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Mental workload profile and its relationship with presenteeism, absenteeism and job performance among surgeons: The mediating role of occupational fatigue

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ABSTRACT

Introduction: Surgeons are one of the most significant jobs in the health care system that plays an important role in the patients' health promotion and their treatment. In the current study, the effect of mental workload on the work performance of surgeons was tested by considering the mediating effect of fatigue on this relationship.

Method: This study was done analytically on 165 surgeons working in the operating rooms of hospitals in Iran. To determine of mental workload, the SURG-TLX method was used. The job performance was measured using the short version of the job performance questionnaire provided by the World Health Organization (WHO-HPQ), and accordingly relative presenteeism, relative absenteeism and job performance variables were calculated. The Swedish Occupational Fatigue Inventory (SOFI) questionnaire was used to determine occupational fatigue. A conceptual model was built to determine the direct and indirect relationship between mental workload and job performance, and the mediating effect of occupational fatigue on the relationship between mental workload and job performance was tested using structural equation modeling (SEM).

Results: Out of 165 distributed questionnaires, 140 questionnaires were completed and delivered to the researchers (85% response rate). The mean ± standard deviations of mental workload, fatigue, and work performance were 16.57 ± 5.83, 6.32 ± 2.86, and 0.65 ± 0.28, respectively. The results of model fit indexes revealed that all indexes are within the acceptable range. Regarding this model, the direct effect of mental workload on job performance was not significant ($\beta = -0.21$; $p = 0.072$). A significant positive relationship was observed between mental workload and fatigue ($\beta = 0.36$; $p < 0.001$). The direct effect of fatigue on job performance was also the opposite and statistically significant ($\beta = -0.39$; $p < 0.001$). Finally, results indicated that the effect of mental workload on work performance mediated by occupational fatigue.

Conclusion: Surgeons suffer a high level of mental workload during their work, and this factor can have a negative effect on surgeons' job performance. The effect of mental workload on job performance in surgeons can be detected, directly and indirectly, through the mediating effect of occupational fatigue. Improving the mental and physical conditions of the work environment can reduce occupational fatigue and improve surgeons' job performance.

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1. Introduction

The health care system is one of the most significant and vital industries, which comprises diverse sectors in different countries. One of the most significant parts of this industry are hospitals, which usually play an important role in the health of humanity as the third level of the healthcare industry. Hospitals aim to offer safe and effective medical services to patients. Nonetheless, occasionally, some hospitals are the source of damage, and despite the advancement in technology and care, medical errors are lead to complications and deaths and impose much costs on patients and society. Due to this fact, in today's world, guaranteeing the safety of patients and stopping the occurrence of medical errors and undesirable events in hospital centers is a global issue [1,2].

To offer health care, various specialties are needed by hospitals who can guarantee the health of patients together [3]. For example, Surgeons play a significant role in the health and treatment of patients in health care systems, particularly in hospitals [4]. Surgeons work at the heart of the hospital in one of its key parts, the operating room. Their attendance in the hospital is essential as the driving engine of the treatment department. Instead, their absence in hospitals can lead to the inefficiency of the treatment department of the health care system [5].

Regarding the type and nature of the surgery, surgeons face many challenges, and most surgeries are done under high-pressure conditions and in a possibly dangerous environment [6,7]. Numerous studies have revealed that stress is a common state during surgery, and in some cases, it can negatively affect the surgeon's performance as well as the safety of patients [5,8,9]. The workload is considered as one of the main stressful factors in the working environment of surgeons and is determined as a multifaceted factor by the interaction of task requirements, working conditions, skills, behaviors and perceptions of the individual [10]. The workload in surgeons has different dimensions, such as mental demands, physical demands, temporal demands, task complexity, situational stress and distraction, which can increase the surgeon's stress during work [11–13]. Because of their direct contact with patients' lives, responding to patients and sometimes their companions, performing complex and stressful treatment protocols, and also increasing the number of surgeries compared to previous years, they suffer a lot of workloads [14]. Workload defined as a whole amount of work that must be done by a person or people in a certain period. The workload is not restricted to the physical tasks of surgeons, but their cognitive and mental tasks also play a noteworthy role in creating their workload [10]. If the mental workload does not match the surgeons' skills and cognitive abilities, their professional performance will be distorted and affected by many factors, including their quality of life, patient safety and the quality of treatment [15]. Job performance refers to the act of doing a job and is the means of achieving a goal or set of goals in a job, role, or organization. Campbell (1990) affirms that job performance is not a single act, but a "complex activity" [16]. The elements of job performance consist of knowledge, thoroughness, responsiveness, motivation and support [17]. The factors contributing to job performance have been discussed in the some studies [18]. Mental workload has recently been introduced as one of the factors affecting job performance. Researchers believe that mental workload reflects the amount of mental resources required to perform a set of concurrent tasks and sustained high mental workload decrease workers performance, and even detrimental health effects in the long run [19]. Yurko et al. [15] stated that the increase in mental workload can cause errors in the treatment processes of patients and negatively affect the performance of surgeons. The results of some studies also show that there is no significant direct relationship between mental workload and job performance [17,20]. Considering the negative consequences of mental workload, especially in surgeons, it can be hypothesized that mental workload can directly effect surgeons' job performance. Therefore, the first hypothesis of this study was as follows:

H1. surgeons' mental workload is negatively related to work performance

Fatigue is a reduction in the mental and physical strength that can reduce people's performance to a level, lower than desired level [21]. Fatigue can lead to several adverse outcomes in different occupational populations. Some of the most important consequences of fatigue are including destruction of cognitive functions such as attention, concentration and reaction time, negative mood changes, reduced physical activities, reduced performance and human errors and injuries [21–23]. In hospital settings, fatigue can increase human error in healthcare personnel, thereby jeopardizing their health and safety as well as their patients. The factors contributing to occupational fatigue have already been investigated and the mental workload was known as one of the causes of fatigue in the workplace [24,25]. The direct relationship between job fatigue, mental workload and job performance has been well defined in some studies. Studies have revealed that the interaction of fatigue and mental workload can negatively affect people's performance, which also seems to be visible in surgeons. Increased mental workload and fatigue can distort the relationship between the surgeon and the patient and significantly affect the surgeon's productivity [26]. In previous studies, high job demands were considered to be a predictor of fatigue with a higher workload leading to greater subjective fatigue [27–29]. Both high workload and fatigue result in performance impairments in daily work. Self-report of fatigue was found to be strongly associated with poor performance in later studies [30,31]. This shows the significant association between fatigue and performance change. Fan et al. [32] stated that the mental workload is a factor that increased fatigue, which then resulted in a change in performance. The study of DeArmond et al. [33] showed that job stressors are related to procrastination. Procrastination can have a negative effect on the organization through a decrease in performance. On the other hand, fatigue can indirectly mediate the relationship between psychological detachment and procrastination. As a result, it can be assumed that fatigue can indirectly mediate the relationship between mental workload and job performance. On the other hand, some studies in healthcare personnel have stated that there is no relationship between mental workload and occupational fatigue [34,35]. According to the background presented above, the mediating effect of fatigue on mental workload and job performance is not well known. Especially in surgeons, there is no specific information in this field. Therefore, the other hypotheses of the present study were as follows:

H2. occupational fatigue partially mediates the relationship between mental workload and surgeons work performance.

Maintaining the health of the employees of any organization to maintain and also increase its efficiency is always at the top of the organizational policies of any organization. Hospitals are not exempt from this rule. Consequently, maintaining the health and productivity of surgeons by controlling their mental workload and fatigue increases the quality of medical services delivered by the hospital and also increases the satisfaction of the hospitals clients [14]. Exploring mental workload, fatigue, and their effect on employee performance in aviation and nuclear industry workers have always been the focus of researchers, but this important issue has been less addressed in healthcare systems [13]. According to our knowledge, the mediating effect of fatigue on the relationship between mental workload and job performance in surgeons has not been investigated so far. Regarding the significance mentioned about the position of surgeons and the importance of their work performance, ding studies on measuring mental workload and investigating its effect on the work performance of surgeons by considering the mediating effect of fatigue can help improve the job status of surgeons. The built model based on the mentioned assumptions is presented in Fig. 1.

2. Methods

2.1. Study design and participants

The current study was done analytically by participating 165 surgeons working in operating rooms in Isfahan city hospitals, Iran, 2022. The participants were surgeons with at least 1 year of work experience without a second job. If a miserable family event (events leading to injury or death in the family members) happened to any participants during the study, they were excluded from the study. Surgeons were selected by a simple random method, and questionnaires were distributed among them.

2.2. Mental workload

SURG-TLX questionnaire was used to determine the mental workload of surgeons. This questionnaire is a modified version of the valid NASA-TLX questionnaire for surgical occupation, presented in 2011 by Wilson et al. [13]. This questionnaire has 6 dimensions including mental demands, physical demands, temporal demands, task complexity, situational stress and distractions. The first part of this questionnaire rates the person's feelings in the mentioned dimensions on a 20-part scale. A score from 0 to 20 is obtained for each indicator using this scale. Along with the sheet that contains the rating scales, a page containing the definitions of the scales was also provided to the employees as a marking reference. In the second part, all the dimensions are measured two by two in 15 possible situations, and the person has to choose his dominant feeling between the two compared dimensions. Then, the number of choices for each dimension is divided into the total possible states (number 15), and the weight of each dimension is determined with a score between 0 and 1. Next, the weight determined for each dimension is multiplied by the score obtained in the first stage, and each dimension's final score is determined. Finally, the total score of SURG-TLX for each person was determined from the sum of the final score of each dimension, which is between 0 and 20 [13].

2.3. Work performance in surgeons

The work performance of surgeons was determined using a shortened version of job performance questionnaire introduced and approved by the World Health Organization (WHO-HPQ) in 2003 [36]. This 12-question questionnaire includes two dimensions of presenteeism and absenteeism, and the combination of these two dimensions which determines the level of a person's work performance. In the dimension of presenteeism, the number of hours a person is present at work is discussed, and in the dimension of absenteeism, the number of absence day from work is discussed with the mentioned reasons.

There is two measurement and scoring methods for absenteeism. The first method relies on the respondent estimating how many hours they worked in four weeks. The second method is to ask about the person's working hours in the past week. The current study determined relative absenteeism based on lost working hours per month. The higher the relative absenteeism score, the higher absenteeism rate at work. Relative absenteeism is the percentage of expected hours and ranges between a negative number (work more than expected) and a 1 (always absent).

The presenteeism variable is used to determine actual performance compared to possible performance. In this variable, unlike absenteeism, a higher score indicates a lower lost performance (a higher score indicates a higher performance). Relative presenteeism is equal to the ratio of an individual's actual performance to the performance of workers in the same job (possible performance). It is

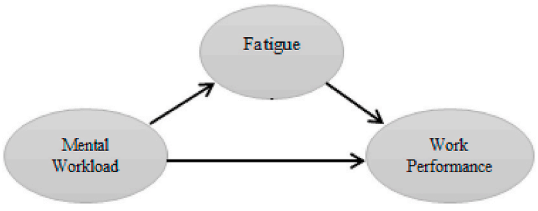

Fig. 1. Hypothetical model of the study.

recommended to limit the distribution of relative presenteeism in the range of 0.25–2, where 0.25 represents the worst relative performance (25% of the performance of other similar workers) and 2 represents the best performance (the individual's performance is 200% or twice that of other workers). It should be noted that the recommended range of 0.25–2 is asymmetrical in terms of design. Because objective ratings show that even the best workers are rarely more than twice as productive as an average worker, while bad workers often have less than half the productivity of an average worker. Sometimes this amount of productivity reaches a quarter of an average worker.

Lastly, the mixture of relative presenteeism and relative absenteeism can be used to determine Work Performance. To this end, the number of relative working hours was first determined (relative working hours are equal to 1 minus relative absence). Lastly, the work performance value was determined from relative work hours and relative presenteeism.

For instance, if the respondent reports his expected work hours per week as 40 (160 h in 4 weeks) and has worked 120 h in the last 4 weeks, his relative absence is equal to:

$$(40x4 - 120) / 40x4 = 0.25$$

As a result, his relative working hours will be equal to:

$$1 - 0.25 = 0.75$$

If the relative Presenteeism of this worker is 1.6, the combined score will be as follows:

$$0.75 \text{ x } 1.6 = 1.2$$

This number shows that this person's performance and work productivity are higher than an average worker's expected productivity. Although this person has lost working hours during the week, he has compensated this lost hours with higher productivity. Because his total score is higher than one. As a result, by combining these two dimensions, a person's Work Performance is calculated [36]. The Persian version of this questionnaire was prepared by Pournik et al., and its reliability and validity have been confirmed [37].

2.4. Occupational fatigue

The Swedish Job Fatigue Questionnaire (SOFI-20) was used to determine the mental fatigue of employees. The SOFI questionnaire is a multidimensional tool that is presented to assess the quality and severity of perceived acute fatigue. This questionnaire is able to assess the psychological and physical aspect of job fatigue [38]. This questionnaire has been used in several studies in various occupations and has been recognized as a reliable tool for determining mental fatigue [39–41]. This method has 5 dimensions of lack of energy, physical effort, physical discomfort, lack of motivation, and drowsiness, each of these dimensions consists of 4 questions (20 questions in total). Employees should score each question from 0 to 10, and finally, the sum of the scores of the questions related to each dimension determines the final score of each dimension (given that each dimension consists of 4 questions, the maximum possible score for each dimension is 40 And the lowest possible score is zero (the final score of the feeling of fatigue, which is obtained from the sum of the scores of the constituent dimensions, can be a number between 0 and 200). The closer the final score is to 200, the higher the fatigue (and vice versa) [42].

2.5. Ethical code

The Research Ethics Committee of Isfahan University of Medical Sciences approved the current study (IR.MUI.RESEARCH.REC.1399.333). All participants were over 18 years of old, and the informed consent form for participating in the research was read and signed by all of them.

Table 1
Demographic characteristics and work-related information of participants.

Variable	Mean ± SD	Range
Age (Year)	34.76 ± 6.17	29–52
Work Experience (Year)	9.28 ± 5.33	2–22
Work hours per week (n (%))	55 ± 9.13	45–70
BMI	24.95 ± 3.44	19.5–28
Mental Workload	16.57 ± 5.83	13–20
Fatigue	6.32 ± 2.86	3–10
Relative Absenteeism	0.31 ± 0.13	−0.25-0.45
Relative Presenteeism	0.91 ± 0.23	0.6–1.5
Performance	0.65 ± 0.28	0.4–1.39
Gender (n (%))	Male	Female
	95 (%68)	45 (%32)
Marital status (n (%))	Single	Married
	42 (%30)	98 (%70)

Table 2
Correlations among the variables of the study (N = 140).

#	Variable	Mean ± SD	1	2	3	4	5	6	7	8	9	10	11	12
1	LoE	4.86 ± 2.27												
2	PyE	5.32 ± 2.81	0.601*											
3	PyD	5.53 ± 2.21	0.769	0.792*										
4	LoM	5.29 ± 2.61	0.618*	0.554*	0.624*									
5	SLi	5.21 ± 2.35	0.776*	0.512*	0.705*	0.572*								
6	MD	17.58 ± 5.36	0.421*	0.324*	0.124	0.289*	0.241							
7	PD	15.64 ± 4.89	0.521*	0.721*	0.621*	0.241	0.105	0.652*						
8	TD	16.43 ± 6.64	0.114	0.125	0.082	0.141	0.051	0.621*	0.712*					
9	TC	18.12 ± 5.92	0.092	0.041	0.152*	0.018	0.024	0.315*	0.219*	0.354*				
10	SS	16.75 ± 4.78	0.119	0.113	0.099	0.021	0.018	0.594*	0.574*	0.549*	0.211*			
11	DIs	14.75 ± 4.51	0.054	0.012	0.051	0.048	0.171*	0.214*	0.514*	0.338*	0.378*	0.471*		
12	RAb	0.31 ± 0.13	0.133	0.175	0.212*	0.181	0.032	0.017	0.142	0.147	0.055	0.182*	0.048	
13	RPr	0.91 ± 0.23	−0.264*	−0.172	−0.100	−0.015	−0.175	−0.055	−0.146	−0.032	−0.027	−0.038	−0.014	−0.471*

Note: SLi: sleepiness; LoE: lack of energy; PyE: physical exertion; PyD: physical discomfort; LoM: lack of motivation; MD: mental demand; PD: physical demand; TD: temporal demand; TC: Task complexity; SS: Situational stress; DIs: Distractions; RAb: Relative Absenteeism; RPr: Relative presenteeism.

2.6. Data analysis

In this study, descriptive statistics were used to summarize demographic data. The hypotheses of the study were investigated using the structural equation modeling (SEM) approach. The goodness of fit of the hypothetical model was assessed using both absolute and comparative fit indices. A fit and acceptable model should satisfy both of these indices types. The ratio of Chi-square to Degree of Freedom ($\chi 2/df$) and the Root Mean Square Error of Approximation (RMSEA) were two absolute indices used to evaluate the goodness of fit of the model. Comparative indices included the normed fit index (NFI), comparative fit index (CFI), and Tucker-Lewis Index (TLI). A $\chi 2/df$ value lower than 3, RMSEA (90% CI) lower than 0.08, and comparative indices higher than 0.9 were regarded as acceptable level [43]. Skew and kurtosis scores were used to investigate the distribution of all variables included in the SEM model.

3. Results

The descriptive results of the demographic and occupational characteristics of the investigated employees are presented in Table 1. Out of 165 distributed questionnaires, 140 questionnaires were completed and delivered to researchers (85% response rate). Most study participants were male (68%) and married (70%). The mean ± standard deviation of their age and work experience were 34.76 ± 6.17 and 9.28 ± 5.33, respectively. Their average working hours were 55 ± 9.13, which were higher than usual in Iran (40 h). The mean ± standard deviation of the main study variables, including mental workload, fatigue and work performance, were 16.57 ± 5.83, 6.32 ± 2.86 and 0.65 ± 0.28, respectively.

The descriptive results of the dimensions that made up mental workload, fatigue and work performance variables and the relationship between them are presented in Table 2. Among the dimensions of mental workload, task complexity and mental demand got the highest score and also lowest scores was related to distraction dimension. Among the dimensions of fatigue, physical discomfort and physical effort got the highest score, and the lowest score was related to lack of energy and sleepiness. All dimensions of fatigue had a strong positive relationship with each other, and in most cases, the relationship was statistically significant ($r > 0.5$; $p < 0.05$). The dimensions of mental workload also had a relatively strong and significant relationship with each other ($r > 0.2$; $p < 0.05$). There was also a direct relationship between mental workload and fatigue. Also, a direct relationship was observed between fatigue dimensions and relative absence. In the meantime, the relationship between physical discomfort and relative absence was statistically significant ($p < 0.05$). There was also a direct relationship between the dimensions of mental workload and relative absenteeism. In the meantime, the relationship between situational stress and relative absence was significant ($p < 0.05$). An inverse relationship was observed between fatigue dimensions and relative Presenteeism. Meanwhile, the relationship between lack of energy and relative Presenteeism was statistically significant ($p < 0.05$). There was an inverse relationship between mental workload dimensions and

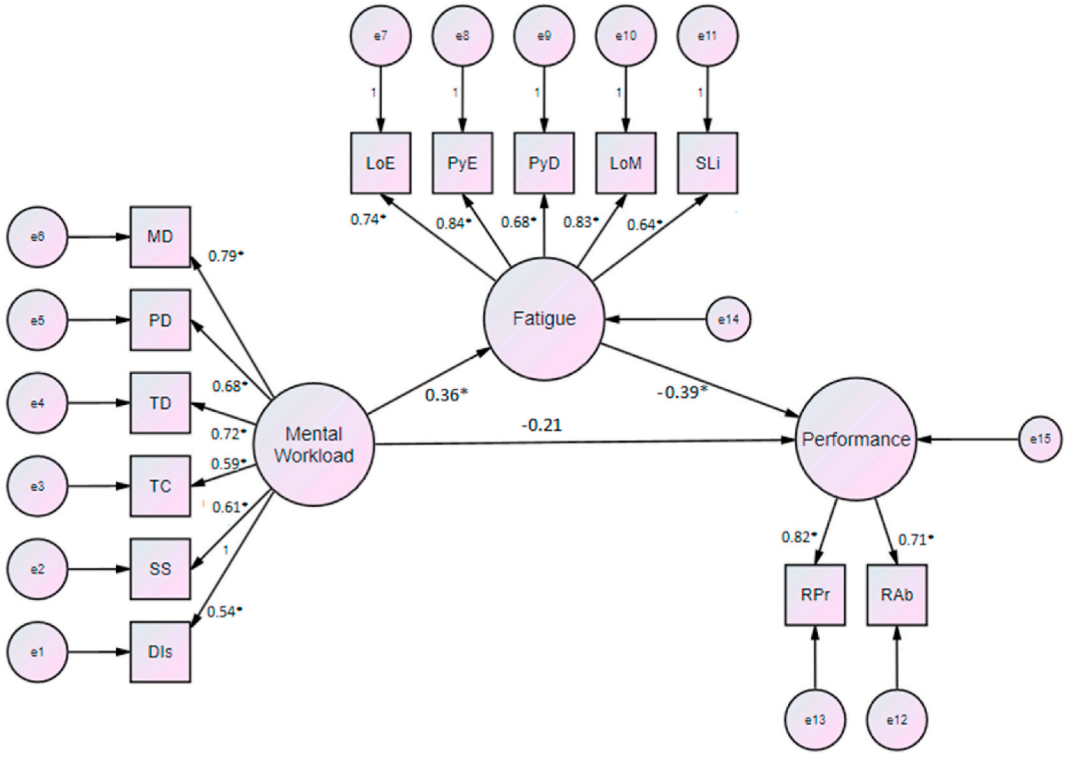

Fig. 2. The SEM model demonstrates occupational fatigue as a mediator of the relationship between mental workload and work performance (signifies path is significant at 0.05).

relative Presenteeism, but this relationship was not statistically significant ($p > 0.05$).

The structural equation model related to the explanation of the relationships between the three variables of mental workload, fatigue and work performance is presented in Fig. 2. The fit indices of the model are presented in Table 3. The results indicated that all the model fit indices were within the acceptable range. Regarding this model, the direct effect of mental workload on work performance was not significant ($\beta = -0.21$; $p = 0.072$). A significant positive relationship was detected between mental workload and fatigue ($\beta = 0.36$; $p < 0.001$). The direct effect of fatigue on work performance was also the opposite and statistically significant ($\beta = -0.39$; $p < 0.001$). As a result, it can be indicated that the effect of mental workload on work performance is mediated by occupational fatigue.

4. Discussion

The current study aimed to investigate the relationship between mental workload and work performance and the role of occupational fatigue as a mediator in surgeons. Fatigue is an integral part of work activities that can never be eliminated. Various studies have introduced fatigue and mental workload as effective factors in a wide range of adverse outcomes [21]. In this study, the adverse effect of these variables on the work performance of surgeons was investigated. In the present study, the effect of mental workload on the work performance of surgeons was tested using the following hypotheses: 1) the direct effect of mental workload on work performance (H_1), 2) the indirect effect of mental workload on work performance through the mediator effect of occupational fatigue (H_2).

The results of the current study revealed that the average mental workload in surgeons is higher than the average and is worrying. Among the dimensions of mental workload, task complexity and mental demand got the highest score and the lowest score was related to distraction. In other words, surgeons declared the high mental demand and complexity of tasks during surgery operation as the most important factors in increasing mental workload. These results was align with the results of some other studies that have used the SURG-TLX tool that investigate the mental workload of surgeons. For example, Jiahui et al. reported the highest score concerning mental demands among the investigated variables of study [44]. Also, Klein et al. [45] indicated that these surgeons suffer moderate to high levels of mental workload during work. Weigl et al. [46] also reported a high level of mental workload while performing various activities and indicated the increase of mental workload during surgery related to changing the type of surgical activities. Likewise, these researchers disclosed that changes in work activities lead to an increase in different aspects of mental workload, including demands, physical demands, temporal demands, complexity and situational stress, and finally, the final score of SURG-TLX. The workload is considered as one of the main stressful factors in the working environment of surgeons and is determined as a multifaceted factor by the interaction of task requirements, working conditions, skills, behaviors and perceptions of workers [10]. The workload in surgeons has different dimensions, such as mental demands, physical demands, temporal demands, task complexity, situational stress and distraction, all of which can increase the surgeon's stress during work [11–13]. Due to dealing with patients' lives directly, responding to patients and sometimes their companions, performing complex and stressful treatment protocols, and increasing the number of surgeries compared to previous years, surgeons bear a heavy workload [14]. This issue is also obviously visible in the current study.

Contrary to the results of the current study, in some studies, the score of mental workload dimensions and the reported final score of SURG-TLX was different from the present study results. Berg et al. reported situational stress and physical demand as the most effective dimensions in the mental workload score of surgeons [47]. The average score obtained in the present study was also higher than that obtained in the study of Kennedy-Metz et al. [48]. The difference in mental workload score in surgeons can be related to the difference in working environment and the type of surgery. In the current study, a wide range of specialties was examined as a group; clearly, the results can be different compared to different specialties in the form of separate groups.

In the current study, presenteeism, absenteeism and work performance were other variables investigated in surgeons. The results indicated that relative presenteeism and relative absenteeism was in their moderate level. Likewise, the average determined work performance of surgeons was lower than a surgeon with average performance (work performance = 1). Inspecting the relationship between mental workload and work performance also revealed an inverse relationship between them. In other words, with the increase in mental workload in surgeons, their work performance decreased. Consequently, hypothesis H1 was confirmed. Various studies have investigated the effect of workplace stressors, diseases, social and family problems, etc., on surgeons' work performance. Rantanen et al. [49] disclosed that socio-economic conditions, acute and chronic diseases and work conditions such as speed of work, mental demand and complexity of work could affect the work performance of nurses and affect doctors' health negatively in the care system. The effect of mental workload on the technical performance of surgeons was also investigated in a study. Weigl et al. [46] found that the increase in mental workload has a negative effect on the technical performance of surgeons.

Table 3
Model fit indices.

Index	Value	Acceptance Model
$\chi 2/df$	1.673	<3.00
CFI	0.993	>0.9
NFI	0.916	>0.9
TLI	0.941	>0.9
RMSEA (90% CI)	0.058 (0.023–0.112)	<0.08

In recent years, the effects of fatigue on job performance have been extensively studied in different occupations. The current study found that the indirect relationship between mental workload and job performance is mediated through job fatigue. Thus, hypothesis H_2 was also confirmed. It can be concluded that mental workload and fatigue do not have an independent relationship. In other words, the mental workload can positively affect occupational fatigue, so the higher the mental workload, the higher the occupational fatigue. The relationship between mental workload and fatigue has been investigated in several studies recently. In most studies, the relationship between these two variables has been confirmed. Fan and Smith [32], declared that workload is one of several predictors of fatigue. Hassanzadeh-Rangi et al. [50] showed that mental workload is associated with all the dimensions of fatigue including mental and physical ones. Mirzaei Tusi et al. [51] showed that the mental fatigue was significantly associated with the mental workload. On the other hand, some studies in healthcare personnel have stated that there is no relationship between mental workload and occupational fatigue [34,35]. This difference can be due to various reasons, including the difference in the nature of tasks in different jobs. Because, some jobs require higher physical demands and some require higher mental and intellectual demands. Also, the use of different tools to measure occupational fatigue can be another reason for this discrepancy.

Nonetheless, the results of the current study highlight that occupational fatigue should be measured seriously in surgeons, because high occupational fatigue can lead to low job performance in them. Regarding these findings, the policymakers of the health care system in Iran should pay more attention to the surgeons' working conditions and special attention to reducing fatigue and mental workload in them. Managing fatigue and increasing job performance in surgeons can lead to more efficient treatment in the health care system [5]. As mental workload and its direct impact on fatigue are understood, finding the roots of mental workload in surgeons is important and must be reduced to the minimum level. Due to their direct responsibility to patients' lives, responding to patients and their companions, performing complex and stressful treatment protocols, time limitations during surgery, and the increase in the number of surgeries due to the lack of surgeons, surgeons tolerate a heavy workload [14]. All these cases can someway lead to an increase in fatigue and a decrease in the job performance of surgeons. In the current study, although the average of the variable of relative presenteeism was less than 1, in many of the surveyed surgeons, this value was higher than 1, which indicates high working hours in multiple shifts and can have a positive effect on mental workload and fatigue. The results of the current study were in line with the accepted studies on the relationship between mental workload, fatigue and job performance. A study by Yurko et al. [15] concluded that a higher mental workload due to increased fatigue could lead to decreased job performance and even surgeon human errors. The effects of fatigue on the job performance of surgeons and the mediating role of job responsibility and role overload have been investigated by Jiandong et al. The results of their study approve the effect of increased fatigue on the performance of surgeons and the amplification of this effect with increasing job responsibility and role overload [52]. Also in another study, Fan et al. [32] stated that mental workload with increased fatigue can lead to a decrease in job performance, and fatigue mediates the relationship between mental workload and job performance. The results of other studies also approve the results of the present study [53,54]. The offered results designate the need for surgeons to follow some controlling strategies to reduce fatigue and workload during surgery. In this context, Janhofer et al. [55] have suggested some measures to control and reduce fatigue during surgery. These techniques include proper planning to maximize team synergy and efficiency and using planned and unplanned breaks during the operation for mental and physical rest and recovery. Likewise, preserving proper focus and attention while performing long-term actions can reduce physical and mental fatigue.

There are several limitations in the current study that should be stated. This study was conducted on a limited number of surgeons, so the conclusions should be cautiously generalized. The surgeons studied in the current study were selected from various specialties. In other words, different specialties were examined as a group, so the generalization of these results for a specific group of surgeons is incorrect. Since the data used in this study were cross-sectional, causal inferences based on SEM should be used with caution. It is suggested to design future studies to investigate and evaluate the causes of fatigue and mental workload in surgeons. As well as mental workload and fatigue, many variables can affect the job performance of surgeons, such as psycho-social characteristics of the work environment, physical and technological characteristics of the operating room, etc., which should be considered for future studies.

5. Conclusion

Surgeons, during their work, undergo a high level of mental workload, and these factors can have a negative effect on surgeons' job performance. The effect of mental workload on job performance in surgeons can be observed in two ways, directly and indirectly, through the mediating variable of job fatigue. Improving the mental and physical conditions of the work environment can reduce occupational fatigue and improve surgeons' job performance.

Declarations

Author contribution statement

Mahdi Jalali: Conceived and designed the experiments.
Reza Esmaeili: Analyzed and interpreted the data; Wrote the paper.
Ehsanollah Habibi: Conceived and designed the experiments; Wrote the paper.
Mohammad Alizadeh: Contributed reagents, materials, analysis tools or data.
Azim Karimi: Performed the experiments.

5.1. Data availability statement

Data included in article/supp. material/referenced in article.

Additional information

No additional information is available for this paper.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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