

The Level of Knowledge, Attitude, and Performance of Healthcare Personnel in COVID-19 Hospitals Regarding the Use of Respiratory Protection Equipment

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Abstract

Background: The present study was performed to investigate the level of knowledge, attitude, and performance of healthcare personnel working in COVID-19 hospitals in Mashhad regarding the use of respiratory protection equipment.

Methods: This cross-sectional study was conducted on 536 personnel working in hospitals admitting COVID-19 patients in Mashhad, Iran. The participants completed a questionnaire containing data related to the knowledge, attitude, and performance of healthcare workers regarding the use of respiratory protection equipment.

Results: According to the results, the evaluated knowledge levels were weak (1.1%), moderate (32.7%), and good (66.2%). Moreover, the levels of attitude were moderate (7.9%) and good (92.1%). In addition, the performance showed moderate (3.6%) and good (96.4%) levels. The mean score of knowledge was significantly higher among employees over 35 years of age ($P<0.001$), employees with 10 years or more work experience ($P<0.001$), and among males, compared to females ($P<0.001$). The mean score of performance was also significantly higher in males than in female employees ($P<0.001$), in married, compared to single employees ($P<0.001$), and among individuals who had close contact with a COVID-19 patient ($P<0.001$).

Conclusion: According to the results of the study, there was an acceptable level of knowledge, attitude, and performance among healthcare personnel working in the COVID-19 hospitals of Mashhad regarding the use of respiratory protection equipment. However, more training in this field seems useful, especially for people with less experience and age.

Key Words: Attitude, Healthcare workers, Knowledge, Performance, Respiratory protection equipment.

* Please cite this article as: Rahimpour F, Ahmadi F, Niroumand S, Sheibani F. The Level of Knowledge, Attitude, and Performance of Healthcare Personnel in COVID-19 Hospitals Regarding the Use of Respiratory Protection Equipment. Int J Pediatr 2023; 11 (03):17453-17462. DOI: **10.22038/ijp.2023.70036.5161**

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Received date: Jan.09,2023; Accepted date:Feb.26,2023

1- INTRODUCTION

Corona disease, which is caused by the coronavirus disease 2019 (COVID-19), is a type of respiratory disease with initial symptoms, including pneumonia, fever, muscle pains, and fatigue (1). According to the latest information from the World Health Organization Website, 883,174,200 people have been infected with this disease in the world up to August 5, 2021, among whom 892, 255, 4 deaths have been reported (2).

Due to the possibility of severe symptoms and complications of this disease or even the risk of death, it is important to pay attention to the protection and prevention issues (2). Undoubtedly, healthcare workers are on the front line of the fight against COVID-19 disease and are also exposed to more contamination (3). Therefore, it is necessary to maintain the safety of healthcare personnel by various control methods, including engineering and management controls, as well as the use of appropriate protective equipment (types of N95 masks and protective clothing) (4).

Considering that one of the ways of COVID-19 virus transmission is through the respiratory tract and healthcare workers are most at risk of contracting this disease (5), familiarity with respiratory protection programs and equipment, such as surgical and N95/FFP2 respiratory masks, as well as measuring and improving their knowledge and performance in terms of effective use of respiratory protection equipment in this field are necessary (6).

Since few studies have been conducted in this regard in Iran, in the present study, an effort will be made to evaluate the level of knowledge, attitude, and performance of healthcare personnel in this serious pandemic. Accordingly, based on the obtained information, policies and programs can be made in similar cases,

such as holding training sessions for personnel and giving importance to the supply of respiratory protection equipment. With this background in mind, this study was performed to investigate the level of knowledge, attitude, and performance of personnel working in COVID-19 hospitals regarding the use of respiratory protection equipment.

2- MATERIALS AND METHODS

2-1. Design and Participants

This cross-sectional study was conducted on 536 health care personnel working in hospitals admitting patients with COVID-19 participants in Mashhad, Iran. It aimed to investigate the level of knowledge, attitude, and performance of the personnel regarding the use of respiratory protection equipment.

2-2. Inclusion and Exclusion Criteria

Inclusion criteria encompassed physicians and nurses with at least 6 months of clinical work experience, having at least an associate degree and willingness to participate in the study. On the other hand, the students and those who failed to complete the questionnaire or refused to continue participating in the study were excluded from the research procedure. Following that, convenience sampling was performed to select the staff from the care and treatment departments of referral hospitals for the treatment of COVID-19 patients.

2-3. Instrument

The questionnaire used in this research was designed based on the OSHA questionnaire (Appendix 1). This questionnaire was confirmed valid by five Occupational Health and Safety experts (OHS) and five healthcare workers. Moreover, it was also implemented in Iran, and its reliability in Iran was calculated by Cronbach's alpha for knowledge, attitude, and performance dimensions ($\alpha=0.860$, $\alpha=0.899$, $\alpha=0.870$, respectively) (7).

The questionnaire includes four sections seeking information regarding the demographic characteristics of the patients (age, gender, level of education, occupation, marital status, and work experience) and other required information related to the knowledge (22 items), attitude (8 items), and performance (7 items) of healthcare workers regarding the use of respiratory protection equipment. The items related to knowledge are rated as 2 (true), 0 (false), and 1 (no knowledge). The items related to attitude are scored based on a 5-point Likert scale from 1 (completely disagree) to 5 (completely agree), and the performance items are classified based on a two-option response: Yes (score 1) and No (score 0). The scores obtained from the sections of knowledge, attitude, and performance are 44, 40, and 7, respectively. The final score for each section is classified into four categories: very poor (0-25%), weak (26-50%), moderate (51-75%), and good (76-100%) (8).

2-4. Procedure

After obtaining approval from the Ethics Committee of the University (ethics code: IR.MUMS.REC.1399.137), the workers of the care and treatment departments of corona center hospitals were requested to participate in this research and complete the mentioned questionnaire. Some questionnaires were delivered to the participants in person by the researcher, and the participants read the questionnaire and after answering the questions for about 20 minutes, the questionnaire was collected. The other questionnaires were delivered to the head of each department of the hospital, and s/he distributed them among the personnel and collected after answering under the above conditions.

2-5. Data Analysis

The qualitative variables were presented in the form of frequency and percentage, and $\text{mean} \pm \text{SD}$ was used to express the

quantitative variables in the form of tables. In order to correlate the studied variables with the level of knowledge, attitude, and performance, independent t-test was used for two-group variables, and ANOVA was utilized for variables with more than two groups. The independent effect of variables affecting knowledge, attitude, and performance was investigated using multivariate linear regression. Data were analyzed using SPSS software (version 20), and $P < 0.05$ was considered statistically significant.

3- RESULTS

A total of 536 people were included in this study, and the majority of the participants were male ($n=292$; 54.5%). The mean values of age and work experience of the subjects were obtained as 30.32 ± 6.11 (age range: 20-60 years) and 5.47 ± 4.70 years, respectively. 248 (46.6%) of the participants had close contact with a COVID-19 patient. The duration of using masks per day was 9.94 ± 6.99 h, and the type of mask was surgical in 337 (63.3%), N95 in 192 (36.1%), cartridge in 1 (0.2%), and PAPR (Powered Air Purifying Respirator) in 2 (0.4%) participants. Among the respondents, 280 (52.3 %) cases used masks all the time, 89 (16.6 %) used them most of the time, 156 (29.2 %) used them sometimes, and 10 (1.9 %) rarely used masks.

In the studied subjects, the mean values of knowledge, attitude, and performance were determined at 35.60 ± 5.30 , 35.01 ± 3.24 , and 12.5 ± 0.98 , respectively. According to the obtained results, the level of knowledge was poor in 6 (1.1%), moderate in 173 (32.7%), and good in 350 (66.2%) subjects. Moreover, the level of attitude was moderate in 42 (7.9%) and good in 491 (92.1%) cases. In addition, the performance showed moderate and good levels in 19 (3.6%) and 514 (96.4%) cases, respectively.

The results of the t-test showed that the mean score of knowledge was significantly higher in employees aged >35 years old ($P<0.001$), in employees with work experience ≥ 10 years ($P=0.008$), and among males, compared to females ($P<0.001$). Moreover, the mean score of attitude was significantly higher in employees aged >35 years old ($P<0.001$), in employees with work experience ≥ 10

years ($P<0.001$), and among those who did not have close contact with a COVID-19 patient ($P=0.004$). The mean score of performance was also significantly higher in males in comparison to female employees ($P<0.001$), in married, compared to single employees ($P<0.001$), and among those who had close contact with a COVID-19 patient ($P<0.001$) (**Table 1**).

Table-1: Demographic and Contextual variables in relation to the level of knowledge, attitude, and performance in regard to respiratory protection equipment

Variable		Knowledge	P-Value	Attitude	P-Value	Performance	P-Value
Age	≥ 35	35.15 \pm 5.44	<0.001	36.42 \pm 3.10	<0.001	12.55 \pm 0.99	0.73
	> 35	37.58 \pm 4.06		36.71 \pm 3.30		12.51 \pm 0.98	
Work experience	< 10	35.36 \pm 50.40	0.008	34.78 \pm 3.14	<0.001	12.55 \pm 0.98	0.62
	≤ 10	37.15 \pm 4.25		36.53 \pm 3.43		12.49 \pm 0.99	
Gender	Female	34.59 \pm 5.57	<0.001	35.03 \pm 3.29	0.90	12.34 \pm 1.03	<0.001
	Male	36.44 \pm 4.91		35 \pm 3.20		12.71 \pm 0.92	
Marital status	Single	35.83 \pm 5.70	0.38	35.03 \pm 3.58	0.22	12.34 \pm 1.11	<0.001
	Married	35.53 \pm 5.09		35 \pm 3.08		12.63 \pm 0.92	
Type of mask	Surgical	35.79 \pm 5.43	0.34	34.93 \pm 3.29	0.46	12.50 \pm 1.02	0.15
	N95	35.34 \pm 4.88		35.15 \pm 3.13		12.63 \pm 0.89	
Close contact with a COVID-19 patient	Yes	35.99 \pm 4.85	0.79	34.73 \pm 3.05	0.004	12.75 \pm 0.91	<0.001
	No	36.11 \pm 5.30		35.55 \pm 3.23		12.3 \pm 0.97	

Considering the working environment, the mean score of knowledge, attitude, and performance of personnel has a statistically significant difference in those working in departments exposed to aerosol, compared to personnel who did not mention exposure to aerosol and non-clinical personnel (those who perform non-clinical and administrative services and are not directly present at the patient's bedside).

The results of the post-hoc Scheffe's test showed that the mean knowledge score of clinical department employees who were exposed to aerosol were statistically significantly different from those who

were not exposed to aerosol ($P=0.01$). Additionally, there was a statistically significant difference between the mean knowledge score of the clinical department employees who were not exposed to aerosol and that of the non-clinical department employees ($P=0.01$).

There was also a statistically significant difference between the mean performance score of the clinical department employees who were exposed to aerosol and that of the non-clinical department employees ($P=0.001$).

In order to eliminate the confounding effect, possible variables affecting the level of knowledge, attitude, and

performance of the participants were entered into the multivariable linear regression model (enter model). Accordingly, age, gender, and occupation type (exposure to aerosol or not) were entered into the model to investigate the independent effect of variables influencing the level of knowledge. As a result, age ($P=0.005$) and gender ($P=0.001$) had an independent effect on the knowledge level of employees. As for the variables influencing the level of employees' attitude, the variables of age, work experience, and history of one-meter

contact with a COVID-19 patient were entered into the model, and finally, only the variable of age group ($P<0.001$) had an independent effect on the level of employees' attitude. Regarding the performance of the personnel, occupation type, gender, marital status, and history of close contact with a COVID-19 patient were entered into the model. The output of the model showed that the variables of occupation type ($P<0.001$), gender ($P=0.001$), and marital status ($P=0.04$) had an independent effect on the personnel performance (**Table 2**).

Table-2: Logistic regression regarding independent variables affecting the level of knowledge, attitude, and performance of employees

Variable		B	CI	P-Value
Knowledge	Age (>35 years)	2.22	0.68-3.76	0.005
	Gender (male)	1.58	0.66-2.51	0.001
Attitude	Age (>35 years)	1.90	0.99-2.80	<0.001
Performance	Occupation type (contact with aerosol)	-0.11	-0.21--0.01	<0.001
	Gender (male)	0.27	0.11-0.44	0.001
	Marital status (married)	0.18	0.001-0.36	0.04

4- DISCUSSION

Based on the results of the present study, healthcare personnel working in COVID-19 centers enjoyed good levels of knowledge (66.2%), attitude (92.1%), and performance (96.4%) regarding the use of respiratory protection equipment. Among the first studies conducted on healthcare workers in Iran in this regard is a study by Nemati et al. (9), who found that only 56.5% of the participants had sufficient knowledge; however, the results of the present study were more satisfactory in this regard. The results of a study conducted by Haghigi et al. (2020) showed that 72.8%, 66.65%, and 67.72% of the healthcare personnel had sufficient knowledge, correct attitude, and good performance, respectively, regarding the use of respiratory protection equipment in the COVID-19 centers (10).

Zhang et al. surveyed 1,357 healthcare workers in Henan province in April 2020 and found that 89% of them had sufficient knowledge about the use of respiratory protection equipment (11). A study in Nigeria evaluated the knowledge, attitude, and performance of 300 healthcare workers, and more than 90% of the workers correctly answered the knowledge questions (12). Therefore, it seems that the healthcare workers in the present study had less COVID-19-related knowledge, compared to those in the studies in China and Nigeria. Differences in the results between the studies may be due to differences in timing, measurement tools, and different groups of healthcare workers in the studies. However, it seems necessary to hold training courses to increase the knowledge of employees working in

COVID-19 centers regarding the use of respiratory protection equipment.

Considering the attitude, the results of the present study were almost similar to those of the other three studies; accordingly, in the studies conducted in Uganda and Pakistan, the attitude of the employees was evaluated as significantly good, and the participants were only concerned about the availability of respiratory protection equipment (12,13). Other results showed that the mean score of knowledge and attitude was significantly higher in employees aged >35 years old and with work experience ≥ 10 years. These findings were consistent with the results of some other studies (14-18) on the knowledge, attitude, and performance of healthcare workers regarding the use of respiratory protection equipment. As people with higher age and work experience have received more training in the field of occupational health and safety and have a better understanding of the risks of the work environment.

The multivariate regression results revealed that age and gender variables had an independent effect on the knowledge level of employees. Moreover, the age group had an independent effect on the attitude level of employees. In addition, occupation type, gender, and marital status had an independent effect on personnel performance. The effect of gender can be explained by the customs of Iranian society, while older personnel, especially in the case of exposure to the Coronavirus, which has a greater risk for people with older age, have more desire to participate and attend training courses. This can increase their knowledge and attitude in this field. The higher level of performance in married employees, compared to single ones, may also be due to the fact that married healthcare personnel have a higher mean age than single people and also show more responsibility towards the family to

comply with personal protection rules while exposed to respiratory risks.

In line with the results of the present study, Honarbakhsh et al. in their study in 2018 stated that the mean scores of knowledge, attitude, and performance in the use of respiratory protection equipment are significantly related to the level of education, age, work experience, history of using respiratory protection equipment, and the marital status of these employees (7). Furthermore, based on the results of a study carried out by Haghigi et al. (2020) (10), the male gender was correlated with a more correct attitude toward the use of respiratory protection equipment. Among nurses, 2-5 years of work experience was associated with better performance; the results of both mentioned studies were consistent with the findings of the present study. Therefore, the full implementation of the training program for the correct use of respiratory protection equipment in hospitals should be put on the agenda, especially for employees with less work experience and younger age.

Gender and work experience were two variables significantly related to the mean scores of knowledge and attitude. Although the previous studies reported a significant association between work experience, knowledge and attitude (19), they do not support the association between gender, knowledge and attitude of healthcare workers (20). Among the reasons for this contradiction, one can mention the cultural norms of our country. According to other results of the present study, the mean score of performance was significantly higher among people who had close contact with a COVID-19 patient. The transmissibility and association of Corona disease with high complications and its potentially fatal nature may intensify the perception of risk in a person, and this will improve his performance during exposure and close contact with COVID-19 patients.

In general, according to the results of the present study, there is an acceptable level of knowledge, attitude, and performance among healthcare personnel working in COVID-19 centers of Mashhad, Iran, regarding the use of respiratory protection equipment. However, there is still a need for more training, especially in the use of respiratory protection equipment for people with less work experience and female personnel.

In recent years, COVID-19 has been the first pandemic to occur both in Iran and across the world; accordingly, in the beginning, due to its newness in terms of symptoms, severity, and transmission, compared to similar cases, as well as lack of complete information in this area, the treatment staff was not provided with comprehensive protocols for the use of personal protective equipment, dealing with a COVID-19 patient, and disease management. There was also no training in this field, except for the time allocated to the instructional courses, and this study focused on these pieces of training to assess the extent of their impact to help improve their quality, if necessary. According to the results of our study, the knowledge level of people regarding the use of respiratory protection devices was acceptable; however, a written instructional program in this field would

significantly improve the quality of health and medical personnel's behavior in similar emergencies.

In addition to improving knowledge, attitude can affect behavior through measures, such as training. When knowledge and attitude are combined, performance and healthy behavior can be promoted. Therefore, the improvement of continuous medical education programs, implementation of isolation and infection control measures, and the appropriate number of healthcare personnel providing services to patients can be effective in enhancing the level of healthcare and maintaining the health of healthcare workers.

5- CONFLICT OF INTEREST

None.

6- ACKNOWLEDGMENTS

This study was extracted from a specialized thesis on occupational medicine, which was performed under the financial support of the Research Deputy of Mashhad University of Medical Sciences, Mashhad, Iran. Hereby, the authors express their gratitude to the Deputy and the hospitals admitting COVID-19 patients in Mashhad for their cooperation.

Appendix 1: Occupational Safety and Health Administration (OSHA) questionnaire

Knowledge	True	Don't know	False
Having facial hair (beard) or acne has a negative influence on the performance of the respirator.			
Surgical and N95 respirators should be discarded after usage.			
Each person should wear a respirator that fits on his/her face dimensions.			
N95 respirators are suitable protection against gasses and vapors from chemicals.			
Surgical masks are as effective as N95 respirators against biological agents.			
Surgical masks or N95 respirators cannot be stored to be reused.			

I know how to correctly don and doff the respirators (adjust respirators on the face, grab the bands in doffing)		
Before using respirators for the first time, it is necessary to be medically evaluated.		
Seal check shall be performed each time wearing N95 respirators.		
After each contact with infectious patients, the N95 respirator should be replaced.		
In case hands contact the outer surface of the respirator, hands should be washed immediately to prevent the transmission of the infection.		
For people with chronic respiratory diseases, heart diseases, or medical conditions, N95 respirators equipped with an expiratory valve are recommended.		
Surgical masks must be replaced after visiting each patient.		
For first exposure to unknown diseases, a Powered Air-Purifying Respirator (PAPR) must be used.		
N95 respirators with expiratory valves should not be used in the operating or sterile room.		
In the operating rooms, surgical N95 respirators should be used.		
PAPR is a suitable respirator for people with facial hair (beard).		
For decontamination and maintenance, PAPR is recommended to be worn.		
To deal with patients with seasonal flu and tuberculosis, N95 or PAPR respirators must be used.		
N95 respirators are not effective protection against hazardous drugs (chemotherapy, hormone).		
To deal with the Severe Acute Respiratory Syndrome (SARS) patients, N95 or PAPR respirators are efficient.		
For protection against infectious aerosols produced during intubation or bronchoscopy, N95 or PAPR respirators should be used.		

Performance	Yes	No
Do you usually have facial hair (beard) when using a respirator?		
Do you use the bands when doffing the respirator?		
Do you adjust the nose clip when donning the respirator?		
Do you perform the seal check (test to ensure the complete fit of the respirator on the face) when wearing the N95 respirators?		
Do you wash your hands after contact with the outer surface of the respirator?		
Have you received a medical evaluation before using the respirator for the first time?		
Do you discard the N95 and surgical mask after each use?		

Attitudes	Completely agree	Agree	No idea	Disagree	Completely disagree
I think that HCWs are aware of the respiratory contaminations of their jobs.					
I think that the hospital staff should be examined for their respiratory system at least once a year.					
Hospital staff should be trained about how to use RPE.					
I think the staff should not have contact with suspected patients and respiratory pollutants, without using a respirator.					
I think using a respirator alone (without ventilation and biological hoods) is not enough to protect against the respiratory pollutants in hospitals.					
I think a completely fit respirator on the user's face is very important for its performance.					
I think respiratory pollutants in hospitals are not so dangerous in order to wear respirators.					
I think short contact with suspected infectious patients using surgical masks is not dangerous.					

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