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Predicting Healthcare Workers' Work Performance Based on Safety- Ergonomic Features of Medical Gloves at Fars Province Hospitals, Iran, 2021

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Abstract

Background: Healthcare workers' work performance is an important issue affected by the clinical work environment and equipment. The present study aims to predict healthcare workers' work performance based on safety-ergonomic features of hands and medical gloves.

Materials and Methods: This cross-sectional study was conducted on healthcare workers at the hospitals of Shiraz University of Medical Sciences, Iran, 2021. Using convenience sampling, 720 healthcare workers were selected. The Patterson's Work Performance Questionnaire and the Medical Gloves Assessment Tool were used to collect the required data on work performance and safety-ergonomic features of medical gloves, respectively.

Results: The work performance score was 40% of the maximum achievable score, and the total score of medical gloves was almost half of the ideal state (50.52%). In addition, there was a significant relationship between work performance and safety-ergonomic features of medical gloves (correlation coefficient = 0.868). The overall regression model showed that safety-ergonomic features of medical gloves could predict the healthcare workers' work performance ($P = 0.001$). Accordingly, tactile sensation, dexterity, fitting, reliability, and hand hygiene could predict work performance ($P < 0.05$), while grip strength alone could not do as such. Besides, fitting was the factor that affected work performance the most (Beta = 0.368).

Conclusions: In general, the results of this study showed that safety-ergonomic features of safety gloves could predict the healthcare workers' work performance. In addition, improving safety-ergonomic aspects of personal protective equipment, including medical gloves, might help enhance the quality of healthcare workers' performance.

Keywords: Work Performance, Protective Gloves, Ergonomics, Safety, Personal Protective Equipment.

Introduction

Patients' physical and mental health is associated with the quality of clinical care and healthcare workers' (HCWs) work performance [1]. HCWs' work performance is defined as being effective in performing responsibilities regarding direct patient care, the decline of which leading to reduced productivity, increased costs, patient dissatisfaction, and increased workload [2]. Due to the important role that HCWs play in patient recovery, their malpractice can have irreparable

consequences; thus, it is important to address factors affecting HCWs' performance [3].

Stress, psychological capital, emotional intelligence, and mental health are among the factors related to personality traits, which exert a direct impact on job performance [4, 5]. Shalani et al investigated the effect of job stress on the relationship between psychological capital and job performance in hospital nurses of Kermanshah Province; accordingly, they reported that nurses with richer psychological capital and less job stress put on better job performance [6]. However, no study has examined the effect of work environment conditions, such as workstation design and equipment used, on the performance of employees, especially nurses. Zarei et al stated that poor working conditions were among the factors affecting nurses' job performance [7]. However, enough information is not available on environmental factors and the way they affect job performance. Nevertheless, various studies have shown that the working environment and equipment have a significant impact on individuals' characteristics and performance, with these factors affecting job performance [8, 9].

Personal protective equipment (PPE) is one of the important environmental factors in the field of medicine. In fact, PPE appropriateness and quality have a direct impact on HCWs' performance [10]. It is worth saying that improper use of personal protective equipment reduces efficiency, thereby making its use ineffective [11].

Medical gloves are among the most important equipment used in clinical settings. In other words, medical gloves are important in terms of safety-ergonomic features because they prevent transmission of infectious agents, being used in highly delicate tasks [12, 13]. The major properties of medical gloves to meet safety-ergonomic functional requirements include the absence of holes, physical properties, suitable dimensions, powder content, and durability [14].

Medical gloves, in addition to protecting people's hands against transmission of infectious agents, have a direct impact on the hands' function. Upon examining medical gloves, Zare et al reported that the nurses' individual performance was directly affected by the type and size of medical gloves [10]. In another study, Jahangiri et al verified the relationship between the stress caused by COVID-19 exposure and the feeling of satisfaction with the performance of medical gloves among nurses [15]. However, in the aforementioned studies, the effect of medical gloves on work performance was measured, with their focus having been put on hand performance.

Various studies have been conducted on the effect of job stress, job burnout, and shift work on HCWs' work performance [16-21]; however, no study has so far been conducted on the effects of structural and functional features of personal protective equipment (PPE), like medical gloves, on HCWs' work performance. Given the importance of medical staff's job performance and the use of PPE, especially medical gloves, studying the effects of medical gloves on medical staff's work performance can be very useful. Global precautionary standards have required HCWs to use gloves when contact with blood or body fluids is predictable [22]. The resulting increase in the use of gloves among HCWs has created a number of problems, including allergies, dermatitis, increased human errors, and reduced quality of work performance [23]. This study, for the first time, tries to examine work performance in terms of safety-ergonomic features of medical gloves to determine the impact of workplace equipment on work performance. Accordingly, the medical staff's job performance was evaluated based on the safety-ergonomic features of medical gloves, in this study.

Materials and Methods

This cross-sectional study was conducted at the hospitals of Shiraz University of Medical Sciences, Fars Province, southern Iran. The study population included 24,359 HCWs (nurses, midwives, and paramedics) [24]. According to Eq. (1), the required sample size was calculated at 379. However, to increase accuracy, 720 HCWs were finally considered.

Formula 1.

$$n = \frac{N z^2 s^2}{N d^2 + z^2 s^2}$$

Where n is the sample size, N represents the population size, z is the value corresponding to the confidence level required (1.96), s is the standard deviation (equal to 0.5), and d represents precision (at the proportion of one; if 5%, d = 0.05).

Using convenience sampling, a sample of 720 HCWs from different wards of 10 random hospitals was selected. The inclusion criteria were giving consent to cooperation in the research and completion of the questionnaires as well as having at least one year of work experience. On the other side, the exclusion criterion was having hand deformities or disorders. The Work Performance Paterson Questionnaire and the Medical Gloves Assessment Tool (MGAT) were used to collect

data. Each participant received the questionnaires in person at their workplace. Out of all eligible subjects, 675 returned the questionnaires (the total response rate of 93.7%).

The Work Performance Patterson's Questionnaire: The Work Performance Questionnaire, developed by Patterson, has 15 questions about discipline, responsibility, honest performance, and quality of work, being a self-assessment performance questionnaire. The subjects gave their responses on a 4-point scale (1 = rarely, 2 = sometimes, 3 = often, and 4 = always). In addition, the maximum and minimum scores were 60 and 15, respectively. This questionnaire was translated into Persian and validated in 1990. The Cronbach's alpha coefficient (reliability) for this questionnaire was 0.85. To determine its validity, the questionnaire was given to a group of professors and experts, and its formal and content validity was confirmed [25].

The Medical Glove Assessment Tool (MGAT): The MGAT is a tool used for evaluating various safety-ergonomic aspects of medical gloves [11]. The questionnaire has 26 questions and 6 domains, including dexterity with 5 items, tactile sensitivity with 3 items, grip strength with 3 items, fitting with 5 items, reliability with 7 items, and hand hygiene with 3 items. The questions in these 6 domains were about the sense of touch (distinguishing bumps as well as recognizing cold and hot objects), hand skills (task speed and quality as well as finger function and movements), ability to grasp (holding tools and applying force), glove size (the size of gloves in different areas of fingers and the wrist as well as satisfaction with the size), ensuring performance of gloves (safety relief, durability, and integrity), and hygiene (allergies and skin problems). The subjects were asked to give their responses on a 5-point scale (0 = never, 1 = rarely, 2 = sometimes, 3 = often, and 4 = always). The score was firstly calculated for each domain (subscale) separately, and secondly the sum of scores of all domains was calculated as the total score of the medical gloves. The Cronbach's alpha coefficient (reliability) was 0.82. To verify its validity, the questionnaire was given to a group of professors and experts, and its formal and content validity was confirmed.

The Ethics Committee of Shiraz University of Medical Sciences reviewed and approved the study protocol under code IR.SUMS.REC.1399.107.

In addition, statistical analysis was performed using SPSS V22.0. Besides, the Kolmogorov-Smirnov test was used to check the normality of the data. According to the results, the significance level of all research variables was greater than 0.05. Therefore, the assumption of normal distribution was verified; thus, it was possible to use the Pearson's correlation coefficient and regression analysis.

Results

A total of 241 males and 479 females participated in the present study. Table 1 shows demographic information of the studied sample. Accordingly, all participants had a bachelor's degree and used latex gloves.

Table 1. Demographic information of the studied sample (n = 720)

Variable	Mean	SD	Median
Age (year)	37.7	7.73	-
Work experience (year)	10.92	8.02	-
Daily glove use (hour)	5.03	3.35	-
Glove changes (per day)	-	-	3

Table 2 shows descriptive statistics of the variables, including work performance, subscales, total scores of medical gloves, and their correlation matrix. Accordingly, the work performance score was 40% of the maximum achievable score, and the total score of the medical gloves was almost half of the ideal state (50.52%). The lowest scores were attributed to the reliability (40.28%) and fitting (41.65) subscales. On the other hand, the highest score was given to the dexterity subscale (64.6). In addition, tactile sensation, grip strength, and hand hygiene subscales had 59, 56.41, and 54.3% of the maximum achievable scores, respectively.

The results showed that the HCW's work performance had a significant positive relationship with the score of medical gloves and their subscales. However, among the features of gloves, fitting had the highest correlation with work performance.

Table 2. Mean and standard deviation of the studied variables and the matrix of correlation coefficients

Variables	Minimum achievable score	Maximum achievable score	Mean (SD)	Work performance
Work performance	15	60	24 (6.56)	1
Total score of medical gloves	0	104	52.55 (17)	0.868**
Tactile sensation	0	12	7.08 (2.6)	0.551**
Dexterity	0	20	12.88 (5)	0.675**
Grip strength	0	12	6.77 (2.79)	0.477**
Fitting	0	20	8.33 (4.75)	0.741**
Reliability	0	28	11.28 (5.96)	0.656**
Hand hygiene	0	12	6.52 (2.77)	0.427**

** Correlation was significant at the level of 0.01.

Table 3 shows regression analysis results of the effect of safety-ergonomic features of gloves on predicting work performance. As the general model showed, the variables of hand hygiene, tactile sensation, grip strength, fitting, reliability, and dexterity altogether could significantly predict work performance (P = 0.001). In a separate evaluation of predictor variables, the Beta coefficient showed that grip strength alone could not significantly predict HCWs' work performance (P = 0.923, Beta = -0.004); however, the general regression model showed that other safety-ergonomic features of medical gloves could predict HCWs' work performance separately. This finding indicates that upon each standard deviation increase in tactile sensitivity, dexterity, fitting, reliability, and hand hygiene, the HCWs' work performance increased by 0.161, 0.221, 0.368, 0.307, and 0.153, respectively. As the correlation evaluation showed, fitting was the most effective factor in the HCWs' work performance.

Table 3. The summary of regression results of the study variables

Predictor variables	B	SE	Beta	T	F	R	R^2	P
General model				8.01	102.18	0.88	0.77	0.001
Tactile sensation	0.407	0.124	0.161	3.27				0.001
Dexterity	0.289	0.071	0.221	4.099				0.001
Grip strength	-0.01	0.102	-0.004	-0.097				0.923
Fitting	0.508	0.064	0.368	7.925				0.001
Reliability	0.338	0.046	0.307	7.289				0.001
Hand hygiene	0.362	0.093	0.153	3.96				0.001

Discussion

The present study evaluated the relationship between safety-ergonomic features of medical gloves and work performance. The results showed that the more efficient safety-ergonomic features of medical gloves were, the better the work performance would be. However, the effect of these features on work performance was not clear.

The effect of safety-ergonomic features of medical gloves on HCWs' work performance had not been studied previously [10, 26, 27]. Preece et al showed medical gloves affected work performance so that using gloves reduced dexterity and sensitivity compared to bare hands [28]. Decreased tactile sensitivity in tasks, such as finding the pulse and examining subcutaneous bumps and abnormalities, reduces the quality of task performance [29]. Basak et al observed that gloves reduced manual dexterity, thereby leading to discomfort problems, such as sweating and lowering satisfaction among nurses [30]. Zare et al showed that the glove size had direct effects on an individual's performance [10]. If the gloves are large or loose, the person may experience a decrease in dexterity and the ability to grasp, which reduces the quality of work performance [31]. Tight gloves reduce blood flow to the hands, cause sensation of pain and numbness, and reduce quality of work [32]. In the study of Gnaneswaran et al, it was found that allergies and dryness made medical gloves have a negative effect on individuals' performance and job quality [22]. Palmar hyperhidrosis, skin dryness, and latex allergy are safety problems associated with glove use.

Consistent with past research, our results showed that tactile sensitivity, manual dexterity, fitting, grip strength, and hand hygiene had a significant positive relationship with work performance. According to Table 2, all studied features had a positive correlation with work performance. In other words, with the improvement of each of the studied

features, individuals' work performance improved. The difference between the present study and the past ones is that the relationship between these features and HCWs' work performance was determined in the present one. In other studies, glove-related safety-ergonomic features were shown to affect individuals' performance, especially hand performance. However, the effectiveness of these features in improving work performance was identified in the present study.

Although the results showed that all the safety-ergonomic features of gloves could predict work performance, it was found that grip strength alone was not able to predict work performance. However, a significant positive correlation was found between grip strength and work performance. Willms reported that gloves had a relatively consistent effect on grip strength and reduced it, with this reduction in strength being actually due to the features of gloves' constituents [33]. Zhao et al reported gloves increasing the distance between fingers, reducing the pressure between fingers, and changing the feedback from the hand and fingers as the most cogent explanations for the decrease in grip strength [34], being consistent with our results.

This study found that by improving safety-ergonomic features of medical gloves, especially fitting, work performance would be expected to improve (Table 3). The present study was the first one to have examined this relationship. However, the results of this study could be used to improve HCWs' work performance and glove design.

There were some limitations in this study. Firstly, the participants were selected only from 10 hospitals in one province; secondly, this study was cross-sectional, so caution should be taken to generalize the results to the entire population of Iranian HCWs; and thirdly, since this research was the only research in this field, it was not possible to compare the results with those of others. Therefore, it is recommended that further studies be conducted with a larger sample size in this field. Demographic characteristics, especially age, gender, and type of job appeared to have positive or negative effects on the relationship among the variables of the present study, yet their intervening effect was not observed in the present study. In this regard, it is suggested that future research, given the effect of mediating variables on the main variables of the research, examine this issue in more detail.

Conclusion

It was found that tactile sensitivity, manual dexterity, fitting, grip strength, and hand hygiene affected HCWs' work performance. It was also found that if gloves provided better tactile sensitivity, had a suitable size, increased the person's ability to perform delicate tasks, and prevented hand allergies, the HCWs' work performance would improve. In general, the results showed that the HCWs' work performance could be predicted using safety-ergonomic features of safety gloves. This study also found that by improving safety and ergonomics of PPE, including medical gloves, the quality of performance could be improved.

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Conflict of interest: None declared.

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