

Original Article

The Effectiveness of the Personal Protective Equipment Course for Medical Interns and Residents during the Outbreak of COVID-19 Pandemic in Jeddah, Saudi Arabia

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Abstract

Background: Understanding the importance of personal protective equipment (PPE) use and its utilization to prevent the transmission of the disease is necessary among healthcare workers (HCWs), to achieve better healthcare outcomes for the HCW, the corresponding patient and the whole healthcare system. This study determines whether the PPE course benefits Saudi interns and residents in the scope of their work aims to determine and measure the level of attitudes, knowledge, and practices towards COVID-19 among residents and interns in Jeddah, Saudi Arabia.

Methods: This is a cross-sectional investigation that was conducted in Saudi Arabia in different settings between July and August 2020. The study used a previously validated survey to explore the attitude, practice, and effectiveness of PPE for residents and medical interns during the COVID-19 pandemic.

Results: A total of 402 participants were included in the final analysis, with a mean age of 24.9 ± 3.6 years. Nearly half of the participants were male (53.5%) and residents (52.5%). Overall, 278 of the participants (69.2%) had taken the PPE course, with approximately one-third (30.3%) having taken it within the past three months. The mean knowledge score for those who took the PPE course was significantly higher (P -value= 0.004) than those who did not (6.8 ± 3.3 versus 5.7 ± 3.0). Additionally, taking the PPE course did not influence participants' attitudes, in almost all tested aspects.

Conclusion: PPE courses are beneficial to medical interns and residents in their work scope against the COVID-19 battle and both medical interns and residents had good awareness and practice regarding the use of PPE.

Keywords: knowledge, awareness, attitude, COVID-19, personal protective equipment, practice, outbreak.

Introduction

In December 2019, a novel disease was reported in China that affected a cluster of severe cases with pneumonia. The etiology was connected with the wet markets in Wuhan, however, the exact etiology was undetermined (1). These events were announced as belonging to the coronavirus family, which was also responsible for the Severe Acute Respiratory Syndrome (SARS), and the Middle East Respiratory Syndrome (MERS) outbreaks. The current worldwide outbreak of the new coronavirus (that is now also known as the COVID-19 pandemic), has spread to many countries across the globe. The World Health Organization (WHO) reported that on June 28, 2020, there were 9,653,048 confirmed COVID-19 cases, of which, 419,128 mortalities were estimated globally (2).

The main route of transmission of the disease is via aerosols and respiratory droplets that can easily be transmitted from infected patients, or when in direct contact with contaminated media (3). The disease has induced a significant burden on all aspects of life over the affected systems. Social, educational, health, and economic parameters have all been affected, whether directly by the disease and the associated morbidities and mortalities, or indirectly by the measures taken to lessen these burdens, such as lockdown measures (4,5). Healthcare workers (HCWs) were also significantly impacted, and many studies have elaborated on the huge burdens that these workers had to face during the pandemic (6–8). To help HCWs face the huge rates of infections, many protective measures have been proposed, including the prevention of transmission-based parameters (as contact and droplet). Personal protective equipment (PPE) was effectively used to achieve the prevention of transmission-based parameters, and it encompasses a gown, gloves, a respirator, a full-face shield, or goggles (9). When respirators are not useful, a face mask is considered an acceptable alternative.

However, using such equipment was not always easy and many difficulties were reported. Additionally, as a result of the shortage of PPE during the pandemic, many approaches were introduced to adjust PPE to maximize the safety measures and prolong the period of equipment life. However, no educational courses were provided about these novel approaches, and therefore, the proper use and utilization of the equipment was not guaranteed. Moreover, no sufficient evidence has been provided regarding the cost of such approaches within the current literature (10). Understanding the importance of PPE use

and its utilization to prevent the transmission of COVID-19 is necessary among HCWs in order to achieve better healthcare outcomes for the HCW, the corresponding patient and the entire healthcare system (11). However, few studies have been undertaken among residents and interns in Jeddah, Saudi Arabia, regarding the use and utilization of PPE during the COVID-19 pandemic. Accordingly, this study aims to determine whether a PPE course would benefit Saudi interns and residents in the scope of their work and to determine and to measure the level of attitudes, knowledge, and practices towards COVID-19 among residents and interns in Jeddah, Saudi Arabia.

Methodology

Study design and target population

This cross-sectional study was conducted among residents and interns in Jeddah, Saudi Arabia between July and August 2020. The sample size was selected via simple randomization by distributing the survey among groups. A required sample size of approximately 382 medical interns and residents was required. The sample size was calculated by the Raosoft sample size calculator with a 95% confidence level and a margin of error of 5%. The study encompasses various universities and hospitals including King Saud University, King Abdul-Aziz University, Al Batterjee Medical College, Ibn Sina National College, King Abdul-Aziz University Hospital, East Jeddah Hospital, King Faisal Specialist Hospital, King Abdullah Medical Complex, Dr. Soliman Fakeeh Hospital, National Guard Hospital, and King Fahad armed forces hospital, King Fahd General Hospital, Althager General Hospital, International Medical Center Hospital and Maternity and Children's Hospital in Jeddah, Saudi Arabia.

Survey tool and scoring system

The study utilized an online validated questionnaire that was previously used by the National Health Commission of the People's Republic of China (12,13). According to World Health Organization (WHO) guidelines for the clinical and community management of COVID-19. The questionnaire consisted of two parts, the first part containing demographic data. These data included gender, age, profession, university college/hospitals, information about whether the participant had taken the PPE course, and when. It also considered whether they

felt confident dealing with COVID-19 patients after taking a PPE course, whether they had been diagnosed with COVID-19, or dealt directly with COVID-19 patient by performing nasopharyngeal swab.

The second part had 16 questions with 12 questions targeted towards evaluating the knowledge of PPE while two questions evaluated the attitude, and a further two questions evaluated the practice. The knowledge questions were answered via true or false options, or ‘I don’t know’; in the attitude questions the first was answered by agreeing or disagreeing, or ‘I don’t know’, the second question by yes or no; and the practice questions were answered by a yes or no. A score of 1 point was given to those who answer correctly while 0 point is given to those who answer wrong or state that they do not know. Knowledge scores ranged from 0 to 12, the higher score indicating a good knowledge regarding COVID-19. A score of 8 or higher was considered “adequate” while a lower score was listed as “inadequate”.

Statistical analysis

Data entry was via Microsoft Excel 2019 and all analysis was undertaken using R version 4.1.1. Values of P ≤0.05 were considered statistically significant for

all tests. All the categorical data were presented as counts and percentages and were compared using the Chi-square test. All continuous data were presented as means (±standard deviations) and were compared using the Mann-Whitney H test that followed the normality of the data distribution. We did a further logistic regression analysis to test different predictors of adequate knowledge score and the effect of the PPE course on participants’ attitudes. The results regarding logistic regression were presented as odds ratio (OR) and 95% confidence interval (CI).

Results:

Characteristics of the included participants

A total of 402 participants were included in the final analysis, with a mean age of 24.9±3.6 years. Nearly half the participants were male (53.5%) and residents (52.5%). Approximately one-third (36.6%) of the participants had been diagnosed with COVID-19, with 36.3% having undertaken a nasopharyngeal swab and only 21.9% receiving a positive swab. Older age (P-value= 0.028) and male gender (P-value= 0.008) were associated with a higher turnout in terms of taking the PPE course (**Table 1**).

Table 1: Characteristics of the included participants

Variables		Did you take Personal Protective Equipment (PPE) course before?				Total		P-value
		Yes		No				
		Count	%	Count	%	Count	%	
Age (years); mean±SD		25.1±3.1		24.6±4.5		24.9±3.6		0.028*
Gender	Female	117	42.1	70	56.5	187	46.5	0.008*
	Male	161	57.9	54	43.5	215	53.5	
Profession	Intern	135	48.6	56	45.2	191	47.5	0.528
	Resident	143	51.4	68	54.8	211	52.5	
Have you been diagnosed with COVID-19 before?	No	183	65.8	72	58.1	255	63.4	0.136
	Yes	95	34.2	52	41.9	147	36.6	
Have you done a nasopharyngeal swab?	No	175	62.9	81	65.3	256	63.7	0.648
	Yes	103	37.1	43	34.7	146	36.3	
If yes then the swab was positive?	I have never done a nasopharyngeal swab	139	50.0	65	52.4	204	50.7	0.456
	No	81	29.1	29	23.4	110	27.4	
	Yes	58	20.9	30	24.2	88	21.9	

*Statistically significant; SD: standard deviation

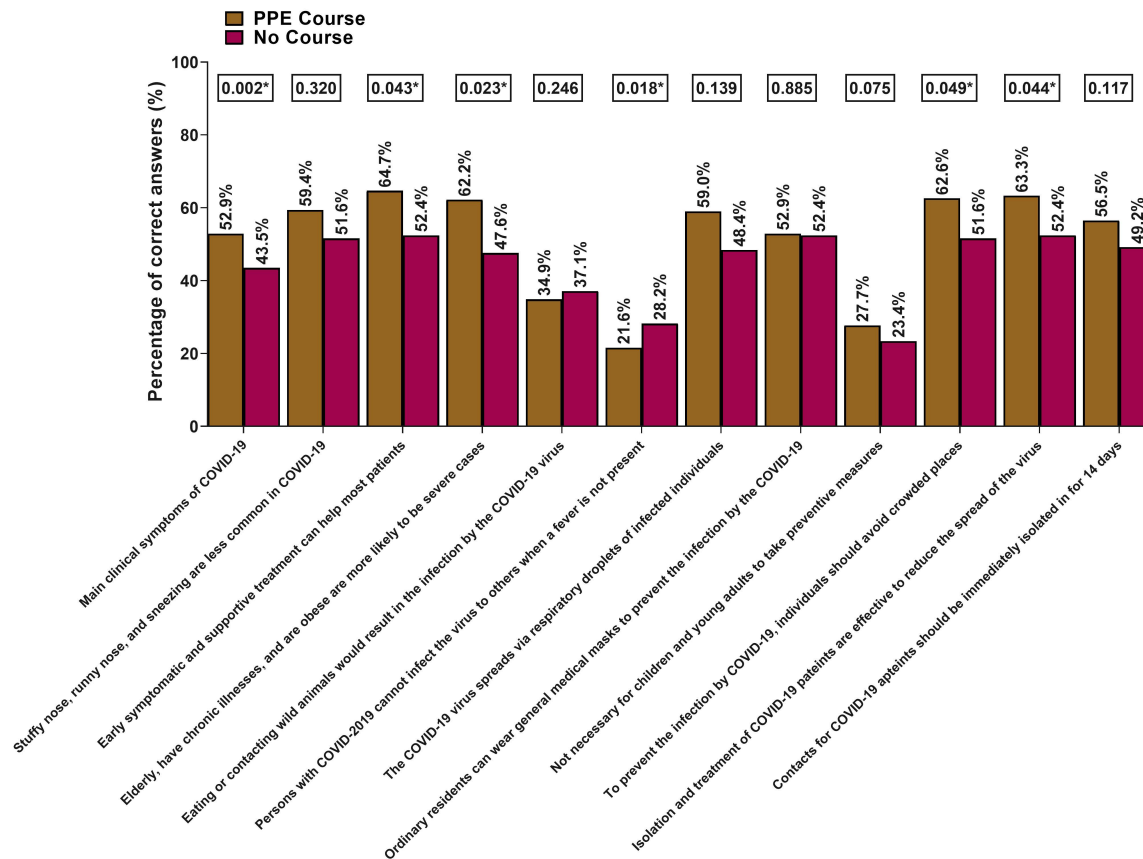


Figure 1. Differences in the individual answers among those who took the course and those who did not

PPE course and predictors of knowledge scores

Overall, 278 of the participants (69.2%) had taken the PPE course, with approximately one-third (30.3%) having taken it within the past three months. The mean knowledge score for those who took the PPE course was significantly higher (P-value= 0.004) than those who did not (6.8±3.3 versus 5.7±3.0). The differences in the individual answers among those who took the course and those who did not are shown in **Figure 1**. The percentages of correct answers were higher among those who took the PPE course, compared to those who did not, in 7 out of 12 knowledge questions. For the other five questions, the percentages were comparable with no significant differences.

Age was a significant predictor of adequate knowledge score (OR=1.25; 95% CI=1.15-1.37; P-value<0.001), where the age of those with adequate scores was older than those with inadequate ones (26.1±4.9 versus 24.2±2.2 years). Similarly, taking the PPE course was associated with higher probabilities of having an adequate knowledge

score (OR=2.06; 95% CI=1.30-3.32; P-value=0.002) and resident doctors had lower probabilities of having an adequate score, compared to the included interns (OR=0.44; 95% CI=0.29-0.67; P-value<0.001). However, gender was not found to be a significant predictor of adequate knowledge score, whether in the univariable or multivariable models (**Table 2**).

Effect of the PPE course on participants' attitudes

Taking the PPE course did not have an influence on participants' attitudes, in almost all tested aspects. For instance, it did not change the way they dealt with COVID-19 cases (OR=1.22; 95% CI=0.79-1.89; P-value=0.367), whether they went to crowded places (OR=0.98; 95% CI=0.64-1.51; P-value=0.930) or wore masks upon leaving home (OR=1.51; 95% CI=0.96-2.37; P-value=0.072). Nevertheless, it increased their confidence in winning the battle against COVID-19 at the national Saudi Arabia level (OR=1.62; 95% CI=1.04-2.51; P-value= 0.033) (**Table 3**).

Table 2: Predictors of adequate knowledge score

Variables		Inadequate score	Adequate Score	OR (univariable)	OR (multivariable)
Age (years); mean±SD		24.2±2.2	26.1±4.9	1.25 (1.15-1.37, P-value<0.001*)	1.30 (1.19-1.44, P-value<0.001*)
Gender	Female	116 (62.0)	71 (38.0)	<i>Reference</i>	
	Male	138 (64.2)	77 (35.8)	0.91 (0.61-1.37, P-value=0.655)	0.80 (0.51-1.25, P-value=0.333)
Profession	Intern	102 (53.4)	89 (46.6)	<i>Reference</i>	
	Resident	152 (72.0)	59 (28.0)	0.44 (0.29-0.67, P-value<0.001*)	0.34 (0.21-0.53, P-value<0.001*)
Took PPE Course	No	92 (74.2)	32 (25.8)	<i>Reference</i>	
	Yes	162 (58.3)	116 (41.7)	2.06 (1.30-3.32, P-value=0.002*)	1.92 (1.16-3.22, P-value=0.012*)

OR: odds ratio; *Statistically significant; SD: standard deviation; PPE: personal protective equipment

Table 3: Effect of the PPE course on participants' attitudes

Variables		No	Yes	OR (95% CI)	P-value
Have you dealt with COVID-19 cases?	No	76 (32.6)	157 (67.4)	-	-
	Yes	48 (28.4)	121 (71.6)	1.22 (0.79-1.89)	0.367
Do you agree that COVID-19 will finally be successfully controlled?	Agree	70 (30.2)	162 (69.8)	-	-
	Disagree	38 (34.9)	71 (65.1)	0.81 (0.50-1.32)	0.386
	I don't know	16 (26.2)	45 (73.8)	1.22 (0.65-2.35)	0.548
Do you have confidence that KSA can win the battle against COVID-19?	No	50 (37.9)	82 (62.1)	-	-
	Yes	74 (27.4)	196 (72.6)	1.62 (1.04-2.51)	0.033*
In recent days, have you gone to any crowded place?	No	69 (30.7)	156 (69.3)	-	-
	Yes	55 (31.1)	122 (68.9)	0.98 (0.64-1.51)	0.930
In recent days, have you worn a mask when leaving home	No	45 (37.2)	76 (62.8)	-	-
	Yes	79 (28.1)	202 (71.9)	1.51 (0.96-2.37)	0.072

OR: odds ratio; CI: confidence interval; *Statistically significant; PPE: personal protective equipment

Discussion:

In the present study, we assessed the benefits of the PPE course for interns and residents in their work scope and aimed to find a difference between the participants who took the PPE course and those who did not, in terms of attitude, knowledge, and practice towards the COVID-19 pandemic, and PPE application among the residents and interns in Jeddah, Saudi Arabia. We found a significant relationship between taking the PPE course and knowledge levels, which is attributable to

the information provided in the PPE course where the mode of transmission and precautions were adequately explained. We also found that taking the PPE course was significantly associated with feeling confident when dealing with COVID-19 cases. Similarly, in a Turkish cross-sectional study, it was demonstrated that emergency medicine residents' practice regarding PPE use was mainly for protection against infectious diseases. They also found a relationship between those who took

relevant training and the increased time spent in the Emergency Department (14). The essential information provided in the PPE course about how to protect yourself against infectious disease gave them the confidence to deal with cases including those with COVID-19, without fear of contracting the infection. On the opposite end of the scale, a Ugandan study estimated that 60% of their HCW participants avoided patients with symptoms similar to COVID-19 (15). Inconsistent findings were also reported in Libya (16). These results indicate how important the PPE course is from a motivational perspective, for the physicians.

We also would like to indicate the importance of the timing of the PPE course for residents and interns in their work, because the timing of the PPE course was significantly associated with knowledge level. This is important due to the updates that could affect PPE application strategies and the association between the timing of the course and the outbreak and severity of the disease spread. This applies to our participants as we found that 30.3% had taken the course within the past three months, when they should have taken it earlier. Accordingly, we believe that the earlier the course, the higher the score recorded. Our findings are similar to a previous study in Saudi Arabia, where it was found that more than one-third of the participants had good knowledge scores (17). On the other hand, an investigation in Vietnam reported that 88.4% of their participants had sufficient knowledge scores (18). Similar findings were also reported in Uganda (15), while in Libya, 47.3% of doctors and almost half of the nurses (54.7%) did not receive adequate training about the use of PPE (16). The different findings may be attributable to many factors as the source of information, the prevalence of COVID-19 in the country, and the timing of the course.

We also determined that the included residents had significantly higher scores than the interns. The difference in the knowledge scores among different occupations has also previously been reported in an investigation by Giao et al. (18) in Vietnam, which indicated that pharmacists scored higher knowledge levels when compared to physicians. This difference could be related to work experiences, where more extensive experience is associated with a faster understanding of diseases and more precautions. Our study also shows that there is a positive attitude towards COVID-19 among our population, which is consistent with a previous study in China, where more than 90% of HCWs responded

positively (18). Similarly, a Saudi study found that 55.2% of the interns had a positive attitude (17). On the other hand, a study of the Makerere University Teaching Hospitals found poor attitudes among HCWs (15). These differences may be due to the variety of health resources provided in the countries and the prevalence of COVID-19. We also detected an appropriate practice towards COVID-19 among the medical interns and residents in our study, which is also similar to the findings that were previously reported in previous investigations (15,17).

It is worth mentioning that many previous studies have indicated high levels of knowledge and attitude towards COVID-19, especially among doctors. In China, a cross-sectional investigation showed that doctors had higher knowledge levels than other HCWs. Moreover, overworked HCWs were found to wash their hands less than others, and fear of COVID-19 infection was associated with better practices (19). Another Indian study also indicated that most HCWs were aware that PPE use was recommended when dealing with suspected COVID-19 patients. Additionally, the authors also demonstrated that more than half of the study participants were aware of the different infection control parameters, including respiratory hygiene, rapid triage, cough etiquette, and providing well-ventilated waiting areas for individuals that are suspected of COVID-19 infection. It was also reported that half of the included HCWs were adequately aware of the right sequence for wearing and utilization of masks (20). A study in Pakistan demonstrated that most HCWs had a good knowledge, attitude, and practice towards COVID-19. The included participants also indicated that inadequate knowledge about disease transmission and limited infection control measures were the significant barriers to achieving proper infection control (21). High levels of knowledge may be attributable to the different environments that HCWs are routinely exposed to, which is usually attributable to the department and the prevalence and severity of COVID-19 within the workplace, and therefore, some residents may be less knowledgeable than others. Therefore, further training of the HCWs is still needed to help them gain further knowledge and perform effectively while facing the current pandemic.

Our study is limited by the sample size, which is relatively small, and the study design, which may be associated with a degree of bias when interpreting the findings, and therefore, we encourage further future investigations for further validation of the evidence.

Conclusion:

We found that the PPE course was beneficial to interns and residents in their work scope. Participants who attended the course demonstrated higher knowledge scores and more confidence. Therefore, more studies should investigate the effectiveness of the PPE course for further validation and application by the healthcare authorities. We also recommend assigning the PPE course for medical interns and residents every 3-6 months to disseminate updates regarding the current and future global health perspectives.

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Declaration:**Statement:**

The authors declare no conflict of interest.

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None

Ethical Consideration:

This study has been approved by the Institutional Review Board (IRB) at Fakeeh College for Medical Sciences (FCMS) in Jeddah.

Data Availability:

The survey used in this paper is attached as a supplementary material.

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