temporal demand, performance, effort, and frustration with regard to their weight, rate, and score. The collected data were analyzed using descriptive (mean and standard deviation) and inferential (Pearson correlation test, t-test, and ANOVA) statistics.

Results: The Mean±SD mental workload was reported 70.21±12.4, where physical demand dimension had the highest score compared to other dimensions (Mean±SD weight=77.73±12; rate=3.25; score=17.01). In addition, the mental workload of ICU nurses had a significant relationship with the type of ICU, the age of nurses, and number of patients under their care in each shift (P<0.05).

Conclusion: Based on the results, the mental workload of younger nurses increased with the increase in the number of patients under care. With the appropriate distribution of human resources and proper training for young nurses to control occupational stress and modify intra-sectoral and intra-hospital rules, their mental load may be reduced.

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Highlights

- The Mean±SD mental workload of ICU nurses was reported 70.21±12.4, where physical demand dimension had the highest scores.

- The mental workload of ICU nurses had a significant relationship with the age of nurses, the type of ICU, and the number of patients under care.

- With the appropriate distribution of human resources and proper training for young nurses, it is possible to reduce occupational tensions and consequently mental workload in nurses.

Plain Language Summary

The mental workload is the amount of mental effort that one uses while performing a task. It is one of the factors affecting the behavior and performance of nurses in the workplace and consequently, the patient safety and the quality of nursing care. Increasing mental workload is one of the most important concerns in health care and particularly in Intensive Care Units (ICUs). This study aimed to evaluate the mental workload and its related factors in ICU nurses. The National Aeronautics and Space Administration-Task Load Index tool was used to measure mental workload under six subscales of mental demand, physical demand, temporal demand, performance, effort, and frustration. The Mean±SD mental workload was reported 70.21±12.4 and physical demand dimension had the highest scores compared to other dimensions. Based on the results, the mental workload of younger nurses increased with the increase in the number of patients under care. With the appropriate distribution of workforce and proper training for young nurses and modifying intra-sectorial and intra-hospital rules, the mental load can be reduced for the ICU nurses.

Introduction

In the past two decades, the intensity of nursing care and nursing workload increased due to the increased patients' awareness and reduced hospitalization stay [1]. The increased workload is one of the most important concerns in healthcare and especially in Intensive Care Units (ICUs) that can have a negative impact on nurses and patients [2]. The workload is one of the influential factors on patient's safety and the quality of nursing care [3]. Nowadays, because of the advancement of modern technology, work environments have changed, and as a result, many of them impose more cognitive needs compared to the physical needs of individuals. Therefore, depending on the type of profession, there is a concept called "mental workload" used in Ergonomics as a general concept. Nursing is one of the professions where this concept can be used. The workload is not limited to the physical tasks of nurses; their cognitive tasks (mental workload) are also a complex part of the overall workload of nurses [3, 4].

Although there is no universally accepted definition of Mental Workload (MW), and it is often considered by analogy to the physical workload [5, 6], it can be said that MW refers to all mental activities such as estimation, decision making, communication, identification and search, and is defined as the relationship between the mental resources required to perform a task and the ability of individuals to use these resources. MW is a subjective concept, which cannot be measured directly or be considered an absolute value. However given that the human mind can process the information at a limited rate, then MW is the percentage of the capacity used at any time point [7].

It is simply the amount of mental effort that one puts into a task [5, 8, 9], and requires actions such as concentration, reminder, decision making, and attention [8], and is essentially related to the individual's mental abilities and how the information is received and processed, and at the end leads to decision making and action [5]. In other words, MW is a level of cognitive need or an analytical effort required by an individual to fulfill the physical, spatial, and environmental demands of a specific task [10].

Various studies show that in professions where MW is high, due to fatigue and inappropriate scheduling, the

efficiency decreases, which reduces memory, damages the thinking process, causes irritability, and reduces learning [11, 12]. Tired people are more likely to choose risky behaviors such as doing shortcuts to perform tasks [12]. Nurses working in specific departments, such as ICUs, are subject to severe MW since they are always making important decisions that relate to the lives of patients. On the other hand, ICU nurses should be continuously responsive to the needs of their patients or the patients' companions and are usually faced with the most severe emotional aspects of patients [12]. Accordingly, Hoonakker et al. [2] study results indicate high MW among ICU nurses.

Increased MW is reported as a major source of stress and burnout in nurses, which can have direct and indirect impacts on nurses and patients. Its direct impacts on patient care may be related to the insufficient time for caring duties, which increases the mortality rate of patients. Its indirect impacts on patient's safety are via affecting communication, reducing job satisfaction and motivation, and causing burnout in nurses [10]. MW is associated with depression, anger, and interpersonal sensitivities [7]. Since MW has a direct relationship with the person's performance and is one of the factors affecting the health, safety, and comfort of individuals, the concept of MW and its effects are one of the main topics of organizational behavior [10]. In this regard, the current study aimed at evaluating MW and its related factors in nurses working in the ICUs.

Materials and Methods

The current analytical study with the cross-sectional design was conducted in 2015 on 105 nurses working in ICUs of educational and medical centers in Rasht City, Iran. They were selected using the census method from nurses working in five ICUs in Rasht who have at least a BS degree and one year of experience. To collect data, a two-part questionnaire was used. The first part included individual and occupational characteristics of the study subjects (gender, age, marital status, work experience, education, type of ICU, number of patients under care, weekly working hours, working shift, resting period before and after the work shift, and working at the other centers). The second part was the National Aeronautics and Space Administration-Task Load Index (NASA-TLX) [2, 13].

It is one of the known tools to evaluate the MW from the individual point of view developed by Hart in 1998 at NASA's Ames Research Center to measure subjective workload in aircraft simulation, and then extended by the Human Performance Group at NASA by conducting more than 40 experiments in three years. It is employed in more 550 research studies and recently used in many other professions, including healthcare [2, 14, 15].

Different studies verified the validity and reliability of this tool [2, 14]. Validity and reliability of its Persian version were verified in special units by Mohammadi et al. [12]. It has six subscales of mental demand, physical demand, temporal demand, performance, effort, and frustration. Each task is scored within a 100-point range based on a 5-point style. After reading descriptions for each scale, nurses give a score to each one from 0 to 100. This step is called "weighting". In the next step, called "rating", there are 15 two-choice items and individuals should choose the factor that plays the most important role in each item.

The weighted score is multiplied by the rated score and then divided by 15 to get an MW score for each subscale. By summing subscale scores, total MW score is obtained. This tool is compared and interpreted based on the mean difference between different groups (e.g. between hospitals, units, or staff). The group with the highest mean is reported to have a higher MW related to other groups.

The method of calculating the mental load of work can be performed either manually or with the help of NASA's application [13]. In the current study, a portion of the information was calculated through the application and partly performed manually. Each questionnaire received a specific code. Since each nurse had to be examined in three work shifts, according to the monthly program of each unit, the next work shift of each nurse was found out and the necessary arrangements were made with the nurses to attend the study. Written informed consent was obtained from all participants.

To determine the MW score, first, the MW data of each nurse was transferred into the software and the weight and rate of the load for 6 subscales and the total MW score were calculated. Since the software does not give the MW score for each of the subscales, their scores were manually multiplied by their rated score and then divided by 15. Thus, for each nurse, three total MW values, three weighted values, three rated values, and three scores for each of the 6 subscales were obtained in three working shifts. In the end, the mean of these values was calculated in three work shifts and used for analysis. The data analysis was performed with SPSS version 21.

Descriptive statistics (Mean and SD) were used to compare total MW, weights, rates, and scores of NASA-TLX subscales. To examine the correlation of MW with the resting period before and after each shift, the number of patients under care, work experience, and weekly working hours, the Pearson correlation coefficient was calculated. The t-test was used to compare MW based on gender, marital status, level of education, and being employed at the other centers. To compare MW load in terms of age, type of ICU, and type of work shift, one-way ANOVA was employed.

Results

The obtained results reported that most of the participants were female (96.2%), married (59%), had a bachelor degree (94.3%), rotating work shifts (96.2%), and with an average age of 30-40 years (61%) (Table 1). The mean MW was 70.21±12.4, where physical demand dimension had the highest scores compared to other MW dimensions (Mean±SD weight: 77.73±12; Mean rate: 3.25; Mean score: 17.01) (Table 2).

A significant relationship was observed between MW and age of the nurses where the ones under 30 years had the highest MW and the ones aged above 40 years reported lower MW scores. A significant correlation was also observed between MW and type of ICU (Table 3), where nurses of cardiac surgery ICU reported the lowest MW score. The MW had a direct and significant relationship with the number of patients under care in each work shift, but no significant relationship was observed between MW of nurses and gender, marital status, level of education, type of work shift, being employed at the other centers, resting period before and after shift, work experience, and weekly working hours.

Table 1. Comparing MW scores based on individual and occupational characteristics of ICU nurses (n=105)

Characteristic		Frequency		MW	Sig.
		no.	%	Mean±SD	
Age, year	<30	37	35.2	72.15±10.83	0.033*
	30-40	64	61	70.03±12.43	
	>40	4	3.8	55.28±17.66	
Gender	Male	4	3.8	68.28±22.16	0.751**
	Female	101	96.2	70.29±12.01	
Marital status	Single	43	41	72.43±12.43	0.128**
	Married	62	59	68.68±12.20	
Work shift	Fixed morning	1	1	43.11±0	0.085*
	Fixed evening	3	2.8	68.81±22.81	
	Rotating	101	96.2	70.52±11.89	
Education level	Bachelor degree	99	94.3	99±70.23	0.965**
	Master degree	6	5.7	70±6	
Being employed at the other centers	No	87	82.9	70.01±12.10	0.718**
	Yes	18	17.1	71.18±13.92	
Type of ICU	General ICU, hospital No. 1	20	19	78.45±10.32	0.0001*
	General ICU, hospital No. 2	28	26.7	77.58±8.97	
	Neurosurgery ICU, hospital No. 2	20	19	68.21±9.92	
	Cardiac surgery ICU, hospital No. 3	21	20	60±9.29	
	Women's ICU, hospital No. 4	11	10.5	63.46±11.83	
	Burn unit, hospital No. 5	5	4.8	61.80±13.44	

* ANOVA; ** t-test

Table 2. Mean±SD of MW subscales among ICU nurses

MW Subscale	Mean±SD	Median	Min	Max
Mental demand weight (0-100)	72.68±12.45	73.33	41.67	93.33
Mental demand rate (0-5)	2.58±1.01	2.67	0	5
Mental demand score (0-33.33)	12.59±5.51	12.45	0	28
Physical demand weight (0-100)	77.73±12.00	78.33	50	98.33
Physical demand rate (0-5)	3.25±0.79	3.33	1	5
Physical demand score (0-33.33)	17.01±5.16	17.22	2.89	26.33
Temporal demand weight (0-100)	69.25±14.47	70	36.67	95
Temporal demand rate (0-5)	2.44±0.91	2.33	0	4
Temporal demand score (0-33.33)	11.96±5.78	11.44	0	24.78
Performance weight (0-100)	45.54±25.02	46.67	5	95
Performance rate (0-5)	2.72±1.03	2.67	0.67	5
Performance score (0-33.33)	8.23±5.94	6.56	0.56	27.45
Effort weight (0-100)	75.21±14.57	76.67	28.33	96.67
Effort rate (0-5)	3.15±0.90	3.33	0	5
Effort score (0-33.33)	31.16±6.00	15.33	0	29.56
Frustration weight(0-100)	52.81±21.08	53.33	5	98.33
Frustration rate (0-5)	0.83±1.09	0.33	0	4.67
Frustration score (0-33.33)	4.11±6.31	1.22	0	30.56
Total MW score (0-100)	70.21±12.37	71.34	42.89	95.23

Table 3. Correlation between mean MW and occupational characteristics of ICU nurses

Occupational Characteristics	Sig.*
Resting period before the work shift	r=0.052 P=0.597
Resting period after the work shift	r=0.009 P=0.924
Mean number of patients under care	r=0.446 P=0.0001
Work experience	r=-0.127 P=0.197
Weekly working hours	r=0.122 P=0.216

* The Pearson correlation test

Discussion

In the current study, the Mean±SD MW of ICU nurses was reported 70.21±12.4. In the studies of Hoonakker et al. [2], Zakerian et al. [3], and Malekpour et al. [16], the mean MW was higher, while Giahi et al. [5] and Sarsangi et al. [10] reported lower values compared with those of the current study. All the mentioned studies used the same study tools like ours. Every occupation has a specific mean of MW, and the obtained results indicate the existence of MW in the nursing profession, especially in the ICUs, which can be due to the nature of this profession and the work environment of the nurses.

Another point to consider is that in the current study, the mental workload was studied and not the workload. Hence, the nurses that reported high mental workload may not necessarily have a high workload. Their high mental workload may be due to their perceptions or the psychological state and familial conflicts as well as their personality. Regarding the comparison of MW dimensions, it was revealed that the dimension of "physical demand" had the highest weight, rate, and scores compared with other dimensions. In the study by Malekpour et al. [16], the dimension of frustration had the highest weight, while in the study by Kazemi et al. [9], it was the mental demand dimension, and in the studies by Sarsangi et al. [10] and Zakerian et al. [3], dimension of effort had the highest weight. Regarding the rate of dimensions, Kazemi et al. showed that frustration had the highest rate values and other studies reported no results about the rates and scores of MW dimensions.

This difference between the results of the current study and those of similar studies may be related to different environmental conditions, sampling, and implementation. For example, in the current study, the MW of nurses was investigated in three separate work shifts using its average value for comparison, while in the mentioned studies it was examined in one work shift. Obviously, examining an MW variable in three work shifts increases the likelihood of obtaining more accurate results. It is possible that factors outside the workplace influence MW and its subscales.

Results of the current study also showed that MW had a significant association with the age factor in ICU nurses where nurses aged less than 30 years had the highest MW level and the ones more than 40 years had the lowest MW scores. It was consistent with the findings of Kazemi et al. [9] and Sarsangi et al. [10] reporting a significant correlation between MW and age. In the study by Kazemi et al. the age group of 22-30 years had the lowest MW level and the age group of >50 years showed the highest MW scores. However, in the study by Hoonakker et al. [2] no significant difference was reported between MW and age factor except in physical demand dimension.

Malekpour et al. [16] reported no significant correlation between them, either. Since studies show a significant relationship between MW and occupational stress [17, 18], probably with increasing age, due to increased control over the environment and working conditions, many occupational stresses are eliminated, and as a result, the MW level decreases. On the other hand, due to the nature of the nursing profession and the work environment of the nurses, long-term nursing is a tedious and stressful job and increases the MW of older nurses, which justifies the results of studies inconsistent with the current study results.

Based on the results of the current study, MW of ICU nurses had a significant relationship with the type of ICU, where the nurses of general ICU of hospital No.3 and cardiac surgery ICU had the highest and lowest MW levels, respectively. In the study by Hoonakker et al. [2] among adult ICU, internal/surgical ICU, burn unit, neurosurgical ICU, neonatal ICU, pediatric ICU, cardiac ICU, and surgical ICU, nurses of adult and cardiac ICUs had higher MW than the ones in neurosurgical and neonatal ICUs. The difference in MW of nurses in various types of ICUs can be due to the type of hospitalized patients, as well as internal rules regarding the allocation of manpower and the number of patients in such sectors.

In the current study, the nurse-to-patient ratio in surgical ICU was 1:1 and the shift manager was not responsible for the care of any patient, while in general ICU the ratio was 1:2 and 1:3 and the shift manager, in addition to direct patient care, was responsible for managerial tasks. Clearly, with the increase in the number of patients under the care and managerial tasks, the responsibility of nurses becomes heavier, which can increase their MW in this section.

The current study found no significant association between MW and the type of work shift. Malekpour et al. [16] reported a higher MW level in the evening and night shifts compared to morning and rotating shifts. In the study by Hoonakker et al. a significant difference was observed between MW and type of work shift where nurses of 12-h shifts (day and night) had a higher overall workload, physical demands, and frustration compared with those of an 8-h shift (morning or evening). Overall workload, temporal demands, and efforts were higher

in 12-h day-shifts than in 12-h night shifts. Sarsangi et al. [10] also reported a significant correlation between MW and work shift. This inconsistency in results may be due to the difference in the sampling method.

A significant association was reported in the current study between MW of ICU nurses and the number of patients under their care in each work shift, in such a way that with the increase in their number, MW of nurses increased. It was in agreement with the results of Kazemi et al. [9] and Malekpour et al. [16]. Regarding this finding, it can be explained that as the number of patients under care increases, the responsibilities and hence MW of nurses increases.

According to the results of the current study, MW of nurses in the ICU of hospital No. 1 was high. According to the significant relationship between MW and the type of ICU, the age of nurses, and the number of patients under care in each shift, and the effect of intra-sectoral and intra-hospital rules on MW, it is necessary to employ interventional strategies to reduce the MW level in this group. In units with higher MW, the number of patients under the care of each nurse should be reduced by appropriate distribution of human resources. Since the MW has a significant relationship with occupational stress [17, 18], with proper training, especially in younger staff (who has fewer skills to overcome stressful factors in the workplace), many tensions and consequently mental workload can be reduced in nurses, and the effects of excessive mental workload on nurses and patients can be prevented.

Uncontrolled mental status and familial conflicts of nurses during filling in the questionnaires and their personality type were among the limitations of the current study. It should also be considered that the current study evaluated the mental workload of the ICU nurses and not their workload. Therefore, the subjects that reported a high mental workload may not necessarily have a high workload, and their high mental workload may be due to their perceptions.

Ethical Considerations

Compliance with ethical guidelines

The current study was approved by the Social Determinants of Health Research Center of Guilan University of Medical Sciences (Registration No. 94070714) and also the Ethics Committee of the University (Ethical code: IR.GUMS.REC.1394.286).

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Authors contributions

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Conflict of interest

The authors declared no conflict of interest.

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Original Paper

Incidence and Extent of Bruising After Subcutaneous Injection of Enoxaparin Sodium in Patients Hospitalized at Coronary Care Units

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ABSTRACT

Introduction: Bruising or ecchymosis after subcutaneous injection of enoxaparin sodium can cause anxiety and discomfort in the patient. Therefore, nurses should know the factors associated with the incidence and extent of this complication.

Objective: This study aims to investigate incidence and extent of bruising after subcutaneous injection of enoxaparin sodium and its related factors in patients hospitalized at coronary care unit of Dr. Heshmat educational and treatment center in Rasht City, Iran.

Materials and Methods: This analytical cross-sectional study was conducted on 84 patients hospitalized at coronary care unit in 2015. They were under treatment with enoxaparin sodium 6000 IU. The samples were selected using consecutive sampling method. To standardize the injection method, all injections were performed by one nurse as the member of research team at the right side of the abdomen and above the navel in 10 seconds (using a chronometer). Evaluation of the incidence and extent of bruising was done by a trained nurse 48 hours after the injection. The study instrument consists of demographic-clinical characteristics of the patients and records of the incidence and extent of bruising. These data were collected by interview, observation, and measurement using a flexible transparent ruler. The incidence and extent of bruising (under three categories of "insignificant bruise", "small bruise", and "large bruise") were analyzed using descriptive (frequency, mean, standard deviation) and inferential (Chi-squared test, Independent t-test, and ANOVA) statistics.

Results: The majority of the study samples were women (65.5%) with a mean age of 66±11 years. Bruising was seen in 53.6% of samples of which 56% of them had insignificant bruising, 23% small bruises, and 21% large bruises. The incidence of bruising had significant relationship with hyperlipidemia (P=0.028) and the extent of bruising was significantly correlated with hypertension (P=0.048).

Conclusion: Based on the results, we should consider and screen hyperlipidemia and hypertension in the patients with heart problems treated with enoxaparin sodium with respect to the incidence and extent of bruising.

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