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ORIGINAL ARTICLE

Evaluating the effectiveness of video training for health professionals on the use of personal protective equipment

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Abstract

The study aimed to evaluate the effectiveness of video training for health workers on the use of personal protective equipment. A training video was prepared on the use of personal protective equipment against Covid-19. The effectiveness of the training was evaluated by comparing the pre-post-training scores obtained from the online application, questionnaire form, and self-assessment knowledge level form developed by the researchers. Video training and collection of research data were carried out through the online joint training module used in the relevant hospitals. The study was completed with 558 health workers. The findings showed that the participants' questionnaire form, self-assessment of knowledge level form, and the online application scores increased statistically significantly after the video training (p<0.001). The majority of the health workers (71.3% n=398) completed the application in a shorter time after the video training (p<0.001). A significant relationship was found between online application and questionnaire scores (p<0.05). The study showed that video training led to an increase in health workers' scores on the questionnaire form, online application and self-assessment forms. Video training can be used as an effective training method in pandemic periods when face-to-face training is undesirable due to the risk of transmission.

Keywords: COVID-19, educational activities, employee safety, healthcare workers, personal protective equipment

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Introduction

The novel coronavirus [COVID-19] infection that appeared in Wuhan, China has turned into a pandemic, resulting in 489.779.062 infected people and 6.152.095 deaths worldwide since December 2019 [1,2]. It has been determined that the COVID-19 virus is primarily transmitted from infected people to others that are in close contact via respiratory droplets [3,4]. The rapid spread of the virus has required isolation to prevent contact with the virus in almost all countries [2]. In this process, health workers have taken on a heavy responsibility for struggling with the pandemic by providing treatment and care for infected patients at high risk of contact [5]. While fulfilling this responsibility, health workers have to prevent the spread of the virus and ensure both their safety and patient safety [6]. However, it has been reported that there are health workers who have got infected and died while performing their duties worldwide [7]. According to the Chinese National Health Commission figures, more than 3300 health workers have been infected since the beginning of March 2019, and at least 22 health workers died by the end of February. In Italy, 20% of health workers have been reported to be infected [5]. In Türkiye, the number of infected health workers was recorded as 7428 by April 30, 2020 [8]. In this process, health workers must use personal protective equipment (PPE) appropriately to reduce the virus load they are exposed to, thus protecting themselves and the patients they care for from infection [9]. It was detected that many health workers become infected as a result of not using PPE or not donning and doffing this equipment appropriately[10]. However, the rapid increase in the number of cases caused health professionals to face difficulties in accessing information about the use of PPE [5]. Personal protective equipment is routinely used during medical interventions. However, contamination can occur easily if the necessary procedures for the use of this equipment are not followed [10,11]. Therefore, health workers should be trained about the correct use of PPE, and their competence should be improved [12,13]. However, the rapid spread of the virus during the COVID-19 pandemic made group training risky for the spread of infection. On the other hand, the high number of cases has made it an essential need for health workers to access information in a short time, and the time issue has been a limiting factor for planning training events. The study aimed to evaluate the effectiveness of video training for health workers on the use of PPE(Personal Protective Equipment) against COVID-19. While the level of knowledge in video and internet-based training can be measured with questionnaires, new tools are required to determine skill development. In line with this requirement, the effectiveness of video training was evaluated with the pre-test post-test application and the online application created within the scope of the research.

Materials and Methods

Ethical Approval

Ethics committee approval (24237859-280) from the Scientific Research Ethics Committee of a public university and institutional permission (No: 2020-04-30T15 03 46) from the Provincial Health Directorate for hospitals affiliated to the Ministry of Health was obtained to carry out the research. Health workers were informed about the purpose and content of the study before replying to the research questions (Table 1). Prior to their inclusion in the study, all the participants gave their informed consent by clicking the consent button, which is compulsory to proceed to other questions.

Participants

The population of the study was health workers (physician, nurse, anesthesia technician, midwife, and emergency medical technician) working in eight hospitals affiliated to the Provincial Health Directorate and providing health services to COVID-19 patients /suspected cases. It was aimed to reach the whole population without using a sampling method.

Video Training

The training video used in the study was recorded in a fully equipped simulation center by a team of emergency medicine specialists, intensive care specialists, and academic research nurses. The video was prepared by reviewing the national and international guidelines on

Table 1. Study Questions.

1. Which of the following options is incorrect about maintaining hand antisepsis during PPE donning?
2. Which of the following options is the correct order of PPE donning?
3. Which of the following options is correct about the use of PPE?
4. Which of the following options is the correct order of PPE doffing?
5. Which of the following options is correct about the PPE doffing areas (dirty, semi-dirty, clean area).
6. Which of the following options is incorrect about maintaining hand antisepsis during PPE doffing?

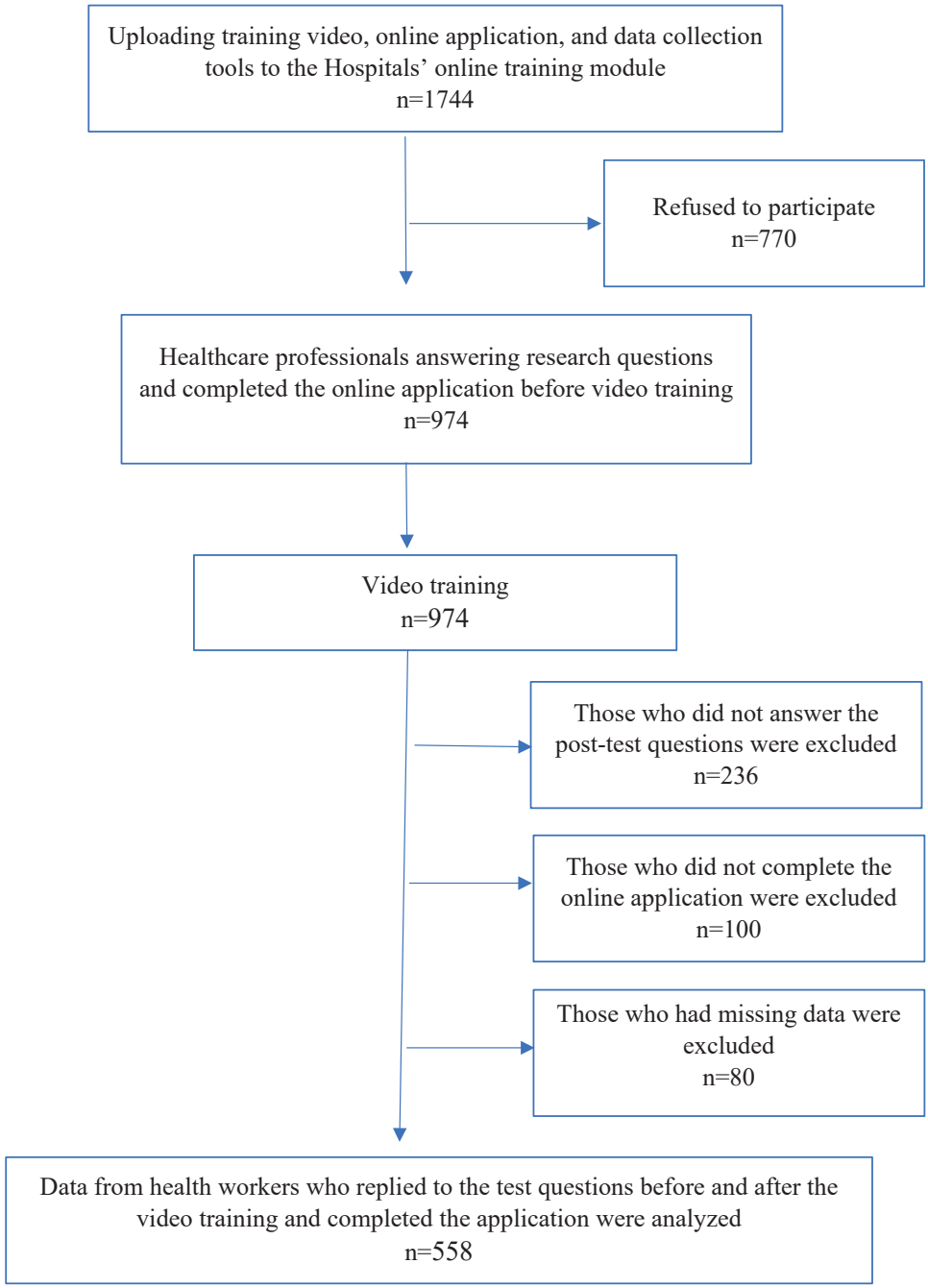

Figure 1. Flow diagram.

the use of PPE for protection from COVID-19 infection [14-16]. The video includes the order of PPE donning and doffing, the things to pay attention, and the presentation of educational information on where each piece of equipment should be removed (dirty, semi-dirty, clean area) (to access to the video, the responsible author can be contacted).

Online Application

For the study, an online application was developed covering the order of PPE donning and doffing and which equipment should be removed in which area. The application was prepared through the ClassMarker (https://www.classmarker.com) application. The online application includes 10 applications for the order of PPE donning (hand disinfection included), 14 applications for the order of PPE doffing (hand disinfection included), and 14 applications for PPE doffing areas (clean area, dirty area, and semi-dirty area) and matching applications. Health workers got one point for each PPE donning and doffing activity in the correct order and area. The total score that health professionals can get from the applications is a minimum of 0 and a maximum of 38 points.

The online application was evaluated with a pilot application with 10 volunteer health workers who were not included in the sampling. It was observed the disinfectant image could not be understood in the application, so it was replaced with a different one. In the pilot application, it was also determined that health workers completed the application in an average of 10 minutes. Considering this data, the maximum time to be given to health workers to complete the application was determined as 10:35 seconds. The online application link has been uploaded to the online joint training module of the hospitals affiliated to the Provincial Health Directorate.

Survey Administration

In the city where the study was carried out, an online training module service is provided by the hospital directorate affiliated to the Provincial Health Directorate. Health workers can access this module with their passwords on corporate personnel pages. The training module is used for health workers to access up-to-date information, to follow announcements regarding training activities. The training video, online application, and data collection tools were uploaded to this training module. Health workers were informed about the study by the responsible person of their unit. Within the scope of the research, health workers first replied to the questionnaire, then completed the online application and then watched the training video. After the video, the research questions were replied again, and the application was completed (Figure 1).

Statistical Analysis

The data were analyzed using the IBM Statistical Package for Social Sciences (IBM SPSS; Armonk, NY, USA) program. Categorical data were presented with numbers and percentages. Normal distribution was evaluated with the *Kolmogorov Smirnov* test. Categorical variables of dependent groups were analyzed using the *McNemar* test. In quantitative data analysis, the *Wilcoxon* test was used for dependent group comparison, and the *Mann Witney U* test and *Kruskal Wallis* analysis of variance tests were used for independent group comparison. The application scores of those who were successful in the pre and post-test were evaluated by ROC analysis. The relationship between pre-test, post-test, application, and self-assessment scores of knowledge level was analyzed using *Spearman* correlation analysis. In the correlation analysis, the correlation coefficient values were accepted as follows, 0.00-0.10 no relationship; 0.10-0.39 a weak relationship; 0.40-0.69 a moderate relationship; 0.70-0.89 strong relationship; and 0.90-1.00 a very strong relationship [18]. Statistical alpha significance level was accepted as $p<0.05$.

Results

For the study, the training video, online application, and data collection tools were uploaded to the corporate personnel page of 1744 health workers. 974 of the health workers agreed to participate in the research. 236 of them did not respond to the post-test, 100 did not complete the online application before and after the training, and data from 80 of the health professionals were missing, so they were excluded from the study. The results of the research were reported

in line with the analysis of the data of 558 health workers who replied the test questions before and after the video training and completed the application. The descriptive characteristics of the health workers participating in the study are presented in Table 2.

The median age of the health workers was 40 (min: 20, max: 64), and the median years of professional experience was 16.5 (min: 1, max: 44). 76.7% of the health professionals were female, 70.6% were nurses, 57.9% had undergraduate education, and 54.5% were employed in state hospitals in districts (Table 2).

Table 2. Descriptive characteristics of health workers (n=558).

	n	%
Age		
18-40	291	52.2
≥41	267	47.8
Years of professional experience		
1-5	75	13.4
6-10	98	17.6
11-15	86	15.4
16-20	91	16.3
≥20	208	37.3
Gender		
Female	428	76.7
Male	130	23.3
Marital Status		
Married	426	76.3
Single	132	23.7
Educational Level		
High School/ Associate Degree	155	27.8
Undergraduate Degree	323	57.9
Post graduate degree	80	14.3
Occupation		
Physicians	68	12.2
Nurse	394	70.6
Midwife	60	10.8
AT*	25	4.5
EMT**	11	2.0
Location of the hospital		
Center	254	45.5
District	304	54.5

* Anesthesia Technician ** Emergency Medical Technician

Table 3. Distribution of correct responses in pre-test and post-test (n=558).

Questions	Pre-test		Post-test		*p*
	n	%	n	%	
Maintaining hand antisepsis during PPE donning	440	78.9	481	86.2	<0.001
The order of PPE donning	255	45.7	482	86.4	<0.001
The use of PPE	255	45.7	482	86.4	<0.001
The order of PPE doffing	284	50.9	449	80.5	<0.001
PPE doffing areas	279	50.0	454	81.4	<0.001
Maintaining hand antisepsis during PPE doffing	376	67.4	415	74.4	0.001

Mc-Nemar Test

Table 4. Comparison of pre-post video training self-assessment of the knowledge level scores, questionnaire scores and online application scores (n=558).

	n	Mean rank	z	Pre-training Median (IQR)	Post-training Median (IQR)	*p*
Questionnaire scores						
-Ranks	50	123.68	-15.998	30.0 (30.0)	50.0 (20.0)	<0.001
+Ranks	390	232.91				
Ties	118					
Total	558					
Self-assessment of knowledge level scores						
-Ranks	78	137.72	-7.170	8.0 (2.0)	9.0 (2.0)	<0.001
+Ranks	208	145.67				
Ties	272					
	Total	558				
Application scores						
-Ranks	91	147.70	-16.317	10.0 (16.0)	23.5 (11.0)	<0.001
+Ranks	445	293.20				
Ties	22					
	Total	558				
The duration of application (min.)						
-Ranks	398	281.35	-12.238	583.5 (179)	414.0 (208)	<0.001
+Ranks	128	207.99				
Ties	32					
	Total	558				

Wilcoxon Signed Rank Test

Table 5. Relationship between online application and questionnaire scores (n=558).

	Pre-training application score			Post-training application score			
Pre-training application score	Order of PPE donning	Order of PPE doffing	Appropriate areas for PPE donning and doffing	Post-training application score	Order of PPE donning	Order of PPE doffing	Appropriate areas for PPE donning and doffing
Order of PPE donning	R 0.294	-	-	Order of PPE donning	r 0.114	-	-
	p 0.000	-	-		*p* 0.007	-	-
Order of PPE doffing	R -	0.147	-	Order of PPE doffing	*r* -	0.183	-
	p -	0.01	-		*p* -	0.000	-
Appropriate areas for PPE donning and doffing	R -	-	0.117	Appropriate areas for PPE donning and doffing	*r* -	-	0.111
	p -	-	0.006		*p* -	-	0.009

Spearman Correlation Analysis

Table 6. Distribution of pre and post-training self-assessment of knowledge level, application and questionnaire scores according to the descriptive characteristics (n=558).

		Pre- training		**Post-training**		***p***
Questionnaire scores		**Mean rank**	**Median (IQR)**	**Mean rank**	**Median (IQR)**	
Age*	18-40	275.04	30.0 (30.0)	286.91	50.0 (20.0)	<0.001
	≥41	284.36	30.0 (30.0)	271.43	50.0 (20.0)	<0.001
		p=0.487		*p*=0.228		
Professional experience (years)**	1-5	270.23	30.0 (30.0)	272.43	50.0 (20.0)	0.295
	6-10	282.72	30.0 (20.0)	310.05	60.0 (12.5)	<0.001
	11-15	278.92	30.0 (22.5)	258.36	50.0 (20.0)	0.186
	16-20	275.90	30.0 (30.0)	278.69	50.0 (20.0)	0.031
	≥20	283.14	30.0 (30.0)	276.75	50.0 (20.0)	<0.001
		p=0.978		*p*=0.207		

Table 6. Distribution of pre and post-training self-assessment of knowledge level, application and questionnaire scores according to the descriptive characteristics (n=558). continue

Gender*	Female	285.63	30.0 (30.0)	284.22	50.0 (20.0)	0.012
	Male	259.32	30.0 (20.0)	263.97	50.0 (20.0)	<0.001
		p=0.097		*p*=0.182		
Education **	High school/Associate degree	263.81	30.0 (30.0)	247.53	50.0 (20.0)	0.002
	Undergraduate degree	288.55	30.0 (30.0)	292.50	60.0 (20.0)	<0.001
	Post-graduate degree	273.36	30.0 (20.0)	288.97	55.0 (20.0)	0.031
		p=0.260		*p*=0.008		
Self-assessment of knowledge level score						
Age*	18-40	268.59	8.0 (2.0)	266.19	9.0 (1.0)	<0.001
	≥41	291.39	8.0 (2.0)	294.01	9.0 (2.0)	<0.001
		p=0.089		*p*=0.036		
Professional experience (years)**	1-5	243.43	8.0 (2.0)	272.31	9.0 (1.0)	<0.001
	6-10	279.59	8.0 (2.0)	256.86	8.5 (2.0)	0.127
	11-15	277.46	8.0 (2.0)	251.05	8.0 (2.0)	0.166
	16-20	290.85	8.0 (1.0)	297.38	9.0 (2.0)	<0.001
	≥20	288.35	8.0 (2.0)	296.70	9.0 (2.0)	<0.001
		p=0.283		*p*=0.068		
Gender*	Female	278.17	8.0 (2.0)	281.23	9.0 (2.0)	<0.001
	Male	283.89	8.0 (2.0)	273.82	9.0 (1.0)	0.001
		p=0.718		*p*=0.637		
Education **	High school/Associate degree	290.30	8.0 (2.0)	292.81	9.0 (2.0)	<0.001
	Undergraduate degree	272.63	8.0 (2.0)	273.19	9.0 (1.0)	<0.001
	Post-graduate degree	286.32	8.0 (1.8)	279.18	9.0 (1.8)	0.020
		p=0.476		*p*=0.440		

Table 6. Distribution of pre and post-training self-assessment of knowledge level, application and questionnaire scores according to the descriptive characteristics (n=558). continue

Application score						
Age*	18-40	297.42	11.0 (14.0)	293.98	24.0 (10.0)	<0.001
	≥41	259.97	9.0 (16.0)	263.72	23.0 (13.0)	<0.001
		p=0.006		*p*=0.027		
Professional experience (years)**	1-5	278.46	10.0 (9.0)	305.55	24.0 (10.0)	<0.001
	6-10	319.31	13.0 (11.3)	321.30	25.0 (7.3)	<0.001
	11-15	268.41	10.0 (16.3)	275.94	24.0 (11.0)	<0.001
	16-20	301.32	11.0 (19.0)	258.31	23.0 (13.0)	<0.001
	≥20	256.16	8.0 (16.8)	261.15	22.0 (13.0)	<0.001
		p=0.014		*p*=0.012		
Gender*	Female	283.50	10.0 (15.8)	287.59	24.0 (11.8)	<0.001
	Male	266.34	10.0 (15.0)	252.86	22.0 (8.0)	<0.001
		p=0.287		*p*=0.031		
Education **	High school/Associate degree	266.47	9.0 (15.0)	265.80	23.0 (13.0)	<0.001
	Undergraduate degree	286.33	10.0 (16.0)	285.57	24.0 (11.0)	<0.001
	Post-graduate degree	277.16	10.0 (11.8)	281.53	24.0 (11.0)	<0.001
		p=0.447		*p*=0.451		

* *Mann Witney U* test; ** *Kruskal-Wallis*

In the study, health workers were asked six questions regarding the use of PPE while providing treatment and care for COVID-19 patients/suspected cases (Table 1). The results showed that the post-video training ratio of correct responses increased significantly compared to the pre-training (p<0.05) (Table 3). 93.4% (n=521) of the health workers stated that they had received training on the use of PPE. The duration of application before video training of those who had training about the use of personal protective equipment before (median=600sec; min=180sec, max=619sec) was longer than those who had not (median=467sec; min=163sec, max=604sec), and the difference between them was statistically significant (p=0.08) No significant difference was found between those who had received training on PPE use and those who had not in terms of pre and post-video training questionnaire score, application scores, self-assessment of the knowledge level scores, and the duration of the application (p>0.05).

The study revealed that participants' questionnaire scores, self-assessment of knowledge level scores, and application scores increased statistically significantly after the video training (p<0.001). It was also determined that the majority of health workers (71.3% n = 398) completed the application in a shorter time after the video training than before the training (p<0.001) (Table 4).

A significant (p<0.05) and weak (0.10<r<0.39) relationship was found between pre and post-training scores regarding the order of PPE donning and doffing, and the online application scores of the appropriate areas for PPE donning and doffing (Table 5).

Besides, a negative, significant and moderate level relationship was seen between the duration of the application and the scores obtained from the application before training (p<0.001, r= -0.568), and a negative significant but weak correlation was found after the training (p<0.001, r= -0.149) (Table 5). Questionnaire, application, and self-assessment of knowledge level scores according to the descriptive characteristics of health professionals are presented in Table 6.

The study demonstrated that the questionnaire scores of those with 1-5 years and 11-15 years of professional experience increased after the video training, but the increase was not significant (p>0.05). No significant change was seen after the video training in the self-assessment of knowledge level scores of health workers with 6-15 years of professional experience (p>0.05). It was found that questionnaire, application, and knowledge level self-assessment scores significantly increased after video training in all other subgroups created according to the descriptive characteristics (p<0.05). The in-group comparisons demonstrated that the post-test scores of those with undergraduate education were significantly higher than those with high school/associate degree education (p=0.007). After the training, self-assessment scores of knowledge level were found to be higher in the group above 41 years of age (p=0.036). The pre and post-training application scores were higher in the 18-40 age group (p<0.05). The pre (p=0.014) and post-training (p=0.023) application scores of those with 6-10 years of professional experience were significantly higher than those with more than 20 years of professional experience. It was also seen that the application scores of the female participants women after the training were higher than the males (p=0.031).

Discussion

This study, in which the effectiveness of the video training prepared to inform health professionals responsible for the care of COVID-19 cases on the use of PPE was evaluated, showed that questionnaire, application, and self-assessment of knowledge level scores of the participants increased significantly after the video training. The self-assessment of the knowledge level post-training scores were higher in the group above 41 years old. On the other hand, pre and post-training online application scores were higher in health workers in the 18-40 age group than the others. Besides, a significant but weak correlation was determined between questionnaire scores and the online application scores, created to evaluate the effectiveness of video training. The study revealed that the ratio of correct responses given to questionnaire about the use of PPE while health workers were providing treatment and care for COVID-19 patients/suspected cases

increased significantly after the video training compared to the pre-training. Similarly, Hon et al. reported that online courses prepared for health professionals increased the level of knowledge and improve the appropriate PPE selection and using skills [19]. Christmann et al. suggested that better results can be obtained if video training on PPE use is supported by different training techniques[20]. The results of the study show that video-based training can be used as an effective method for the training of health workers in pandemic periods when face-to-face training poses a risk in terms of infection spread. The results of the study showed that the majority of health workers had an increase in the questionnaire, online application, and self-assessment scores after training; however, there were also health workers whose scores did not change or decreased after video training. This situation may have resulted from inappropriate learning conditions and negligent attitude of health workers due to hospital environment. In this respect, it is thought that if the hospital administrations provide a suitable environment and the necessary time health workers to attend the training through the training module, it will make a significant contribution to the training outcomes. A significant but weak relationship was determined between pre and post-training questionnaire scores and application scores in the study. Hung et al. indicated that the educational simulation application for the use of PPE can be used as an effective tool in increasing and measuring the knowledge level [12]. Prior to this study, health professionals were not informed about how to use the online application. In addition, the time allocated to complete the online application is limited to 10:35 seconds, and if the time goes out of time, the system deactivates the user. It is thought that the weak relationship between questionnaire score and application scores determined in the study may be due to these reasons. The participants who had previously been trained on the use of PPE completed the online application in a shorter time, and the duration of the participants to complete the application was shorter after the training. The use of personal protective equipment is a routine part of health professionals' duties. However, the rapid transmission of COVID-19 infection requires special use of PPE other than routine applications while providing care for COVID-19 cases. Therefore, health professionals should be trained on the subject. The results obtained from this study show that the effectiveness of PPE usage can be increased through repeated training. In the study, the self-assessment scores of the knowledge level were found to be higher in the group over 41 years of age than the others. This situation seems to be related to the fact that the group over the age of 41 has more professional experience and knowledge than other health workers. Besides, online application scores were higher in the 18-41 age group. Prensky (2001) defined the generations familiar with digital technology as digital natives and those who are not as digital immigrants [21]. Those born after 1980, called digital natives, are more likely to use technology products than previous generations, called digital immigrants[22]. The difference seen in the study may have resulted from this difference between generations.

Limitations

Training activity could not be evaluated at specific time intervals in the study, which creates a limitation for the research. In addition, the fact that health workers were not given preliminary information about the online application, the video training was watched only once, and the change in the skill level of health professionals could not be evaluated objectively are other limiting features of the study. Another limitation is that the study provided health professionals with only online video training and did not compare it with any other training method.

Conclusion

Video-based training is an effective and practical method that can provide quick access to the information needed by health professionals in pandemic conditions where group training cannot be carried out due to high contagiousness and rapid spread. However, there is a need to develop valid measurement tools to evaluate the effectiveness of this training in terms of knowledge and skill development.

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Conflict of interest

There is no conflict of interest between the authors.

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