Work 76 (2023) 3–10
DOI:10.3233/WOR-220083
IOS Press

Effects of wearing personal protective equipment (PPE) and its role in affecting the work efficiency of dentists during the COVID-19 pandemic

Vedushi M. Jain[a], Soumya Raj Singh Parihar[a], Shruthi Acharya[b,*] and Shashidhar Acharya[c]
[a]*Manipal College of Dental Sciences, Manipal Academy of Higher Education (MAHE), Manipal, India*
[b]*Department of Oral Medicine and Radiology, Manipal College of Dental Sciences, Manipal, Manipal Academy of Higher Education (MAHE), Manipal, India*
[c]*Department of Public Health Dentistry, Manipal College of Dental Sciences, Manipal, Manipal Academy of Higher Education (MAHE), Manipal, India*

Received 12 February 2022
Accepted 11 January 2023

Abstract.
BACKGROUND: The risk of exposure to COVID-19 infection through droplets/aerosol in dental clinics has renewed focus on the utility and possible adverse effects of using personal protective equipment (PPE) on dentists.
OBJECTIVE: To obtain information from a cross-section of dentists regarding their PPE usage and to evaluate the possible risk factors that can influence their work efficiency.
METHODS: A 31-item cross-sectional survey with a structured multiple-choice questionnaire was designed. Social media and emails were used to circulate the questionnaire among dental professionals worldwide. A total of 317 respondents returned the completed forms.
RESULTS: A total of 184 (55%) participants reported getting soaking wet while wearing PPE at the end of the working hours (approximately eight hours of working). Many respondents ($n = 286$, 90%) reported that the use of PPE resulted in reduced visibility of the operating field. The majority of respondents (84%) felt that their overall work efficiency had reduced after using PPE. Binary logistic regression had shown that two significant factors that were associated with reduced work efficiency included, pre-existing systemic illness and getting soaking wet from wearing a PPE.
CONCLUSION: Definite protocols should be introduced that mandate the doffing of PPE for every patient, in a separate well-ventilated area where the skin can recuperate from the heat and pressure points caused by the PPE. Dentists should take greater care in choosing the appropriate PPE to prevent exacerbation of pre-existing illnesses, which may reduce their work efficiency.

Keywords: Aerosols, healthcare workers, questionnaire, dental clinic, SARS-Cov-2

1. Introduction

The COVID-19 pandemic has caused unprecedented changes in all aspects of our life, especially for healthcare workers. Dental professionals fall under the high-risk category [1] and are most likely to

*Address for correspondence: Dr. Shruthi Acharya, MDS, Associate Professor, Department of Oral Medicine and Radiology, Manipal College of Dental Sciences, Manipal Academy of Higher Education (MAHE), Manipal, India. E-mail: shruthi.acharya@manipal.edu.

be exposed to COVID-19 virus = SARS-Cov-2 as they work near the oral cavity. The personal protective equipment (PPE) used by healthcare workers includes close-fitting N95 face masks/powered air-purifying respirators (PAPR), protective eyewear, gowns, and surgical gloves. In real-world practice, wearing PPE is uncomfortable for healthcare workers, especially if worn for an extended period, and dentists are no exception. Studies have shown that wearing PPE, face shields, and N95 masks increases dentists' discomfort [2, 3]. Adverse skin reactions [4] and an increase in the frequency of headaches [5] are seen due to the prolonged use of mouth masks and face shields. Hence, it is critical to identify the problems associated with wearing PPE at an initial stage to mitigate or prevent them from progressing and reducing the quality of patient care.

Numerous studies describe the knowledge, attitudes, and practices regarding PPE and their usage patterns among dentists from different parts of the world, especially in the context of the COVID-19 pandemic [6]. Comparisons have been made with age, experience, specialty, gender, type of practice for PPE usage, and effects. However, the information available in most of the previous research is primarily empirical [7, 8].

Studies that delve into the detail and specifics of PPE usage and the symptoms of injuries and discomfort associated with their use are relatively uncommon. There is a paucity of reports that have described the possible risk factors associated with decreased work efficiency with the use of PPE. Many pre-existing risk factors can magnify the discomfort and possible loss of efficiency caused by PPE. Thorough knowledge of these risk factors may help dentists take preventive action to mitigate the adverse effects of wearing PPE for long hours. Hence, the study's objectives were to obtain information from a cross-section of dentists regarding their PPE usage and to evaluate the possible risk factors which influence the working efficiency of dentists.

2. Materials and methods

A 31-item cross-sectional survey with a structured multiple-choice questionnaire was designed. A cross-sectional study design was used as it helps capture a specific point in time, which describes multiple variables and allow the researchers to compare them simultaneously. Two subject experts validated the questionnaire and made minor corrections. It was divided into the following sections: demographic data; duration and type of PPE used; signs and symptoms like skin abrasions; headaches arising from the use of different components of the PPE; and other infection control procedures. The dentists were also asked about the effect of adopting these protocols on the overall work efficacy. Pictorial depictions and photographs were used to describe the questions. Social media and email were used to circulate the questionnaire among dental professionals working in diverse setups - private, hospital/polyclinic, and hospitals attached to dental schools worldwide. All the completed forms were sought for three months, after which the survey was closed. After eliminating the incomplete questionnaires, the final sample of 317 was obtained. Responses obtained during the study were kept strictly anonymous and confidential. Ethical approval from the Institutional Ethics Committee (394/2020) was obtained. Participation in the survey was voluntary. The inclusion criteria were: dentists who wore PPE while working in clinical settings, aged 23 years and above and provided informed consent.

SPSS version 20 statistical software (IBM Corp) was used for data analysis. Frequency distribution was done to describe items included in the survey. Percentages were used to describe the frequency distributions. Spearman's Rank correlation was used to test the correlation between efficiency-related variables. Binary logistic regression analysis was conducted to test the associations for reduced work efficiency. Binary logistic regression was used to analyze multiple independent variables or predictors influencing a binary outcome [9].

3. Results

A total of 317 respondents from 10 countries (India-285, USA-12, Malaysia-9, Australia-1, Kenya-1, Middle East- 8 and Nepal-1) returned the completed forms. Amongst the participants, 189 (57%) were practicing in a hospital attached to a dental school, while the rest were engaged in private practice/polyclinic. Two hundred and four (64%) participants reported using the full sets of PPE for three or more months. More than half of the dentists (54%) used full PPE. Most respondents (68%) did not have a pre-existing systemic illness. Among those with a positive medical history, migraine was most common, followed by headache, sinusitis, atopic dermatitis, and bronchial asthma. Most of the par-

Table 1
Frequency distribution of respondent characteristics, PPE, and previous medical and allergy history

Variable	Specifics	n	%
Age	20-30 years	182	57.4
	31-40 years	93	29.3
	41-50 years	33	10.4
	51-60 years	9	2.8
Workspace	Private practice	126	37.8
	Hospital/polyclinic	53	15.9
	Hospital attached to dental college	189	56.7
Gender	Female	176	55.5
	Male	141	44.5
Duration of use of PPE	1-2 months	113	35.6
	2-3 months	81	25.6
	>3 months	123	38.8
Type of PPE	Enhanced PPE	61	19.2
	Full PPE	171	53.9
	Standard PPE	85	26.8
Previous medical history	Migraine	36	11
	Primary headache	30	9
	Sinusitis	26	8
	Atopic dermatitis	13	4
	Bronchial asthma	9	3
	Bronchitis	6	2
History of allergy	None	281	84
	Latex	23	7
	Chemicals	20	6
Heat/moisture discomfort due to PPE	Getting soaking wet while wearing PPE	184	55
	Reduced visibility due to PPE	289	90

ticipants (84%) gave no history of allergy, while 7% of dentists reported allergy to latex and 6% to other chemicals. A total of 184 (55%) participants reported getting soaking wet while wearing PPE at the end of the long working hours. Many respondents ($n = 286$, 90%) reported that the use of PPE had led to reduced visibility of the operating field (Table 1).

N95 masks were used by a majority (78%) of our respondents, followed by a triple-layer surgical mask (26%). About half of the participants (47%) used mouth masks for more than six hours daily. Almost all participants (87%) used face shields. Most participants (77%) reported discomfort while wearing the N95 mouth mask. This discomfort was attributed to the tightness of the elastic band in 48% of the respondents, followed by feeling suffocated or hypoxic (41%) and sweating due to prolonged usage of the mouth mask (38%). More than half of the dentists did not report any change in the frequency of pre-existing headaches. Only 89 (27%) dentists had a rise in the frequency of headaches after using PPE. Headaches were associated with tightness of the elastic band of the mouth mask in 51 (16%) cases, due to the face shield in 36 (11%), and tightness of the head cap in 11 (4%) of the cases. Among the participants, 35 (11%) reported a new onset of headache, and 2 (0.6%) reported new-onset migraine. Only 51 (16%) practitioners reported an increase in the frequency of headaches (Table 2).

Table 3 describes the other symptoms and the sites of adverse skin reactions. We noted that 83% of participants did not report adverse skin reactions despite following the COVID-19 infection control protocols. Amongst the dentists with skin reaction, almost half of them, i.e., 74 (47%), reported dryness of skin to be the most common symptom, followed by itching ($n = 49$, 31%) and roughness ($n = 32$, 20%). Most of these skin changes were present in the hands ($n = 36$, 23%), nose ($n = 27$, 17%), and forehead ($n = 18$, 12%) regions. We found that 60% of dentists did not report pressure injuries. Amongst those who had injuries, 73 (23%) had stage 1 pressure injuries, and only one individual had stage 2 pressure injuries. Most pressure injuries were restricted to the middle third of the face seen in 47 (30%) participants, followed by the periorbital region and upper third of the face in 30 (19%) participants. About 267 (84%) respondents felt that their overall work efficiency had reduced after using PPE.

Age had a positive correlation with the frequency of PPE usage and handwashing. The pre-existing systemic illness was correlated with allergies, skin reactions, and pressure injuries. The duration of wearing a mouth mask was correlated with a reduction in the visibility of the working field (Table 4).

Binary logistic regression analyzed the role of factors like- prior history of allergies, medical conditions, being engaged in private practice, suffering from pressure injuries or adverse skin reactions, getting soaking wet after wearing a PPE, and country of practice in influencing work efficiency. Among all the factors, only two, namely having a prior medical history of systemic illnesses and getting soaking wet from wearing a PPE, were associated with reduced work efficiency during the COVID-19 pandemic (Table 5).

4. Discussion

Exposure to bioaerosols during dental procedures is inevitable. Hence strict adherence to COVID-19-specific infection control protocols has become a part of routine dental practice. We found widespread usage of PPE among dentists, which was quite reas-

Table 2
Characteristics of mouth mask use and features of associated headache

Variable	Specifics	n	%
Type of mouth mask (based on the frequency of use)	N95	260	78
	Triple-layer	87	26.1
	Commercially available mouth mask	12	3.6
	P100 respirator	8	2.7
	Full face respirator	3	0.9
	Self-contained breathing apparatus	1	0.3
Duration of use	2-4 hours	77	24.3
	4-6 hours	92	29.0
	>6 hours	148	46.7
Causes of discomfort due to mouth mask use	Tightness of the elastic/tying bands of the mouth mask	159	47.7
	Ears hurt	123	36.9
	Hypoxic/suffocated feeling	138	41.4
	Sweating due to prolonged usage of the Mouth mask	126	37.8
	The fact that it is being re-used	61	18.3
	The smell of the mouth mask	50	15
Headache was associated with tightness of	Face shield	36	11.4
	Head cap	11	3.5
	Mouth mask	51	16.1
	Not applicable	219	68.7
Characteristics of headache	Decreased	4	1.3
	Increased	51	16.1
	New-onset headache	35	11.0
	New onset migraine	2	0.6
	No change in pre-existing headache	38	11.4
	Palpitations	6	1.9
Frequency of headache	More than once a week	39	11.7
	Once a week	42	12.6
	Once a fortnight	23	6.9
Time interval between onset of headache and removal of PPE	After 6 hours	20	6.3
	In 2-6 hours	52	16.4
	Within an hour	25	7.9
	Not Applicable	180	56.8

Note: Percentages may not add up to a hundred as choosing multiple options were allowed for each question.

suring. At the same time, numerous issues caused by the usage of PPE were noted. The various problems related to perspiration and moisture like fogging visors/eyewear and excessive sweating were rampant among the respondents, which was in agreement with previous research [7, 10, 11]. Increased duration of wearing mouth mask was associated with visibility reduction of the working field which is attributed to the fogging of eyewear which resulted in reduced work efficiency.

Skin dryness was the most common symptom amongst our participants and was seen on the hands. The health care professionals who adhere to hand hygiene protocols presented with skin dryness, itching, and irritant contact dermatitis (ICD), and this finding was similar to other studies [10, 12, 13]. Prolonged usage of gloves increases the immunologic reaction to irritants [14]. A minority of participants had skin irritation due to PPE. It was clinically mild in intensity and mostly confined to the central region of the face. Hu et al. also reported similar results [4, 13]. The chances of COVID-19 transmission increase through skin abrasions that occur as a result of frequently touching the face [15].

Overall, around 20 % of the respondents reported pressure injuries due to wearing masks and visors. This was in line with previous research [12]. Mask indentations over the nose and cheek were the most common pressure injury reported by dentists in our study. Similar findings were put forth by Singh et al. [16] and Jiang et al. [17]. PPE-induced skin changes occur due to the friction and occlusion effect of the PPE [18]. Sweating, mask fit and wearing PPE duration contribute to these skin changes.

Table 3
Characteristics of adverse skin reactions

Variables	Specifics	n	%
Type of pressure injuries	Stage 1	73	23
	Stage 1 and stage 2	1	0.3
	Absent	243	76.6
Site of pressure injury	Upper third of the face	30	19.1
	Periorbital region	30	19.1
	Middle third of the face	47	29.9
	Others (wrist, ear)	10	6.4
Presenting symptoms	Dryness	74	47.1
	Itching	49	31.2
	Roughness	32	20.4
	Erythema/redness	19	12.1
	Burning	11	7.0
	Scaling	11	7.0
	Fissuring	7	4.5
	Blistering	6	3.8
	Fissuring	1	6
Location of injury	Hands	36	22.9
	Nose	27	17.2
	Forehead	18	11.5
	Auricular area	7	4.5
	Trunk and extremities	4	1.3
Reduction in efficiency	Efficiency reduced by more than 50%	189	59.62
	Efficiency reduced by less than 50%	78	24.6
	No change	50	15.8

Note: Percentages may not add up to a hundred as choosing multiple options were allowed for each question.

Table 4
Correlation between variables associated with work efficiency

Variable		A	B	C	D	E	F	G	H	I	J
Age (A)	r	1.0	**.22***	-.05	.01	**.15***	**-.12***	-.01	.03	-.09	-.06
	p		**<.01**	.34	.93	**.01**	**.03**	.89	.64	.12	.45
Use of PPE (B)	r	.22	1.0	.01	.04	.03	**.14***	.07	.08	.02	.04
	p	<.01		.82	.46	.56	**.01**	.21	.17	.80	.61
Medical history (C)	r	-.05	.01	1.0	**.22***	.04	.02	**.20****	**.14***	.04	**.19***
	p	.34	.82		**<.01**	.53	.69	**<.01**	**.01**	.47	**.01**
Allergy history (D)	r	.01	.04	**.22***	1.0	.06	.03	**.29****	**.11**	.01	.03
	p	.93	.46	**<.01**		.29	.66	**<.01**	**.06**	.80	.67
Handwash frequency (E)	r	**.15***	.03	.04	.06	1.0	.07	.10	.06	-.01	-.09
	p	**.01**	.56	.53	.29		.22	.07	.32	.88	.23
Duration of mouth mask (F)	r	**-.12***	**.14***	.02	.03	.07	1.0	.06	.06	**.15***	.06
	p	**.03**	**.01**	.69	.66	.22		.33	.30	**.01**	.39
Skin reactions (G)	r	-.01	.07	**.20***	**.29***	.10	.06	1.0	**.22***	.05	.07
	p	.89	.21	**<.01**	**<.01**	.07	.33		**<.01**	.36	.37
Pressure injury (H)	r	.03	.08	**.14***	.11	.06	.06	**.22****	1.0	.05	.03
	p	.64	.17	**.01**	.06	.32	.30	**<.01**		.38	.72
Visibility reduction (I)	r	-.09	.02	.04	.01	-.01	**.15***	.05	.05	1.0	**.34***
	p	.12	.80	.47	.80	.87	**.01**	.36	.36		**<.01**
Work efficiency (J)	r	-.06	.04	**.19***	.03	-.09	.06	.07	.03	**.34***	1.0
	p	.45	.61	**.01**	.67	.23	.39	.37	.72		

R: Spearman's Rank correlation coefficient, *: Statistically significant ($p < 0.05$).

N95 respirators and medical masks used by health professionals for non-aerosol-generating procedures offer comparable protection against viral respiratory infections [19]. However, N95 respirators are uncomfortable, often causing skin irritation [20]. Around half of the respondents reported wearing masks for more than 6 hours a day, similar to the findings of Nguyen et al. [13]. Around one-third of the respondents reported headaches due to wearing PPE, with most of them citing the use of N95 masks. This was in agreement with previous research [21]. Some respondents reported de novo headaches, the frequency, and

Table 5
Binary logistic regression to test the associations for the reduction in work efficiency among dentists

Variables	B	S.E.	Wald	Sig.	Exp(B)	95%(CI)	
						Lower	Upper
History of allergies (Yes/No)	-.203	.588	.119	.730	.816	.258	2.584
History of prior medical conditions (Yes/No)	-1.018	.424	5.767	.016	.361	.158	.829
Working in private practice (Yes/No)	.106	.358	.088	.767	1.112	.551	2.245
Getting soaking wet after work (Yes/No)	-.970	.325	8.902	.003	.379	.201	.717
Suffering from adverse skin reaction after PPE use/hand hygiene products (Yes/No)	-.292	.543	.290	.590	.746	.258	2.164
Suffering from pressure injuries due to PPE (Yes/No)	.036	.431	.007	.934	1.036	.445	2.411
Country of practice (India/other)	.101	.513	.039	.844	1.106	.405	3.021

$p \leq 0.05$ was considered statistically significant. Cl: confidence interval; S.E: Standard error.

severity of which aggravated in respondents with a known history of headaches. Similar findings were stated by Lim et al. [5] and Ong et al. [22]. Proper fit is achieved by using elastics with adequate tension to hold the mouth mask in place. The tightness of these ties, when used for an extended duration, causes compression of superficial nerves and the sensitive skin of the face [5]. PPE-induced headaches may be caused by hypercapnia because of the snug seal around the nose and mouth [23, 24].

Since this study was conducted among a convenience sample of dentists, mainly from India and a few from other countries, the results cannot be generalized to all dentists. This was an online survey; hence, there is a chance of non-response, subjective bias, and the inability to reach remote areas with limited internet coverage. Lack of random sampling may lead to questionable (if any) statistical confidence and margin of error.

The fear of contracting COVID-19 is high among dental professionals [25, 26]. Hence, there may be a tendency to overdo the protection measures. This phenomenon has been observed among healthcare workers by other investigators [27]. For instance, dentists may wear both N95 and triple-layer masks for non-aerosol procedures, while the recommendations clearly state that the triple-layer alone is sufficient [28]. Such indiscriminate use may lead to added discomfort for the dentist. Our findings are in concurrence with previous researchers who found that dental professionals reported moderate to severely impaired working ability [7, 21, 29]. We concur with the findings of Galanis et al. who stated that pre-existing risk factors like diabetes, obesity, and headaches were associated with decreased work efficiency [6]. In addition to PPE, the stress and anxiety of working in a high-risk COVID-19 environment may cause these symptoms. Some of the problems faced by dentists in our study are probably specific to tropical countries where air-conditioning is not the norm. The fear of droplet/aerosol infection forced many dentists/dental managers to desist from using air conditioners which further compounded the heat/perspiration problem. Getting soaking wet due to excessive sweating inside a PPE was one of the main reasons cited for reduced efficiency in our study. The acute shortage of PPE at the start of the pandemic would have forced many dentists to use one PPE for multiple patients, which could have led to problems associated with the prolonged wearing of PPE. This phenomenon was universal to most countries during the initial months of the pandemic. The excess of cheap, low-quality PPE after that, too, would not have helped matters.

This study is not without limitations. COVID-19 positive status of participants was not elicited, thus the possibility of headache as a consequence of post-COVID-19 syndrome was not documented. Regarding the duration of usage of the mouth mask, the questionnaire did not specify if the respondent used the mouth mask post the working hours also, i.e. during visits to the supermarket.

5. Conclusion

Some of the pandemic's changes in infection control protocols may not go away with the pandemic. There is a need to introduce permanent protocols that mandate the doffing of PPE for every patient with a short break in a separate well, ventilated safe area where the skin can breathe and recover from the heat and pressure points caused by PPE. Non-irritant hand wash/sanitizers can also be made mandatory. Dentists need to take greater care in choosing the appropriate PPE so that there is no exacerbation of pre-existing illness, which may reduce their work efficiency.

Acknowledgments

The authors are grateful to all the respondents who participated in the study.

Ethical approval

Approval was obtained from the Kasturba Medical College and Kasturba Hospital Institutional Ethics Committee (Registration no. ECR/146/Inst/KA/2013/RR-19, DHR registration no. EC/NEW/INST/2019/374, IEC no. 394/2020).

Informed consent

All participants were informed that participation was based on the principles of confidentiality and volunteerism. Prior to data collection, informed consent was obtained from all participants.

Conflict of Interest

The authors have no conflict of interest to declare.

Funding

This research did not receive any specific grant from the funding agencies in the public, commercial, or not-for-profit sectors.

Author contributions

VJ, SP, and ShA conceived and designed the study, conducted the research, provided research materials, and collected and organized data. SA analyzed and interpreted the data. ShA and SA wrote the initial and final draft of the article and provided logistic support. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

References

[1] Szymańska J. Dental bioaerosol as an occupational hazard in a dentist's workplace. Ann Agric Environ Med. 2007;14(2):203-7.

[2] Bansal K, Saji S, Mathur VP, Rahul M, Tewari N. A Survey of Self-perceived Physical Discomforts and Health Behaviors Related to Personal Protective Equipment of Indian Dental Professionals during COVID-19 Pandemic. Int J Clin Pediatr Dent. 2021;14(6):784-789. DOI: 10.5005/jp-journals-10005-2061.

[3] Saccomanno S, Manenti RJ, Giancaspro S, Paskay LC, Katzenmaier CS, Mastrapasqua RF, et al. Evaluation of the effects on SpO2 of N95 mask (FFP2) on dental health care providers: a cross-sectional observational study. BMC Health Serv Res. 2022;22(1):248. DOI: 10.1186/s12913-022-07648-5.

[4] Hu K, Fan J, Li X, Gou X, Li X, Zhou X. The adverse skin reactions of healthcare workers using personal protective equipment for COVID-19. Medicine (Baltimore). 2020;99:e20603.

[5] Lim ECH, Seet RCS, Lee KH, Wilder-Smith EPV, Chuah BYS, Ong BKC. Headaches and the N95 face mask amongst healthcare providers. Acta Neurol Scand. 2006;113:199-202.

[6] Galanis P, Vraka I, Fragkou D, Bilali A, Kaitelidou D. Impact of personal protective equipment use on health care workers' physical health during the COVID-19 pandemic: A systematic review and meta-analysis. Am J Infect Control. 2021;49(10):1305-1315. doi: 10.1016/j.ajic.2021.04.084. Epub 2021 May 7.

[7] Malandkar V, Choudhari S, Kalra D, Banga P. Knowledge, attitude and practice among dental practitioners with regard to overcoming the barriers created by personal protective equipment in the COVID-19 era and delivering effective dental treatment: A questionnaire-based cross-sectional study. Dent Med Probl. 2022;59(1):27-36. DOI: 10.17219/dmp/142357. PMID: 35179833

[8] Khoury Absawi M, Fahoum K, Haim S, Dror AA, Oren D, Kablan F, et al. COVID-19 knowledge and adherence of dental practitioners to health authority safety guidelines during a pandemic. Quintessence Int. 2022;53(2):186-191. DOI: 10.3290/j.qi.b2091211. PMID: 34595907.

[9] Cramer JS. The origins of logistic regression (PDF) (Technical report). Vol. 119. Tinbergen Institute. 2002, pp. 167-178. doi:10.2139/ssrn.360300.

[10] Gürlek Kısacık Ö, Özyürek P. Skin-related problems associated with the use of personal protective equipment among health care workers during the COVID-19 pandemic: A online survey study. J Tissue Viability. 2022;31(1):112-118. doi: 10.1016/j.jtv.2022.01.003. Epub 2022 Jan 8.

[11] Hacıbeyoğlu G, Eren AS, Arıcan Ş, Yılmaz R, Reisli R, Tuncer Uzun S. Research for the factors affecting the headache experienced by the health-care personnel in COVID-19 pandemic: A monocentric survey study. Agri. 2022;34(1):7-15. English. doi: 10.14744/agri.2021.47108.

[12] Cebeci D, Karasel S, Rıfkı D, Yesildağlı H, Kalfaoglu M. The Effect of Personal Protective Equipment (PPE) and Disinfectants on Skin Health During COVID- 19 Pandemia. Med Arch. 2021;75(5):361-365. doi: 10.5455/medarh.2021.75.361-365.

[13] Nguyen C, Young FG, McElroy D, Singh A. Personal protective equipment and adverse dermatological reactions among healthcare workers: Survey observations from the COVID-19 pandemic. Medicine (Baltimore). 2022;101(9):e29003. DOI: 10.1097/MD.0000000000029003.

[14] Warner RR, Boissy YL, Lilly NA, Spears MJ, McKillop K, Marshall JL, et al. Water disrupts stratum corneum lipid lamellae: damage is similar to surfactants. J

Invest Dermatol. 1999;113(6):960-6. doi: 10.1046/j.1523-1747.1999.00774.x.

[15] Cavanagh G, Wambier CG. Rational hand hygiene during the coronavirus 2019 (COVID-19) pandemic. J Am Acad Dermatol. 2020;82(6):e211. doi: 10.1016/j.jaad.2020.03.090. Epub 2020 Apr 5.

[16] Singh M, Pawar M, Bothra A, Maheshwari A, Dubey V, Tiwari A, et al. Personal protective equipment induced facial dermatoses in healthcare workers managing Coronavirus disease 2019. J Eur Acad Dermatol Venereol. 2020;34(8):e378-e380. doi: 10.1111/jdv.16628. Epub 2020 Jun 2.

[17] Jiang Q, Liu Y, Wei W, Zhu D, Chen A, Liu H, et al. 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):1300-1309. doi: 10.1111/iwj.13391. Epub 2020 May 12.

[18] Razvigor D, Nikolai T. COVID-19 pandemic and the skin: what should dermatologists know? Razvigor. Clin Dermatol 2020;38:785-7.

[19] Bartoszko JJ, Farooqi MAM, Alhazzani W, Loeb M. Medical masks vs N95 respirators for preventing COVID-19 in healthcare workers: A systematic review and meta-analysis of randomized trials. Influenza Other Respi Viruses 2020;14:365-73.

[20] Jefferson T, Del Mar CB, Dooley L, Ferroni E, Al-Ansary LA, Bawazeer GA, et al. Physical interventions to interrupt or reduce the spread of respiratory viruses. Cochrane Database Syst Rev. 2020;11(11):CD006207. DOI: 10.1002/14651858.CD006207.pub5.

[21] Jafari E, Togha M, Kazemizadeh H, Haghighi S, Nasergivehchi S, Saatchi M, et al. Evaluation of headache associated with personal protective equipment during COVID-19. Brain Behav. 2021;11(12):e2435. doi: 10.1002/brb3.2435. Epub 2021 Nov 13.

[22] Ong JJY, Bharatendu C, Goh Y, Tang JZY, Sooi KWX, Tan YL, et al. Headaches Associated With Personal Protective Equipment – A Cross-Sectional Study Among Frontline Healthcare Workers During COVID-19. Headache. 2020;60(5):864-877. DOI: 10.1111/head.13811. Epub 2020 Apr 12.

[23] Rebmann T, Carrico R, Wang J. Physiologic and other effects and compliance with long-term respirator use among medical intensive care unit nurses. Am J Infect Control 2013;41:1218-23.

[24] Bharatendu C, Ong JJY, Goh Y, Tan BYQ, Chan ACY, Tang JZY, et al. Powered Air Purifying Respirator (PAPR) restores the N95 face mask induced cerebral hemodynamic alterations among Healthcare Workers during COVID-19 Outbreak. J Neurol Sci. 2020;417:117078. doi: 10.1016/j.jns.2020.117078. Epub 2020 Aug 3.

[25] Ahmed MA, Jouhar R, Ahmed N, Adnan S, Aftab M, Zafar MS, et al. Fear, and Practice Modifications among Dentists to Combat Novel Coronavirus Disease (COVID-19) Outbreak. Int J Environ Res Public Health. 2020;17(8):2821. DOI: 10.3390/ijerph17082821.

[26] Martinho FC, Griffin IL. A Cross-sectional Survey on the Impact of Coronavirus Disease 2019 on the Clinical Practice of Endodontists across the United States. J Endod 2021;47:28-38.

[27] Zangoue M, Safari H, Royce SG, Zangooie A, Rezapour H, Zangouei A, et al. The high level of adherence to personal protective equipment in healthcare workers efficiently protects them from COVID-19 infection. Work. 2021;69(4):1191-1196.

[28] Lammers MJW, Lea J, Lea J, Westerberg BD. Guidance for otolaryngology health care workers performing aerosol-generating medical procedures during the COVID-19 pandemic. J Otolaryngol – Head Neck Surg 2020;49:1-8.

[29] Farronato M, Boccalari E, Del Rosso E, Lanteri V, Mulder R, Maspero C. A scoping review of respirator literature and a survey among dental professionals. Int J Environ Res Public Health. 2020;17:1-12.