The prevalence of facial pressure injuries among nurses during COVID-19 pandemic and its relationship to COVID-19 infection

Özge Uçar [a,*], Sevim Çelĭk [a], Emrah Altun [b], Elif Karahan [a]

[a] *Bartin University Faculty of Health Sciences, Department of Nursing, Bartin, Turkey*
[b] *Bartin University Faculty of Sciences, Department of Mathematics, Bartin, Turkey*

ARTICLE INFO

ABSTRACT

Aim: The aim of this study was to investigate the prevalence of facial pressure injuries related to personal protective equipment use in nurses and the relationship with getting COVID-19 infection.
Design: The study used descriptive and correlational online survey design.
Methods: Nurses in Turkey were recruited via an electronic link sent to their social media platforms (e.g., Facebook, Instagram, Twitter), WhatsApp, and e-mail during the study: March–April 2021. Of them, 603 participants completed the survey form from all over Turkey.
Results/Findings: Facial pressure injuries develop in nurses due to use of personal protective equipment. The rates of facial pressure injuries were higher in the nurses who were younger (p=0.002) and those who had less experience years (p=0.005) than the other nurses. The statistically significant variables were determined as age, status of using face shield, status of wearing overalls and status of wearing shoe covers (p<0.05). We determined that facial pressure injuries were not significantly associated with getting COVID-19 infection (p>0,05).
Conclusions: This study showed that facial pressure injuries associated with personal protective equipment use among nurses, who work on the frontlines in the COVID-19 pandemic period, is highly prevalent. Experiencing facial pressure injuries did not have a significant effect on the participants' statuses of getting infected with COVID-19. Providing training in health institutions may present an effective strategy in lowering problems.

1. Introduction

Facial pressure ulcers are injuries that occur when the face is under pressure as a result of prolonged contact with a support surface such as medical devices or personal protective equipment. Healthcare workers working in the frontlines during the COVID-19 pandemic period have had to use personal protective equipment continuously for at least 8–10 h a day. Sweating and pressure caused by personal protective equipment have been reported to cause dermatological damage in healthcare workers [1,2].

The novel coronavirus disease 2019 (COVID-19) entered the agenda of the entire world after the World Health Organization (WHO) declared it a pandemic on 11 March 2020, and the disease has spread to all continents in a very short time [3,4]. Unexpected problems were experienced in the health systems of many European countries, especially Spain, Italy, the United Kingdom, and Turkey. As in the case of healthcare workers all around the world, nurses in Turkey have also faced an unprecedented infection that is highly contagious and had experienced

difficult working conditions [5,6]. Based on case reports, it has been understood that COVID-19 spreads fast through the air or through direct contact with mucous membranes [7,8]. The only way of protection for nurses who have provided care for contagious COVID-19 patients has been using full-fledged personal protective equipment (PPE) [8]. WHO has recommended the use of PPE that protects the facial area from exposure to aerosols and droplets such as N95 facemasks, goggles, and face shields in the COVID-19 pandemic. In this context, a vast increase has been observed in the use of PPE among healthcare workers [9–11].

Information in the literature supports the view that COVID-19 does not directly lead to dermatological disorders [12]. Nevertheless, it is worth noting that the use of PPE (goggles, face shields, N95 facemasks, gloves, overalls/medical coats, hairnets, and shoe covers) for prolonged times may lead to various dermatoses [11].

Previous studies have reported that the prolonged use of PPE may result in various dermatoses, including the exacerbation of previously existing skin disorders such as facial pressure injuries (FPI), contact dermatitis, pressure urticaria, seborrheic dermatitis, and acne [4,11,13].

It has been frequently observed that especially in healthcare workers, pressure injuries develop in the face after the prolonged use of facemasks and face-protective equipment [14]. When PPE is used, especially throughout an entire working shift that can last as long as 12 h, it will create constant pressure, friction, and abrasion on the skin it has contact with. Additionally, due to the mental and physical stress in clinical personnel who are providing care to COVID-19 patients, the moisture created by the excessive sweating of the skin will make the skin more likely to develop FPI [15]. The excessive exposure of the skin to moisture leads to a reduction in the strength and hardness of the stratum corneum (SC), and thus, the general tolerance of SC for mechanical pressure decreases [16].

Recently, sources in China emphasized that skin injuries associated with PPE use in the employees of the primary health sector reached a prevalence of up to 97% in the fight against the COVID-19 pandemic [17]. Lin et al. reported that in the COVID-19 period, 75.4% of healthcare workers experienced unwanted developments in their skin, including peeling, erythema, and injuries related to PPE use, while most of them (71.8%) developed pressure injuries on the nasal bridge. The authors underlined that these problems occurred more frequently in female healthcare workers and healthcare workers using PPE for longer than 6 h [18].

Some studies have emphasized that when healthcare workers experience skin wounds and irritations caused by dermatoses with the increasing frequency of COVID-19 cases, their risk of exposure to COVID-19 infection could increase if they touch these areas frequently [19]. This is because the cellular receptor of COVID-19, the angiotensin-converting enzyme-2, is abundantly found in the basal layer of the epidermis and blood vessels [19]. According to the literature, in clinical environments, PPE-related injuries may result in the access of bacteria, fungi, and viruses, including the virus causing COVID-19 infection (SARS-CoV-2), to the blood circulation by passing through the skin. Additionally, this situation may cause potentially significant problems in those who are affected [16,20].

Failure to prevent reactions developing in connection to PPE use leads to an increased risk of these problems among healthcare workers, loss of morale and motivation, reduction in quality of life, and tendencies to distance oneself from one's job [20,21]. Considering that SARS-CoV-2 can also pass through the mucous membrane, FPI in healthcare workers are a significant problem that needs to be taken into account [16,19]. There is an urgent need to determine the extent of this problem among healthcare workers and plan preventive interventions.

The aim of this study is to evaluate the prevalence of facial injuries in nurses who are in the frontlines of the fight against COVID-19 and the relationship between this prevalence and the likelihood of COVID-19 infection. We hypothesized that there is a relationship between facial pressure injuries due to personal protective equipment use and contracting COVID-19.

2. Materials and methods

2.1. Study design

A descriptive and correlational online survey design was used to identify the frequency of the development of facial pressure injuries due to the use of personal protective equipment and the relationship of this frequency to the transmission of COVID-19. In order to guarantee comprehensive and accurate research reporting, we used the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guideline for cross-sectional studies [22].

2.2. Participants

All nurses (N = 198,465) working under the Turkish Ministry of Health and providing care for COVID-19 patients during the pandemic constituted the population of the study. The minimum required sample size was calculated as 390 participants with a 0.05 standard error, according to the n = Nt2 pq/d2 (N-1) + t2pq formula [23]. Nurses over the age of 18, who could read and write in Turkish, had participated in active patient care during the pandemic, used PPE, had been in the frontlines of COVID-19 response, and voluntarily agreed to participate were included in the study. Nurses under the age of 18, those who did not provide care for COVID-19 patients during the pandemic, those who did not use personal protective equipment, those who did not fill out the survey completely, and those who did not agree to participate in the study were excluded. A total of 611 Turkish nurses answered the survey. The survey forms of the 603 nurses who met the inclusion criteria and filled out the survey completely were included in the analyses.

2.3. Data collection

The survey form that included 20 questions was developed for this study based on information in the relevant literature. For this objective, the literature in English and Turkish was reviewed using the keywords COVID-19, facial injury, PPE and nurses, and health professionals [2,18, 21]. The form included questions on sociodemographic and job-specific characteristics such as age, gender, level of education, years in the profession, the clinic of work, chronic disease status, type of mask used, use of personal protective equipment, time spent wearing personal protective equipment, training on pressure injury prevention strategies related to personal protective equipment use, status of developing facial pressure injuries due to the use of personal protective equipment, area of facial pressure injury, and status of COVID-19 infection. First, the comprehensibility of the survey questions was evaluated by implementing a pilot study with 20 nurses. The survey was revised in line with the recommendations of these nurses whose data were not included in the analyses. An online survey form (Microsoft Forms, Office 365) was created. The final form of the online survey form was sent to all nurses who were included in the sample via social media platforms (e.g., Facebook, Instagram, Twitter), WhatsApp, and e-mail. The data were collected between March and April 2021. Filling the survey took about 5 min for each participant.

2.4. Ethical considerations

Ethical approval for conducting the study was obtained from the XXX University Social Sciences and Humanities Ethics Committee (Ethics committee decision no: 2021-XXX-0130). An information sheet about the study's background, objective, and methods was presented to eligible individuals. Before data were collected from the eligible individuals who agreed to participate in the study, they e-signed consent forms. All collected information was kept confidential and anonymous. No one other than the research team could access the data, which will be destroyed after five years.

2.5. Data analysis

The R software was used to analyze the data. The normality assumptions of the data were examined with the Kolmogorov-Smirnov test. Independent-samples t-tests were used to compare two independent groups. The relationship between two categorical variables was analyzed by chi-squared analysis. Once a relationship was observed, the odds ratio was calculated and interpreted. Binary classification methods were used to determine the factors affecting the risk of FPI. These methods included the logistic regression, random forest (RF), regression tree (RT), and support vector machine (SVM) methods.

Four machine learning methods were used to model the risk of FPI by using the predictors/covariates determined by the Boruta algorithm. The **glm** function of the **R** software was used to obtain the results of the LR method. The **randomForest** package was used for the RF method. The **e1071** package was used for the SVM method. Finally, the **rpart** package was used for the RT method.

A true positive (TP) represents the number of correct classifications of the positive labels. A true negative represents the number of correct classifications of the negative labels. A false positive (FP) and a false negative (FP) represent the numbers of misclassified positive and negative labels, respectively. Sensitivity and specificity show the true positive and true negative rates. The kappa coefficient measures the consistency between the original and predicted values of the class labels. First, using the **createDataPartition** function of the R software, the dataset was split into training and test datasets. The **createDataPartition** function allocated 80% of the data into the training set, and it allocated the remaining part into the test set. The level of statistical significance was accepted as 0.05 in all analyses.

Other important criteria used in model selection are the Receiver Operating Characteristic (ROC) Curve and Area Under the Curve (AUC) (see Hernandez-Orallo, 2013). The ROC curve draws the TP rate against the FP rate and calculates the AUC value. If the AUC value is smaller than 0.5, there is no discrimination between the two groups. An acceptable AUC value should be over 0.7. An AUC interval of 0.8–0.9 can be considered excellent.

3. Results

Among the 603 nurses who participated in this study, 510 (84.6%) were female. The mean age of the participants was 30.4 ($\pm$7.1) years. Most participants had bachelor's degrees (75.5%; n = 455). The mean professional experience of the participants was 8.1 ($\pm$7.3) years. The rate of those who had chronic diseases was 15.6% (n = 94).

Table 1 shows the distributions of the clinical characteristics of the participants. The two types of clinics that the majority of the participants worked were intensive care (29.2%) and pandemic (24.4%) clinics. The

most frequently preferred types of masks were medical masks (36.3%) and N95 masks (32.9%). Moreover, the most frequently preferred types of PPE were gloves (21.7%), face shields (17.9%), and medical caps (17.1%). While 66.3% of the participants used PPE for 6 h or longer per day, only 7% had received training on the use of PPE. It was determined that 77.6% of the participants had been vaccinated. Additionally, 42.1% of the participants had been infected with COVID-19.

FPI were observed in 48.8% of the participants. The areas where these FPI occurred due to the use of PPE were the nose (34.3%), the forehead (20.3%), the cheeks (16.4%), the ears (15.4%), the eyes (9.9%), and the chin (3.7%) in descending order (Table 2).

As shown in Table 3, we concluded that there was no statistically significant relationship between the occurrence of FPI and the statuses of the participants to work at the following units: pandemic clinics, surgical clinics, internal medicine clinics, and operating rooms (p > 0.05). However, there was a statistically significant relationship between the occurrence of FPI and the statuses of the participants to work at intensive care units, gynecology clinics, primary care clinics, and contact-tracing clinics (p < 0.05). The participants working at intensive care units had a 1.809 times higher risk of developing FPI than the others. Moreover, the risk of FPI development for the participants working at gynecology and primary care clinics was quite low.

Table 3 shows that there was a statistically significant relationship between FPI development and chronic diseases (p < 0.05). The risk of FPI development was 1.593 times as high for the participants who had chronic diseases.

The experience FPI among the participants was investigated based on their mean age and years of experience in the profession. The results showed that the rates of FPI were higher in the participants who were younger (p = 0.002) and those who had less experience (p = 0.005) than the other participants (Table 3).

Four machine learning methods were used to model the risk of FPI by using the predictors/covariates determined by the Boruta algorithm. The Boruta algorithm was utilized for features to decide the most significant variables for the classification of the FPI development statuses of the participants. The results are graphically summarized in Fig. 1. In Fig. 1, the green boxplots represent the significant variables, while the red boxplots represent the rejected variables. Accordingly, eight variables were found as significant variables based on the Boruta algorithm. These were the mean duration of using PPE per day, status of wearing shoe covers, status of wearing overalls, working at primary care clinics, status of wearing face shields, age, status of wearing medical caps, and experience in the profession. The other variables were found insignificant and removed from the next step.

A stepwise logistic regression model was used to predict the risk of FPI development based on the covariates obtained using the Boruta algorithm. The results of the stepwise logistic regression model are given in Table 4. The statistically significant variables were determined as age, status of using face shields, status of wearing overalls, and status of wearing shoe covers (p < 0.05).

Table 1
The clinical features of nurses (N = 603).

Variables		n	%
Clinic[a]	Intensive care	263	29.2
	Pandemic clinics	220	24.4
	Gynaecology	25	2.8
	Surgery	102	11.3
	Internal	80	8.9
	Operating room	17	1.7
	Pediatry	33	3.7
	Emergency	108	12,8
	Primary care	17	1.9
	Filiation	5	0,6
	Others[b]	32	3.5
Use of mask	N95	377	32.9
	FFP2	242	21.1
	FFP3	112	9.8
	Medical mask	416	36.3
Other protective equipment[a]	Gloves	585	21.7
	Goggles	354	13.1
	Face shield	484	17.9
	Medical cap	463	17.1
	Fluidrepellient gown	311	11.5
	Overall	287	10,6
	Shoe cover	218	8.1
PPE usage time (hours/day)	1–1	9	1.5
	2–3	53	8.8
	4–5	41	23.4
	6 and over	400	66.3
Education about pressure injury	Yes	42	7.0
	No	561	93.0
Vaccination	Yes	468	77.6
	No	135	22.4
Getting Covid-19 infection	Yes	254	42.1
	No	349	57.9

[a] Multiple response.
[b] Physiotherapy, endoscopy, oncology, supervisor.

Table 2
Occurrence of facial pressure injury among nurses (N = 603).

Variables		n	%
Facial pressure injury	Yes	294	48.8
	No	309	51.2
Stages of facial pressure injury (n = 294)	Stage 1	231	78.6
	Stage 2	60	20.4
	Stage 3	3	1.0
Area of the facial pressure injury[a]	Nose	263	34.3
	Forehead	156	20.3
	Chin	28	3.7
	Ears	118	15.4
	Cheeks	126	16.4
	Eyes	76	9.9

[a] Multiple response.

Table 3

Relationship between the demographic and clinical features of nurses and the occurrence of facial pressure injury (N = 603).

Features		Facial pressure injury due to the use of PPE						
		Yes		No				
		n	%	n	%	p-value	χ2	OR
								(%95 CI)
Clinics								
Intensive care	Yes	147	24.4	147	24.4	0.000	12.777	1.809
	No	199	18.2	110	33.6			(1,305–2,507)
Pandemic	Yes	115	19.1	105	17.4	0.190	1.714	
	No	179	29.7	204	33.8			
Surgical	Yes	92	15.3	98	16.3	0.911	0.012	
	No	202	33.5	211	35.0			
Internal	Yes	65	10.8	74	12.3	0.592	0.287	
	No	229	38.0	235	39.0			
Operating room	Yes	21	3.5	29	4.8	0.318	0.996	
	No	273	45.3	280	46.4			
Gynaecology	Yes	7	1,2	18	0.3	0.034	4.497	0.394
	No	287	47.6	291	48.3			(0,162–0,958)
Primary care	Yes	3	0.5	12	0.2	0.024	5.091	0.255
	No	291	48,3	297	49.3			(0,071–0,914)
Filiation	Yes	0	0	5	0.8	0.029	4.797	1.016
	No	294	48.8	304	50.4			(1,002–1,031)
Chronic diseases*	Yes	55	18.7	239	81.3	0.039	4.241	1.593
	No	39	12.6	270	87.4			(1,020–2,488)
	Yes		**No**			**p-value**		
	Mean ± SD		**Mean ± SD**					
Age	29.51 ± 6.80		31.27 ± 7.30			0.002		
Experience in occupation (years)	7.29 ± 6.92		8.96 ± 7.65			0.005		

* Hypertension, diabetes mellitus, autoimmune diseases vs. χ2: Chi-square test p < 0,05 OR: Odds Ratio CI: Confidence Interval.
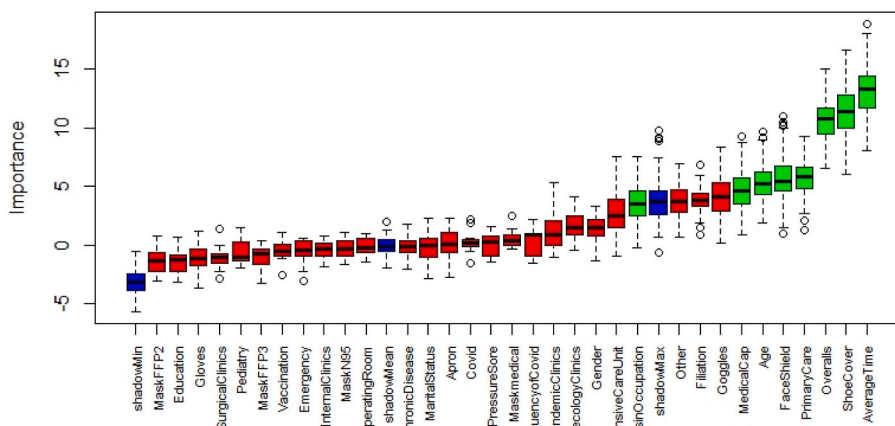

Fig. 1. Feature selection by Boruta method.

Table 4

Results of the stepwise logistic for risk of facial pressure injury.

Variables	Estimated Parameters	Standard errors	p-value
Intercept	1.188	0.789	0.132
Age	−0.046	0.015	0.002*
Face shield (No)	−0.585	0.291	0.044*
Medical cap (No)	−0.447	0.272	0.100
Overall (No)	−0.462	0.233	0.047*
Shoe cover (No)	−0.501	0.245	0.040*
PPE usage time (2–3 h)	−0.115	0.684	0.866
PPE usage time (4–5 h)	0.804	0.631	0.202
PPE usage time (6 and over hours)	1.161	0.616	0.059

*p < 0,05.

Fig. 2 displays the variable significance plots of the RF and RT methods. Based on the results of the RF method, age was the most significantly effective characteristic for the RF method. The other variables can be sorted based on their significant levels as experience in the profession, PPE usage duration, shoe cover use, use of overalls, use of medical caps and face shield, and working at primary care clinics. Based on the results of the RT method, the most significant variable was shoe cover use, followed respectively by PPE usage duration, age, use of overalls, experience in the profession, and medical cap use.

The ROC curves and AUC values of the models are displayed in Fig. 3. The highest AUC value was found with the RF method as 0.820. So, the RF model was the best among the others for the training dataset.

Fig. 4 displays the ROC curves and AUC values of the models. As in the training dataset, the RF model had the highest value of AUC as 0.710 for the test dataset. Therefore, the RF model was selected as the best model for both training and test datasets.

In the study, there was a statistically significant relationship between vaccination status and COVID-19 infection status (p < 0.05). The odds
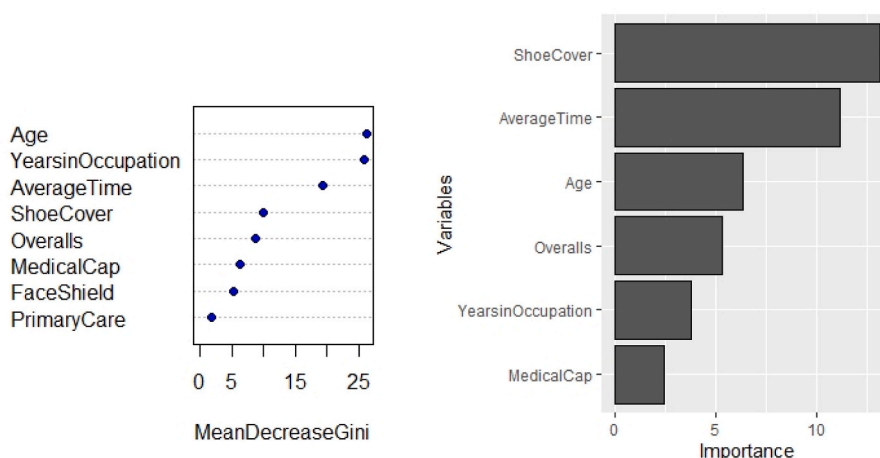
Fig. 2. Variable importances for the RF (left) and RT (right) methods.
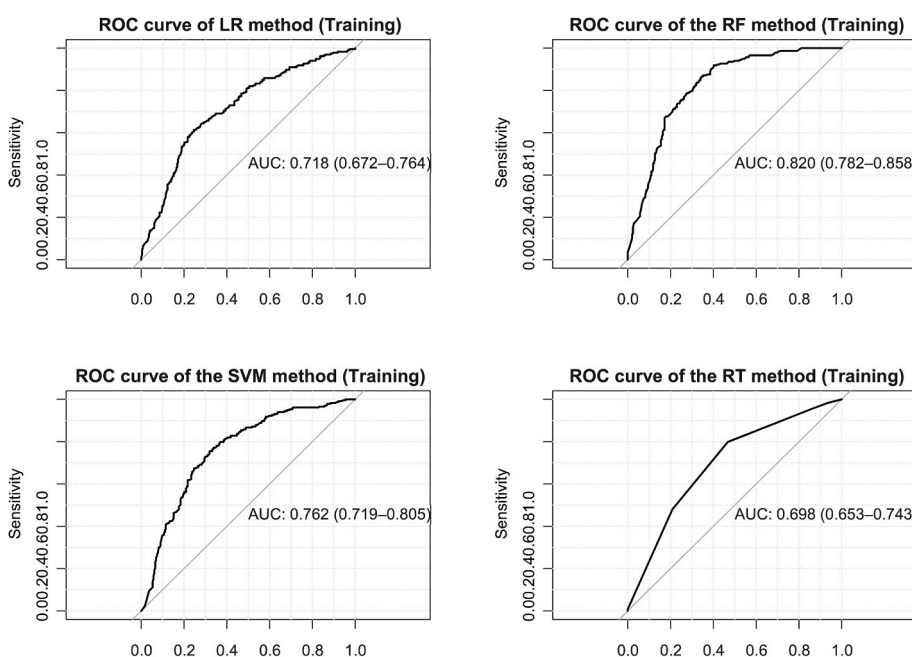

Fig. 3. ROC curves of classification methods for training data.

ratio regarding this parameter was obtained as 0.625. This meant that those who were not vaccinated were 1.6 (0.625^{-1}) times as likely to be infected with COVID-19 as those who were vaccinated. On the other hand, there was no statistically significant relationship between FPI development and COVID-19 infection status (p > 0.05) (Table 5).

4. Discussion

Facial pressure injuries (FPI) associated with the use of personal protective equipment (PPE) have been a highly significant problem from the past to the present. In terms of the development of FPI in relation to PPE use in the COVID-19 pandemic period, nurses are in a high-risk group [16]. In this study, the prevalence of PPE-related FPI was determined as 48.8%. Although there has not been a single methodology in studies in the literature, the result of this study was in parallel with the rates and types of FPI reported in other studies. Jiang et al., [2020a] found the general prevalence of PPE-related skin injuries in healthcare workers as 42.8%. Jose et al. (2021) showed that PPE users developed conditions like itching on the face, injuries of the nasal bridge, rashes,

skin cracks, and irritation. A previous study reported the prevalence of PPE-related FPI as 30.04% [24]. A study conducted with 191 healthcare workers working at hospitals in China found this rate as 30% [24]. The result of this study was much higher than the rate of PPE-related FPI development that was found as 27.9% in a study carried out in Australia [25]. Moreover, in their study conducted in Italy, Atzori et al. stated that the rate of PPE-related FPI development had a constant tendency to increase [26]. The differences in the results of these studies may have occurred as a consequence of the differences between their sample sizes and the clinics where they were conducted. Additionally, as these studies have been carried out in different countries, different skin types, different COVID-19 caseloads of countries, and differences in their health systems may have resulted in different findings. In our study, the number of nurses who had received training about FPI was very low. No other study that examined the status of individuals to receive training on PPE-related FPI was encountered in the literature. This situation suggested that the FPI development levels of the nurses who participated in this study were high as their rate of having received FPI prevention training (7%) was low.
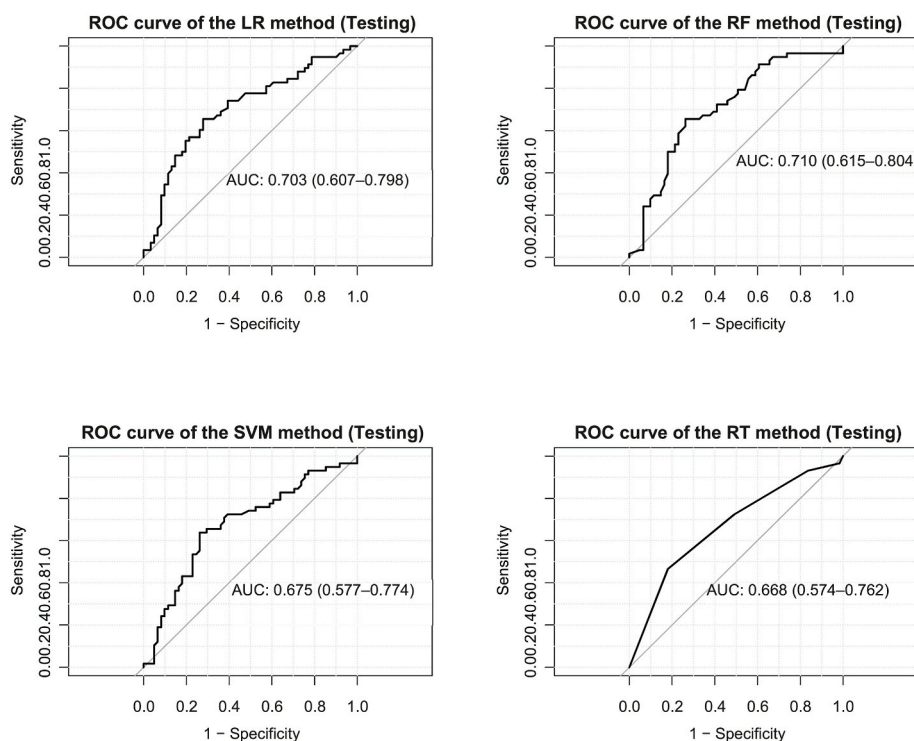
Fig. 4. ROC curves of classification methods for testing data.

Table 5
Relationship between the vaccination, facial pressure injury and getting COVID-19 infection (N = 603).

		Getting COVID-19 infection						
		Yes		No				
		n	%	n	%	p-value	χ2	OR (95% CI)
Vaccination	Yes	185	30.7	283	81.1	0.016	5.764	0.625
	No	69	11.4	66	10.9			(0,425–0,919)
Facial pressure injury	Yes	131	51.6	163	46.7	0.249	1.395	
	No	123	48.4	186	53.3			

OR: Odds Ratio CI: Confidence Interval χ2: Chi-square test.

In the study conducted by Jiang et al., the prevalence of PPE-related FPI in healthcare workers over the age of 35 was determined as 46.3% [24]. Another study that was performed in China determined the same rate in healthcare workers over the age of 35 as 31.4% [2]. In this study, we observed that the risk of FPI development was lower among the nurses who were over the age of 27. Furthermore, in contrast with other studies, it was determined in our study that the risk of FPI development increased in the participants who were at younger ages. This result indicated that as a nurse's experience in the profession would increase with their age, their level of awareness about PPE-related FPI development would increase. It was also concluded that the rate of FPI development in the participants of this study who were younger than 27 years old may have been higher as a result of the fact that in Turkey, young nurses are employed more frequently in critical units with high workloads such as intensive care units.

It was reported that PPE-related FPI developing in Chinese healthcare workers were stage 1 and stage 2 injuries at a rate of 98.8% [2]. A study conducted in the United States found a stage 2 FPI rate of 32% and a stage 1 FPI rate of 28% in nurses [27]. In our study, stage 1 FPI was the most frequently encountered stage at 38.1%. This result was similar to the results of other studies in the literature. It was considered an ordinary outcome that the pressure injuries on the faces of the participants of our study mostly remained at stage 1 as they started to take precautions as soon as they felt symptoms such as pain, itching, and peeling.

A study that was carried out in China showed N95 facemasks, goggles, and protective masks as equipment that primarily caused PPE-related FPI formation in medical personnel [2]. It was stated that PPE-related pressure injuries mostly occurred on the nasal bridge, followed in order by the cheeks, the forehead, and the ears [2]. In this study, the nose, forehead, ear, and cheek regions were determined as the most frequently encountered sites of pressure injuries. In this sense, the results of this study were compatible with the literature.

Moreover, in difference to previous studies, it was determined in this study that wearing overalls and shoe covers increased the risk of FPI development. This result made us think that shoe covers and overalls increase sweating and moisture, thus preparing an environment for the formation of FPI. Similarly, Jiang et al. reported that moisture and sweating raised FPI rates [24].

In the literature, the use of PPE has been reported to increase the likelihood of developing FPI [16,24,27]. In our study, no significant relationship was found between the durations of working with PPE among the participants and their FPI development rates. Jiang et al. observed an FPI development rate of 47.3% in healthcare workers who used PPE for more than 4 h per day [24]. Another study conducted in China showed that 33.29% of healthcare workers wore PPE for more than 4 h per day, and they started to sweat within 30 min after wearing PPE [16]. A report from Brazil emphasized that 27.7% of healthcare workers worked in PPE for up to 6 h per day, whereas 72.3% worked for

more than 6 h per day wearing PPE [27].

According to Bambi et al., PPE-related FPI developed in 77.1% of nurses who worked in intensive care in the COVID-19 pandemic period [14]. The results of our study revealed the risk of FPI development in the participants who worked in intensive care to be 1.8 times as high as the risk of others. Additionally, the nurses in this study who worked at gynecology and primary care clinics had a lower risk of FPI formation than others. These results may be interpreted as that the duration of the exposure of these nurses to PPE was shorter as care periods at gynecology and primary care clinics are shorter.

In this study, the risk of the development of FPI in the nurses who had chronic diseases was found to be 1.5 times as high as the risk of others. Dang et al. also reported that having a chronic disease increased the risk of pressure injury development [28]. According to the report published in 2018 by Jaul et al., the risk of developing pressure injuries increases as comorbidities disrupt circulation and the nutrition of tissues [29]. Accordingly, the results of this study were in agreement with other studies in the literature.

The literature review that was conducted for this study revealed no other study that investigated the relationship between PPE-related FPI development and COVID-19 infection. Nonetheless, researchers have speculated that an irritated skin mucosa contains cellular receptors for COVID-19 and creates a high risk of infection [21]. In our study, no significant relationship was found between PPE-related FPI and COVID-19 infection.

4.1. Limitations

There were some limitations in this study. For example, using the online survey method to reach the whole country may have increased the risk of bias in the sample. Additionally, this study was conducted in Turkey and only reflects the results of nurses in this region. Future studies should compare different countries to further explore differences stemming from cultural and institutional aspects.

In addition, the presence and degree of facial pressure sores were recorded only based on the self-reports of the participants, without being seen by a specialist. As one of the other limitations, because no similar research could be found in the literature, the survey form that was used in this study was created by the researchers. Furthermore, the use of N95 in daily life outside the hospital may also affect the likelihood of facial pressure injury development.

5. Conclusions

This study showed that the development of facial pressure injuries associated with personal protective equipment use among nurses, who worked in the frontlines in the COVID-19 pandemic period, was highly prevalent. Furthermore, it was determined that experiencing facial pressure injuries did not have a significant effect on the participants' COVID-19 infection statuses. It was observed that being under the age of 27, using shoe covers or wearing overalls, and having a chronic disease increased the risk of facial pressure injury development. In consideration of nurses who have a risk of facial pressure injury development and are using personal protective equipment, it is recommended for institutions and authorities to take the necessary precautions to keep these individuals' duration of using PPE under 6 h per day and prevent the formation of injuries on their facial skin.

Declaration of competing interest

The author declares no conflicts of interest.

References

[1] Gasparino RC, Lima MHM, de Souza Oliveira-Kumakura AR, da Silva VA, de Jesus Meszaros M, Antunes IR. Prophylactic dressings in the prevention of pressure ulcer related to the use of personal protective equipment by health professionals facing the COVID-19 pandemic: a randomized clinical trial. Wound Repair Regen 2021;29 (1):183–8. https://doi.org/10.1111/wrr.12877.

[2] Jiang Q, Liu Y, Wei W, Zhu D, Chen A, Liu H, Wang J, Jiang Z, Han Q, Bai Y, Hua J, Zhang Y, Guo J, Li L, Li J. The prevalence, characteristics, and related factors of pressure injury in medical staff wearing personal protective equipment against covid-19 in China: a multicentre cross-sectional survey. Int Wound J 2020;17(5): 1300–9. https://doi.org/10.1111/iwj.13391.

[3] Kong X., Cao Y, Luo X, He L. The correlation analysis between the appearance anxiety and personality raits of the medical staff on nasal and facial pressure ulcers during the novel coronavirus disease 2019 outbreak 2020; Nursing Open, 8(1), 147-155. https://doi.org/10.1002/nop2.613.

[4] Gefen A, Ousey K. Update to devide-related pressure ulcers: secure prevention covid-19, face masks and skin damage. J Wound Care 2020;29(5):245–59. https://doi.org/10.12968/jowc.2020.29.5.245.

[5] Salome GM, Dutra RAA. Prevention of facial injuries caused by personal protective equipment during the COVID-19 pandemic. Rev Bras Enferm 2021;74(Suppl 1): e20201219. https://doi.org/10.1590/0034-7167-2020-1219.

[6] Abiakam N, Worsley P, Jayabal H, Mitchell K, Jones M, Fletcher J, Spratt F, Bader D. Personel protective equipment skin reactions in healthcare professionals during covid-19. Int Wound J 2021;18(3):312–22. https://doi.org/10.1111/iwj.13534.

[7] Badanta B, Acevedo-Aguilera R, Lucchetti G, de Diego-Cordero R. 'A picture is worth a thousand words'—a photovoice study exploring health professionals' experiences during the covid-19 pandemic. J Clin Nurs 2021;30:3657–69. https://doi.org/10.1111/jocn.15887.

[8] Chen F, Zang Y, Liu Y, Wang X, Lin X. Dispatched nurses' experience of wearing full gear personal protective equipment to car efor covid-19 patients in China- A descriptive qualitative study. J Clin Nurs 2021;30:2001–14. https://doi.org/10.1111/jocn.15753.

[9] Dell'Era V, Aluffi Valletti P, Garzaro M. Nasal pressure injuries during the covid-19 epidemic. Ear. Nose & Throat Journal 2020;99(9):567–8. https://doi.org/10.1177/0145561320922705.

[10] Smart H, Opinion FB, Darwich I, Elnawasany MA, Kodange C. Preventing facial pressure injury for health care providers adhering to covid-19 personal protective equipment requirements. Adv Skin Wound Care 2020;33(8):418–27. https://doi.org/10.1097/01.ASW.0000669920.94084.c1.

[11] Keng B, Gan WH, Tam YC, Oh CC. Personal protective equipment-related occupational dermatoses during covid-19 among health care workers: a worldwide systematic review. JAAD International 2021;5:85–95. https://doi.org/10.1016/j.jdin.2021.08.004.

[12] Patrick MT, Zhang H, Wasikowski R, Prens EP, Weidinger S, Gudjonsson JE, Elder JT, He K, Tsoi LC. Associations between covid-19 and skin conditions identified through epidemiology and genomic studies. J Allergy Clin Immunol 2021;147(3):857–69. https://doi.org/10.1016/j.jaci.2021.01.006. e7.

[13] Nani FS, Stéfani KC, Busnardo FF, Monteiro G, Santos M, John VM, Gouvêa D, Carmona M. Ulcer pressure prevention and opportunity for innovation during the covid-19 crisis. Clinics 2020;75:e2292. https://doi.org/10.6061/clinics/2020/e2292.

[14] Bambi S, Giusti GD, Galazzi A, Mattiussi E, Comisso I, Manici M, Rosati M, Lucchini A. Pressure injuries due to personal protective equipment in covid-19 critical care units. Am J Crit Care 2021;30(4):287–93. https://doi.org/10.4037/ajcc2021178.

[15] Kottner J, Black J, Call E, Gefen A, Santamaria N. Microclimate: a critical review in the context of pressure ulcer prevention. Clin BioMech 2018;59:62–70. https://doi.org/10.1016/j.clinbiomech.2018.09.010.

[16] Aguilera SB, De La Pena I, Viera M, Baum B, Morrison BW, Amar O, Beustes-Stefanelli M, Hall M. The impact of covid-19 on the faces of frontline healthcare workers. J Drugs Dermatol JDD 2020;19(9):858–64. 10.36849/JDD.2020.10.36849/JDD.2020.5259.

[17] Gross JV, Mohren J, Erren TC. Covid-19 and healthcare workers: a rapid systematic review into risks and preventive measures. BMJ Open 2021;11(1):e042270. https://doi.org/10.1136/bmjopen-2020-042270.

[18] Abiakam N, Worsley P, Jayabal H, Mitchell K, Jones M, Fletcher J, Spratt F, Bader D. Personal protective equipment related skin reactions in healthcare professionals during COVID-19. Int Wound J 2021;18(3):312–22. https://doi.org/10.1111/iwj.13534.

[19] Singh M, Pawar M, Bothra A, Maheshwari A, Dubey V, Tiwari A, Kelati A. Personal protective ewuipment induced facial dermatoses in healthcare workers managing coronavirus disease 2019. J Eur Acad Dermatol Venereol 2020;34(8). https://doi.org/10.1111/jdv.16628. 2020.

[20] Long H, Zhao H, Chen A, Yao Z, Cheng B, Lu Q. Protecting medical staff from skin injury/disease caused by personal protective equipment during epidemic period of covid-19: experience from China. Journal of the European Academy of Dermatology and Venerology 2020;34(5):919–21. https://doi.org/10.1111/jdv.16388.

[21] Cook TM. Personal protective equipment during the coronavirus disease (covid) 2019 pandemic- A narrative review. Anaesthesia 2020;75(7):920–7. https://doi.org/10.1111/anae.15071.

[22] von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP, STROBE Initiative. The strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. Lancet (London, England) 2007;370(9596):1453–7. https://doi.org/10.1016/S0140-6736(07)61602-X.

[23] Erdoğan S, Nahcivan N, Esin MN, editors. Hemşirelikte araştırma süreç, uygulama ve kritik. İstanbul: Nobel Tıp Kitabevi; 2014.

[24] Jiang Q, Song S, Zhou J, Liu Y, Chen A, Bai Y, Wang J, Jiang Z, Zhang Y, Liu H, Hua J, Guo J, Han Q, Tang Y, Xue J. The prevalence, characteristics, and prevention status of skin ınjury caused by personal protective equipment among medical staff in fighting covid-19: a multicenter, cross-sectional study. Adv Wound Care 2020;9(7):357–64. https://doi.org/10.1089/wound.2020.1212. 2020b.

[25] Barakat-Johnson M, Barnett C, Wand T, White K. Medical devide-related pressure injuries: an exploratory descriptive study in an acute tertiary hospital in Australia. J Tissue Viability 2017;26(4):246–53. https://doi.org/10.1016/j.jtv.2017.09.008.

[26] Atzori L, Ferreli C, Atzori MG, Rongioletti F. Covid-19 and impact of personal protective equipment use: from occupational to generalized skin care need. Dermatol Ther 2020;33(4):e13598. https://doi.org/10.1111/dth.13598.

[27] Kayser SA, VanGilder CA, Ayello EA, Lachenbruch C. Prevalence and analysis of medical device-related pressure injuries: results from the international pressure ulcer prevalence survey. Adv Skin Wound Care 2018;31(6):276–85. https://doi.org/10.1097/01.ASW.0000532475.11971.aa.

[28] Dang W, Liu Y, Zhou Q, Duan Y, Gan H, Wang L, Zhu Q, Xie C, Hu A. Risk factors of medical device-related pressure injury in intensive care units. J Clin Nurs 2021:1–10. https://doi.org/10.1111/jocn.15974. 00.

[29] Jaul E, Barron J, Rosenzweig JP, Menczel J. An overview of co-morbidities and the development of pressure ulcers among older adults. BMC Geriatr 2018;18(1):305. https://doi.org/10.1186/s12877-018-0997-7.