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IZVORNI ZNANSTVENI RAD

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Prolonged Face Mask Wearing Worsens Self-Reported Dry Eye Symptoms during the COVID-19 Pandemic in Dental Healthcare Practitioners

Dugotrajno nošenje maski za lice kod stomatologa pogoršava samoprijavljene simptome suhog oka tijekom pandemije bolesti COVID-19

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Abstract

Objectives: The aim of the study was to evaluate self-reported MADE during the COVID-19 pandemic in dental healthcare practitioners and identify their possible risk factors. **Material and Methods:** An anonymous questionnaire was sent to doctors of dental medicine in the time period from February 2022 to August 2022. The online questionnaire included demographic characteristics and clinical characteristics: presence and deterioration of DED symptoms while wearing the face mask, personal protective face equipment, use of contact lenses, history of eye surgery, current use of medications, number of hours wearing face mask, and evaluation of subjective DED symptoms using modified Ocular Surface Disease Index (OSDI). **Results:** A total of 405 participants were included in the study and an overall prevalence of MADE was 29.1% (95% CI: 24.7 - 33.6). The participants who used masks more than 6 hours per day during the whole day reported a higher OSDI score (12.5 (IQR = 2.6 – 29.2)) compared to the participants who used masks less than 6 hours/day (6.25 (IQR = 0 – 22.92); Mann-Whitney U Test p = 0.066). Multivariable logistic regression revealed the following possible risk factors for self-reported MADE: age (older than 61 years) OR: 3.522 (95% CI 1.448 - 8.563); p=0.05, and wearing the face mask more than 6 h at work OR: 1.779 (95% CI 1.017 – 3.113); p=0.044. **Conclusion:** The prevalence of self-reported MADE among dental healthcare practitioners appears to be significant. The use of a face mask for a prolonged duration increases OSDI scores. MeSH Terms: face masks, dry eye, MADE, ocular discomfort, COVID-19, protective face equipment

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Introduction

Chronic condition known as dry eye disease (DED) is a major issue on a global scale. One of the most frequent reasons patients visit ophthalmologists is DED, which affects hundreds of millions of people globally. DED was for-

Uvod

Kronično stanje poznato kao bolest suhoga oka (engl. *dry eye disease* – DED) veliki je problem na globalnoj razini. S obzirom na to da pogađa stotine milijuna ljudi diljem svijeta, to je stanje jedan od najčešćih razloga zbog kojih pacijen-

mally classified as a new entry disease 30 years ago, with its definition changing and upgrading up until 2017, when a new update was given by the second International Dry Eye Workshop and the new definition was reported. DED disease is defined as "a multifactorial disease of the ocular surface characterized by a loss of homoeostasis of the tear film, and accompanied by ocular symptoms, in which tear film instability and hyperosmolarity, ocular surface inflammation and damage, and neurosensory abnormalities have etiological roles" (1).

DED is a rapidly expanding health issue globally, with a prevalence ranging from 20 to 50% worldwide (2). It is more prevalent with age and in females (2), and traditionally it is considered pertaining to the elderly population. The prevalence of DED is not globally constant. Factors such as systemic medications, an ophthalmic surgery, as well as environmental factors contribute to the increased prevalence of DED (1). However, it is on the rise among the young; large numbers of people are now experiencing it at a much earlier age (3, 4). The increase in the prevalence of DED requires attention of ophthalmologists because of the effects it has on a patient's quality of life.

The World Health Organization has officially recognized that COVID-19 could be spread via the aerosol route, hence the widespread use of face masks as well as physical distancing and hand hygiene was recommended during the COVID-19 pandemic (5). Although physical distancing has not always been practicable during the COVID-19 pandemic, it is advised that people wear face masks in both public and enclosed areas to prevent the spread of the virus. (6, 7). In most countries, the use of face masks has been mandatory and it has become part of our daily routine. Hence, it is recommended for healthcare professionals to wear a face mask as important infection prevention measure in healthcare facilities. According to recommendations, Croatian dentists should continue to wear face masks in dental offices (8). Since December 2019 and the beginning of the COVID-19 pandemic, when wearing face masks became integrated as a daily routine, a new complication of prolonged mask wearing has been reported, named the mask-related dry eye (MADE) syndrome (9-11). DED is characterized by a number of symptoms, such as soreness, dryness, itching, and a foreign body sensation (12). For an accurate assessment of DED, it is beneficial to record the subjective symptoms of DED using questionnaires completed by the patients themselves in addition to clinical results (13). The aim of this study was to evaluate self-reported MADE during the COVID-19 pandemic in dental healthcare practitioners and identify their possible risk factors.

Material and methods

This cross-sectional study was carried out in cooperation with the School of Dental Medicine, University of Zagreb, and the Sestre milosrdnice University Hospital Centre. The participants were registered dentists working in Croatian national healthcare facilities (both in private and public clinics), as well as general or specialist dentists.

ti posjećuju oftalmologe. DED je službeno klasificiran kao nova bolest prije 30 godina, a njezina se definicija mijenjala i nadopunjavala sve do 2017., kada je na 2. Međunarodnoj radionici suhoga oka (engl. second International Dry Eye Workshop) ažurirana postojeća i objavljena nova definicija. Tako se sada DED definira kao „multifaktorijalna bolest površine oka koju karakterizira gubitak homeostaze suznog filma i praćena je očnim simptomima u kojima nestabilnost suznoga filma i hiperosmolarnost, upala i oštećenje površine oka i neurosenzorne abnormalnosti imaju etiološku ulogu" (1).

DED je globalni zdravstveni problem koji se brzo širi, s prevalencijom od 20 do 50 % diljem svijeta (2). Češće se pojavljuje s porastom dobi i kod žena (2), a tradicionalno se smatra bolešću starije populacije. Globalna prevalencija DED-a nije konstantna; čimbenici kao što su sistemski lijekovi, oftalmološka kirurgija te okolišni čimbenici pridonose povećanoj prevalenciji (1). No među mladima je u porastu – kod velikoga broja ljudi sada se pojavljuje u ranijoj dobi (3, 4). Porast prevalencije DED-a zahtijeva pozornost oftalmologa zbog učinaka koje ima na kvalitetu života oboljelih.

Svjetska zdravstvena organizacija službeno je priznala da se bolest COVID-19 može širiti aerosolom, pa je tijekom pandemije preporučena široka uporaba maski za lice, držanje razmaka i higijena ruku (5). Također se savjetovalo korištenje maski za lice u zatvorenim prostorijama i na javnim mjestima gdje distanciranje nije uvijek bilo moguće kao zdravstvena mjera za sprječavanje širenja bolesti COVID-19 (6, 7). U većini zemalja korištenje maski za lice bilo je obvezno i postalo je dio svakodnevne rutine. Zato se zdravstvenim radnicima preporučivalo nošenje maske za lice kao važna mjera za prevenciju infekcija u zdravstvenim ustanovama. Prema preporukama, hrvatski stomatolozi trebali bi nastaviti nositi maske za lice u svojim ordinacijama (8). Od prosinca 2019. i početka pandemije bolesti COVID-19, kada je nošenje maski za lice postalo svakodnevna rutina, prijavljena je nova komplikacija zbog dugotrajnog nošenja maske nazvana sindrom suhoga oka povezanog s maskom (engl. *mask-related dry eye* – MADE) (9 – 11). DED karakteriziraju brojni simptomi kao što su bol, suhoća, svrbež i osjećaj stranog tijela (12). Za točnu procjenu, uz kliničke rezultate, korisno je zabilježiti subjektivne simptome DED-a s pomoću upitnika koje ispunjavaju sami pacijenti (13). Cilj ove studije bio je procijeniti samoprijavljeni MADE kod stomatologa tijekom pandemije bolesti COVID-19 i identificirati moguće čimbenike rizika.

Materijal i metode

Ovo presječno istraživanje provedeno je u suradnji Stomatološkog fakulteta Sveučilišta u Zagrebu i KBC-a Sestre milosrdnice. Sudionici su bili doktori dentalne medicine zaposleni u državnim zdravstvenim ustanovama (u privatnim i državnim klinikama) te stomatolozi opće i specijalističke struke. Doktorima dentalne medicine registriranima u Hr-

Doctors of dental medicine registered with the Croatian Dental Chamber were emailed a link to a questionnaire made using the open-source Google Forms® tool. The period of data collection was from February 2022 to August 2022. The questionnaire was sent to 1000 dental healthcare professionals, to which 405 dental professionals responded, which accounts for the response rate of 40.5%. Participation in the survey was fully voluntary and completely anonymous. Since it was done online, participants did not sign their agreement to participate. Prior to being able to access the questionnaire, the participants had to read the informed consent document and certify that they had read, understood, and agreed to participate in the study. The Ethics Committee of the School of Dental Medicine at the University of Zagreb approved the study while taking the Declaration of Helsinki's principles into account.

The online questionnaire consisted of 17 questions in three main sections. The first part included demographic characteristics of the participants: age, gender, and place of work (21 counties were grouped into five regions: the City of Zagreb, Istria, Lika, Gorski kotar and Kvarner, Dalmatia, Northern Croatia, and Slavonia), two questions related to the duration of face mask wearing analyzing the number of hours wearing the face mask during the working hours as well as during the whole day (divided into four categories: using a mask less than 3 hours, from 3 to 6 hours, from 6 to 9 hours, and more than 9 hours), and four YES/NO questions regarding the presence of previous DED symptoms, current use of artificial tears or other lubricant therapy to relieve dry eye symptoms, presence of new DED symptoms using the face mask, deterioration of DED symptoms while wearing the face mask. The second part of the questionnaire collected the data related to risk factors for DED symptoms including use of contact lenses for refractive errors, history of eye surgery, current use of medications, and wearing additional protective face equipment (visor, refractive glasses with or without magnification, protective glasses, etc.).

The examination of subjective DED symptoms using the modified Ocular Surface Disease Index (OSDI) was the final step. An objective scale for determining the severity of DED is the OSDI, and the original OSDI questionnaire was modified by adding "while wearing a face mask" to the end of each question (e.g., Have you experienced any of the following during the last week while wearing a face mask?) to determine the presence of DED symptoms or worsening of previous symptoms, if present, after wearing a face mask during the COVID-19 pandemic (14). A widely used, reliable, and valid scale for assessing the subjective severity of DED is the 12-question Ocular Surface Disease Index (OSDI). The questionnaire was divided into three parts (three questions) to evaluate three aspects of dry eye symptoms: the frequency of symptoms experienced, how they affect vision-related quality of life, and whether any environmental triggers are present. There were three question types: "Have you experienced any of the following during the last week while wearing a face mask?" (items 1–5: eyes that are sensitive to light, eyes that feel gritty, painful or sore eyes, blurred vision, and poor vision); "Have problems with your eyes limited

vatskoj stomatološkoj komori e-poštom poslana je poveznica na upitnik izrađen korištenjem Google Forms® alata otvorenog koda. Podatci su se prikupljali od veljače do kolovoza 2022. Upitnik je poslan na adrese 1000 stomatologa, a odgovorilo je njih 405, što čini stopu odaziva od 40,5 %. Upitnik je bio potpuno anoniman, a sudjelovanje dobrovoljno. Budući da se provodio online, sudionici nisu dali pristanak u obliku potpisa. Ipak, prije nego što su mogli pristupiti upitniku morali su pročitati informirani pristanak i potvrditi da su ga pročitali, razumjeli i pristali sudjelovati u istraživanju. Etičko povjerenstvo Stomatološkog fakulteta Sveučilišta u Zagrebu odobrilo je studiju uzimajući u obzir načela Helsinške deklaracije. Online upitnik sastojao se od 17 pitanja podijeljenih u tri glavna dijela. Prvi dio obuhvaćao je demografske podatke sudionika: dob, spol i mjesto rada (21 županija grupirana je u pet regija: Grad Zagreb, Istra, Lika, Gorski kotar i Kvarner, Dalmacija, Sjeverna Hrvatska i Slavonija), dva pitanja odnosila su se na trajanje nošenja maske analizirajući broj sati tijekom radnog vremena te tijekom cijelog dana (podijeljeno u četiri kategorije: korištenje maske manje od 3 sata, od 3 do 6 sati, od 6 do 9 sati i više od 9 sati) i četiri DA/NE pitanja o prisutnost prethodnih simptoma DED-a, o trenutačnoj upotrebi umjetnih suza ili drugih lubrikantnih terapija za ublažavanje simptoma suhog oka, o pojavi novih simptoma DED-a zbog korištenja maski te o pogoršanju simptoma DED-a tijekom nošenja maske za lice. U drugom dijelu upitnika tražili su se podatci koji se odnose na čimbenike rizika za simptome DED-a, uključujući korištenje kontaktnih leća za refrakcijske pogreške, povijest kirurških zahvata na oku, trenutačnu upotrebu lijekova i nošenje dodatne zaštitne opreme za lice (vizir, refrakcijske naočale s povećanjem ili bez povećanja, zaštitne naočale itd.). Ispitivanje subjektivnih simptoma DED-a korištenjem modificiranog indeksa bolesti očne površine (engl. Ocular Surface Disease Indeks – OSDI) bio je posljednji korak. Objektivna ljestvica za određivanje ozbiljnosti DED-a bio je OSDI, a izvorni OSDI upitnik prilagođen je dodavanjem sintagme „dok nosite masku za lice" na kraju svakog pitanja (npr., Jeste li doživjeli nešto od sljedećega tijekom prošlog tjedna dok ste nosili masku za lice?) za utvrđivanje simptoma DED-a ili pogoršanje prethodnih simptoma, ako su prisutni, nakon nošenja maske za lice tijekom pandemije bolesti COVID-19 (14). Široko korištena, pouzdana i valjana ljestvica za procjenu subjektivne težine DED-a jest indeks bolesti očne površine (OSDI) od 12 pitanja. Upitnik je podijeljen u tri dijela (tri pitanja) kako bi se procijenila tri aspekta simptoma suhog oka: učestalost simptoma, kako oni utječu na kvalitetu života povezanu s vidom i postoje li neki okolišni okidači. Bile su tri vrste pitanja: „Jeste li doživjeli nešto od sljedećega tijekom prošlog tjedna dok ste nosili masku za lice?" (stavke 1 – 5: oči koje su osjetljive na svjetlo, oči u kojima se pojavljuje osjećaj pijeska, bolne ili otečene oči, zamagljen i loš vid); „Jesu li vas problemi s očima ograničavali u obavljanju bilo čega od sljedećega tijekom prošlog tjedna dok ste nosili masku za lice?" (stavke 6 – 9: čitanje, noćna vožnja, korištenje računala ili bankomata i gledanje televizije); i „Jeste li osjećali neugodu u očima u bilo kojoj od sljedećih situacija tijekom prošlog tjedna dok ste nosili masku za lice?" (stavke 10 – 12: mjesta ili područja

you in performing any of the following during the last week while wearing a face mask?" (Items 6 –9: reading, nighttime driving, using a computer or ATM, and watching TV); and "Have your eyes felt uncomfortable in any of the following situations during the last week while wearing a face mask?" (Items 10 –12: locations or areas with minimal humidity, windy conditions, and air-conditioned spaces). Each response was scored on a 5-point scale (ranging from 0 to 4). There were five options in the OSDI response structure related to the frequency of the symptoms of ocular surface disease: none of the time (0), some of the time (1), half of the time (2), most of the time (3), and all the time (4). The formula OSDI= (sum scores) x25 / (number of questions answered) was used to generate the overall OSDI score, which ranges from 0 to 100). As a result, the OSDI was scored on a scale of 0 (being normal) to 100 (indicating severely dry eyes). The participants were classified into four groups based on the severity of their dry eye symptoms as determined by their OSDI score: normal (scores 0–12), mild (13–22), moderate (23–32), and severe dry eye symptoms (33–100). This study also adopted the criteria of other authors; therefore, symptomatic DED is defined as any OSDI score above 22 (15).

MADE was defined as new onset or worsening of pre-existing DED symptoms while wearing a face mask. Both participants who developed new DED symptoms while wearing a face mask and those whose existing DED symptoms became worse while using a face mask were considered a part of the MADE.

SPSS software (Statistical Program for Social Sciences, version 18.0, Chicago, IL) was used for the statistical analysis. The Kolmogorov-Smirnov analysis revealed that the OSDI results were not normally distributed, thus non-parametric tests—the Mann-Whitney test for comparisons between two groups and the Kruskal-Wallis test for comparisons between several groups were applied. A comparison of categorical variables was made using the Chi square test. To identify potential risk factors connected to MADE, univariate and multivariate multinomial logistic regression analyses were conducted. Based on the 95% CI, odds ratio (OR) was determined. Confidence Interval (CI) and a p value of <0.05 were used to assess the extent of the relationship between variables and MADE.

Results

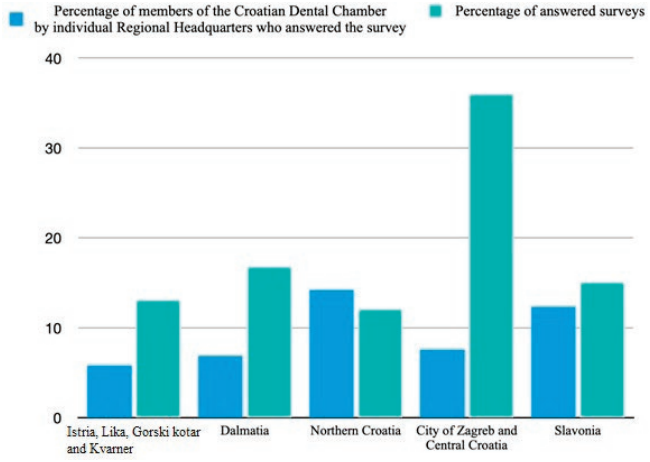
A total of 405 dental health professionals completed the questionnaire and were included in the study. Dentists from all Croatian regions were included, although the majority of the participants worked in Zagreb (36%) during the course of the study. According to distribution by individual Regional Headquarters of the Croatian Dental Chamber, most of the members who completed the survey were from the Northern Croatia region (16) (Figure 1).

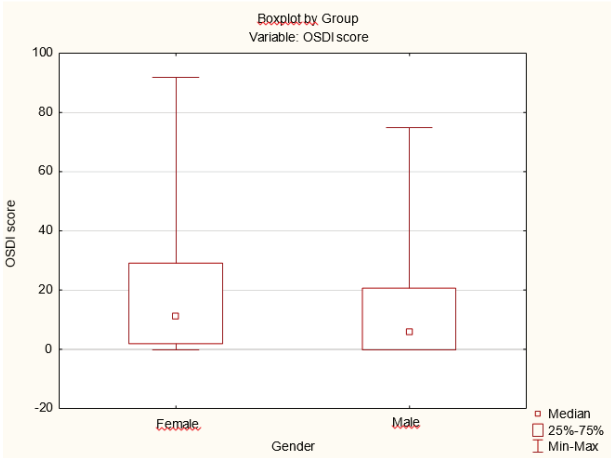
All participants were divided into three groups according to their age, with more than a half (56.5%) younger than 40 years. The majority of the participants, 75.6% of them, were female (Table 1). 13.6% participants used contact lens-

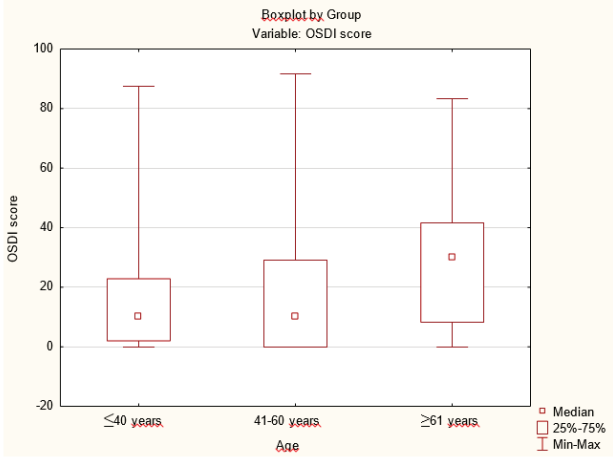
s minimalnom vlagom, vjetroviti uvjeti i klimatizirani prostori). Svaki je odgovor ocjenjivan na ljestvici od pet stupnjeva (u rasponu od 0 do 4). Postoji pet opcija u OSDI strukturi odgovora koje se odnose na učestalost simptoma bolesti površine oka: ni jedanput (0), dio vremena (1), pola vremena (2), većinu vremena (3) i cijelo vrijeme (4). Formula OSDI = (zbroj rezultata) x 25/(broj odgovorenih pitanja) korištena je za generiranje ukupnog rezultata koji se kreće od 0 do 100). Kao rezultat toga, OSDI se ocjenjuje na ljestvici od 0 (što je normalno) do 100 (što upozorava na jako suhe oči). Sudionici su bili razvrstani u četiri skupine na temelju ozbiljnosti simptoma suhoga oka prema OSDI rezultatu: normalni simptomi suhoga oka (rezultati 0 – 12), blagi (13 – 22), umjereni (23 – 32) i teški (33 – 100) . U ovoj su studiji također prihvaćeni kriteriji drugih autora; zato se simptomatski DED definira kao bilo koji OSDI rezultat iznad 22 (15). MADE je definiran kao nova pojava ili pogoršanje već postojećih simptoma suhoga oka tijekom nošenja maske za lice. I sudionici kod kojih su se pojavili novi simptomi DED-a dok su nosili masku za lice i oni čiji su se postojeći simptomi pogoršali tijekom korištenja maske za lice, smatrani su dijelom MADE-a. Za statističku analizu korišten je softver SPSS (Statistical Program for Social Sciences, verzija 18.0, Chicago, IL). Kolmogorov-Smirnovljevom analizom otkriveno je da OSDI rezultati nisu normalno distribuirani i zato su primijenjeni neparametrijski testovi — Mann-Whitneyev za usporedbe između dviju skupina i Kruskal-Wallisov za usporedbe između nekoliko skupina. Usporedba kategorijskih varijabli obavljena je hi-kvadrat testom. Kako bi se identificirali potencijalni čimbenici rizika povezani s MADE-om, provedene su univarijatne i multivarijatne multinomne logističke regresijske analize. Na temelju 95 % CI-ja određen je omjer izgleda (OR). Interval pouzdanosti (CI) i p vrijednost < 0,05 korišteni su za procjenu opsega odnosa između varijabli i MADE-a.

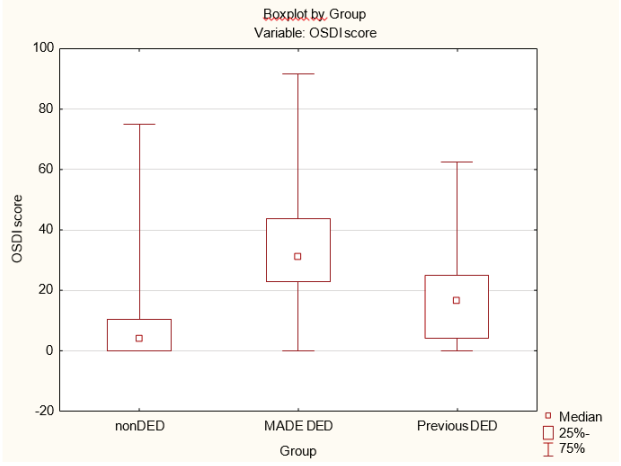
Rezultati

Ukupno 405 stomatologa ispunilo je upitnik i tako se uključilo u istraživanje. Bili su iz svih hrvatskih regija, iako je većina tijekom istraživanja radila u Zagrebu (36 %). Prema raspodjeli po pojedinim regionalnim sjedištima Hrvatske stomatološke komore, većina članova koji su ispunili anketu bila je iz sjeverne Hrvatske (16) (slika 1.). Svi ispitanici podijeljeni su u tri skupine prema dobi – više od polovine (56,5 %) bilo je mlađe od 40 godina. Većina sudionika, njih 75,6 %, bile su žene (tablica 1.). Kontaktnim lećama koristilo se 13,6 % sudionika, a 42,2 % prijavilo je nošenje refrakcijskih naočala. Kad je riječ o trenutačnoj upotrebi lijekova, 11,1 % izjavilo je da redovito uzima hormonsku terapiju, 7,2 % an-









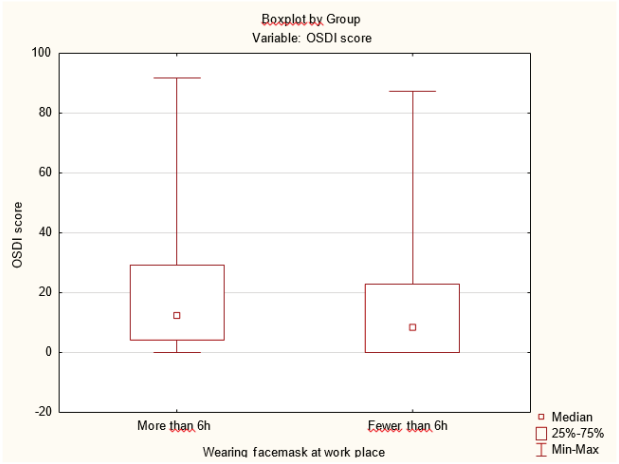


Figure 1 Geographical distribution of the participants in the study and answered surveys by the number of members of the Croatian Dental Chamber by individual Regional Headquarters (Y-axis = percentage of participants)
Slika 1. Geografska distribucija sudionika istraživanja i popunjenih anketa prema broju članova Hrvatske stomatološke komore po pojedinim regionalnim sjedištima (os Y = postotak sudionika)
Figure 2 OSDI score according to gender
Slika 2. OSDI rezultat prema spolu
Figure 3 OSDI score according to age
Slika 3. OSDI rezultat prema dobi
Figure 4 OSDI score according to DED
Slika 4. OSDI rezultat prema DED-u
Figure 5 OSDI score according to daily mask-wearing duration
Slika 5. OSDI rezultat prema dnevnom trajanju nošenja maske

es, while 42.2% reported wearing refractive glasses. Regarding the current use of medications, 11.1% reported taking regular hormonal therapy, 7.2% antihistamines, and 6.9% antihypertensives. The most common reported personal protective face equipment was a visor (68.1%).

Regarding the duration of face mask wearing during the working hours, 42.5% of the participants used masks less than 6 hours, and 57.6% of them wore them for more than 6 hours. During the COVID-19 pandemic, prolonged mask

tihistaminike, a 6,9 % antihipertenzive. Najčešća prijavljena osobna zaštitna oprema za lice bio je vizir (68,1 %). Što se tiče trajanja nošenja maski za lice tijekom radnog vremena, 42,5 % ispitanika koristilo se njima manje od 6 sati, a 57,6 % više od 6 sati. Tijekom pandemije bolesti COVID-19 zabilježeno je produljeno nošenje maski tijekom dana (na radnom mjestu i izvan radnog mjesta), a 77,1 % stomatologa prijavilo je takvu zaštitu dulju od 6 sati na dan. Također je 23,2 % (94/405) sudionika izjavilo da su već imali barem jedan od

Table 1 Study sampled demographic characteristics
Tablica 1. Demografska obilježja uzorka studije

		Non-DED No (%) • Ne (%)	MADE No (%) • Ne (%) Prevalence (%) • Prevalencija (%) (95% CI)	Previous DED No (%) • Ne (%)	Total No • Ukupni No Prevalence (%) • Prevalencija (%) (95% CI)	P value • P vrijednost
Overall • Ukupno		**238 (58.8%)**	**118 (29.1%)**	**49 (12.1%)**	**405 100%**	
Age (years) • Dob (godine)	≤40	151 (63.45%)	56 (47.46%)	22 (44.90%)	229 56.5% (51.6-61.5)	p=.00219
	41-60	76 (31.93%)	45.(38.14%)	21(42.86%)	142 35.1% (30.4-39.7)	
	>61	11 (4.62%)	17 (14.41%)	6 (12.24%)	34 8.4% (5.7-11.1)	
Sex • Spol	Female • Ženski	172 (72.27%)	93 (78.81%)	41(83.67%)	306 75.6% (71.4-79.8)	p=.13781
	Male • Muški	66 (27.73%)	25 (21.19%)	8 (16.33%)	99 24.4% (20.2-28.6)	

wearing during the day (in the workplace and outside the workplace) was recorded, and 77.1% of dentists reported wearing a mask for more than 6 hours a day. 23.2% (94/405) of participants reported that they had already had at least one of the symptoms of DED (previous DED) before they started prolonged mask wearing. Hence, 47.9% (n=45) of these participants reported deterioration of previously existing DED symptoms while wearing a face mask, while the remaining 52.1% (n=49) reported that there was no change in DED symptoms due to wearing a mask. These 49 participants whose DED symptoms did not deteriorate while wearing a mask were considered as previous DED. The reported prevalence of previous DED was 12.1%. (95% CI: 9.1 - 15.8). An overall prevalence of MADE was 29.1% (95% CI: 24.7 - 33.6). Therefore, 11.1% of the previous DED participants reported a deterioration of symptoms while wearing a face mask and 18% participants reported a new onset of DED symptoms while wearing a face mask. 58.8% (95% CI: 54.1 -64.5) participants did not report any DED symptoms. The prevalence of MADE was 78.8% (CI: 73.3 - 94.0) and 21.2% (CI: 13.8 - 28.6) for females and males respectively. The prevalence of MADE in the participants younger than 40 years was 47.5%, (CI: 38.7 - 56.4), and in those aged 41 to 60 years, and older than 61 years it was 38.1% (CI: 29.9 - 47.1) and 14.4% (CI: 8.1 - 20.7), respectively.

About one half of the participants (52.3%) reported a normal OSDI score, 15.1% mild presence of DED symptoms, 14.1% moderate dry eye symptoms, and 18.5% severe dry eye symptoms. The median (IQR) OSDI score of all participants was 10.42 (2.08 - 27.08) and the prevalence of symptomatic DED (OSDI score above 22) was 32.6%. The female participants had a statistically higher OSDI score compared to male participants (11.46 (IQR = 2.08 – 29.17) vs 6.25 (IQR = 0 – 20.83); Mann-Whitney U Test, p = 0.030; Figure 2), and the oldest age group (over 61 years of age) had a statistically higher OSDI score (30.21 (IQR = 8.33 – 41.67)); compared to the other two groups (10.42 (IQR = 2.08 – 22.92), 10.42 (IQR = 0 – 29.17), The Kruskal-Wallis test, p =.0015; Figure 3). The prevalence of symptomatic DED was statistisimptoma DED-a (prethodni DED) prije nego što su počeli dugotrajno nositi masku. Stoga je 47,9 % (n = 45) tih sudionika prijavilo pogoršanje već postojećih simptoma DED-a tijekom nošenja maske za lice, a preostalih 52,1 % (n = 49) izjavilo je da nije bilo promjene simptoma DED-a zbog nošenja maske. Kod tih 49 sudionika simptomi su smatrani prethodnim DED-om. Prijavljena prevalencija prethodnoga DED-a bila je 12,1 % (95 % CI: 9,1 – 15,8). Ukupna prevalencija MADE-a iznosila je 29,1 % (95 % CI: 24,7 – 33,6). Stoga je 11,1 % prethodnih sudionika DED-a prijavilo pogoršanje simptoma tijekom nošenja maske za lice, a 18 % prijavilo je nove simptome tijekom upotrebe maske za lice. Istaknimo da 58,8 % (95 % CI: 54,1 – 64,5) sudionika nije prijavilo nikakve simptome DED-a. Prevalencija MADE-a bila je 78,8 % (CI: 73,3 – 94,0) i 21,2 % (CI: 13,8 – 28,6) za žene i muškarce. Prevalencija MADE-a kod ispitanika mlađih od 40 godina iznosila je 47,5 % (CI: 38,7 – 56,4), a u dobi od 41 do 60 godina i starijih od 61 godine 38,1 % (CI: 29,9 – 47,1) i 14,4 % (CI: 8,1 – 20,7). Oko pola sudionika (52,3 %) prijavilo je normalan OSDI rezultat, 15,1 % blage simptome DED-a, 14,1 % umjerene i 18,5 % teške simptome suhoga oka. Medijan (IQR) OSDI rezultata svih sudionika bio je 10,42 (2,08 – 27,08), a prevalencija simptomatskoga DED-a (OSDI rezultat iznad 22) iznosila je 32,6 %. Žene su imale statistički viši OSDI rezultat u usporedbi s muškarcima (11,46 (IQR = 2,08 – 29,17) u odnosu na 6,25 (IQR = 0 – 20,83); Mann-Whitney U test, p = 0,030; slika 2.), a i najstarija dobna skupina (stariji od 61 godine) imala je statistički viši OSDI rezultat (30,21 (IQR = 8,33 – 41,67)); u usporedbi s drugim dvjema skupinama (10,42 (IQR = 2,08 – 22,92), 10,42 (IQR = 0 – 29,17), Kruskal-Wallisov test, p =,0015; slika 3.). Prevalencija simptomatskog DED-a bila je statistički veća kod sudionika MADE-a – 76,3 %, u usporedbi s prethodnim sudionicima DED-a i ne-DED-a 36,7 % odnosno 10,1 %. Sudionici koji su prijavili simptome MADE-a imali su statistički višu OSDI ocjenu (31,25 (IQR = 22,92 – 43,75)) u usporedbi s prethodnim sudionicima DED-a i ne-DED-a (16,67 (IQR = 4,17 – 25), 4,17 (IQR = 0 – 10,42)), (slika 4.). Kad je riječ o trajanju nošenja maske za lice tijekom radnog vremena, sudio-

cally higher in the MADE participants 76.3%, compared to the previous DED and non-DED participants, 36.7% and 10.1% respectively. The participants who reported MADE symptoms had a statistically higher OSDI score (31.25 (IQR = 22.92 – 43.75)) compared to the previous DED and non-DED participants (16.67 (IQR = 4.17 - 25), 4.17 (IQR = 0 – 10.42)) respectively (Figure 4).

Regarding the duration of face mask wearing during the working hours, the participants who used masks more than 6 hours per day reported a statistically higher OSDI score (12.5 (IQR = 4.17 – 29.17)) compared to the participants who used masks less than 6 hours a day (8.33 (IQR = 0 – 22.92); The Mann-Whitney U Test p = 0.040) (Figure 5). The participants who used masks more than 6 hours per day during the whole day reported higher OSDI score (12.5 (IQR = 2.6 – 29.2)) compared to the participants who used masks less than 6 hours/day (6.25 (IQR = 0 – 22.92); The Mann-Whitney U Test p = 0.066). 68.6% of participants who reported MADE symptoms reported wearing a face mask at work for more than 6 hours/day, compared with 57.1% of previous DED participants and 52.1% of non-DED participants (p=0.012). Univariable logistic regression revealed some risk factors associated with self-reported MADE, statistically significant risk factors were as follows: age (older than 61 years) OR: 4.67 (95% CI 1.839 – 9.443); p<0.01, wearing the face mask more than 6 h at work OR: 2.013 (95% CI 1.265 – 3.203);p=0.003, wearing the face mask more than 6 h all day OR: 1.796 (95% CI: 1.015 – 3.177); p=0.044, and using the antihypertensive therapy OR: 1.009 (95% CI: 1.133 – 5.672); p=0.024. Multivariable logistic regression revealed as possible risk factors for self-reported MADE age (older than 61 years) OR: 3.522 (95% CI 1.448 - 8.563); p=0.05, and wearing the face mask more than 6 h at work OR: 1.779 (95% CI 1.017 – 3.113); p=0.044 (Table 2).

nici koji su se njima koristili dulje od 6 sati na dan prijavili su statistički viši OSDI rezultat (12,5 (IQR = 4,17 – 29,17)) u usporedbi s onima koji su ih upotrebljavali kraće od 6 sati (8,33 (IQR = 0 – 22,92); Mann-Whitney U test p = 0,040) (slika 5.). Sudionici koji su se koristili maskama dulje od 6 sati na dan tijekom cijeloga dana prijavili su viši OSDI rezultat (12,5 (IQR = 2,6 – 29,2)) u usporedbi s onima koji su ih upotrebljavali kraće (6,25 (IQR = 0 – 22,92)); Mann-Whitney U test p = 0,066). Istaknimo da je 68,6 % sudionika koji su prijavili simptome MADE-a izjavilo su da su nosili masku za lice na poslu više od 6 sati/dan, u usporedbi s 57,1 % prethodnih sudionika DED-a i 52,1 % onih bez DED-a (p = 0,012). Univarijabilna logistička regresija otkrila je čimbenike rizika povezane s MADE-om prema samoprocjeni – statistički značajni čimbenici rizika bili su dob (stariji od 61 godine) OR: 4,167 (95 % CI 1,839 – 9,443); p < 0,01, nošenje maske dulje od 6 sati na poslu OR: 2,013 ((95 % CI 1,265 – 3,203); p = 0,003, nošenje maske dulje od 6 sati cijeli dan OR: 1,796 (95 % CI: 1,015) – 3,177); p = ,044 i primjena antihipertenzivne terapije OR: 1,009 (95 % CI: 1,133 – 5,672); p = 0,024. Multivarijabilna logistička regresija otkrila je kao moguće čimbenike rizika za MADE dob prema samoprocjeni (stariji od 61 godine) OR: 3,522 (95 % CI 1,448 – 8,563); p = 0,05 i nošenje maske za lice dulje od 6 sati na poslu OR: 1,779 (95 % CI 1,017 – 3,113); p = 0,044 (tablica 2).

Table 2 Possible risk factors for MADE
Tablica 2. Mogući čimbenici rizika za MADE

Factor • Čimbenik	OR	CI	p	OR	CI	p
Older than 61 years • Stariji od 61 godine	4.167	1.839 - 9.443	<0.01	3.522	1.448-8.563	0.05
Female gender • Ženski spol	1.427	0.845 - 2.413	0.18			
Wearing facemask at workplace more than 6h per day • Nošenje maske na radnom mjestu više od 6 sati na dan	2.013	1.265 - 3.203	0.003	1.779	1.017-3.113	0.044
Wearing facemask more than 6h per day • Nošenje maske dulje od 6 sati na dan	1.796	1.015 - 3.177	0.044	1.173	0.591-2.327	0.648
Eye surgical procedure • Kirurški zahvat na oku	0.655	0.253 - 1.696	0.383			
Contact lenses • Kontaktne leće	1.372	0.712 - 2.644	0.344			
Antihypertensives • Antihipertenzivi	2.535	1.133 - 5.672	0.024	1.422	0.576-3.513	0.445
Hormonal therapy • Hormonska terapija	1.009	0.486 - 2.097	0.98			
Antihistamines • Antihistaminici	1.718	0.797 - 3.702	0.167			
Visor • Vizir	0.896	0.559 - 1.437	0.649			
Refractive glasses • Refrakcijske naočale	1.05	0.672 - 1.643	0.829			
Protective glasses • Zaštitne naočale	1.505	0.745 - 3.039	0.254			
No protection • Bez zaštite	0.68	0.294 - 1.570	0.366			
Previous dry eye disorder • Prijašnji poremećaj suhog oka	1.11	0.662 - 1.863	0.692			

Discussion

Face masks, which are considered personal protective equipment, are crucial for preventing the spread of aerosols when someone coughs, talks, or sneezes (17). Being frontline workers, dentists are at a significant risk of catching infectious diseases that can be transmitted through instruments or bodily fluids such as blood or saliva (18). Dental professionals are encouraged to use face masks as infection prevention to reduce the risk of infection. A face mask provides protection against viral, bacterial, and fungal diseases. Face masks are the primary piece of protective gear used by dentists to prevent the transfer of an illness while using mechanical instruments, according to the CDC (Centres for Disease Control and Prevention) (19). As a basic level of infection control practice, mask wearing had been routinely done among dentists in the time before the COVID-19 pandemic. The World Health Organization (WHO) was warned of an outbreak of viral pneumonia on December 31, 2019, by the authorities in Wuhan, China. The novel coronavirus from 2019 (SARS-CoV-2) had its genome sequence determined by January 2020. The WHO classified COVID-19 as a global pandemic in March 2020 (20, 21). A number of preventive measures, including protective gear for medical staff caring for patients with suspected or confirmed COVID-19, were advised by the WHO and the United States CDC, with masks being one of the most efficient (22). While face masks as a protective measure became a part of the daily routine, mask wearing has been designated mandatory for healthcare professionals, and side effects of prolonged use of face masks on the ocular surface has been introduced. Ever since the use of the face mask all day long became an essential part of our daily lives due to the pandemic, a marked increase in DED symptoms has been reported. Surgical masks and N95 particulate respirator masks, which filter out airborne particles, are the two main types of face masks. Both of these forms of face masks (surgical mask and N95) cause a significant decline in tear film parameters (24, 25). Uncertainty persists regarding the pathophysiological elements that can make DED symptoms worse during extended face mask use. Numerous studies have revealed that the convection of air around the eyes brought on by an incorrectly fitted mask may have an impact on the ocular surface. Face masks greatly decrease the flow of air outward, and when the mask is worn loosely against the face, the air that is exhaled is likely to travel upward, which increases tear evaporation and aggravates the symptoms of ocular surface disease (10). A face mask with a gap at the top edge may result in unstable tear films, elevated corneal and bulbar conjunctival temperatures, and increased blood flow in the bulbar conjunctiva (26). In a recent study, Shalaby et al. (25) reported a greater risk for DED symptoms with surgical masks than with N95 particulate respirator masks. In contrast, a study by Motwani reported a significantly greater risk with N95 than with a surgical mask (27). According to research by Azzam et al., using a N95 mask was linked to higher symptoms of dry eyes than using a surgical mask (24). Given that N95 masks are more air-sealed than surgical masks, this result was unexpected. This can

Rasprava

Maske za lice, koje se smatraju osobnom zaštitnom opremom, ključne su za sprječavanje širenja aerosola kada netko kašlje, govori ili kiše (17). Budući da su zaposleni na prvoj crti, dakle, stomatolozi, u velikoj opasnosti od zaraze bolestima koje se mogu prenijeti preko alata ili tjelesnih tekućina poput krvi ili sline (18), oni se potiču na nošenje maske za lice radi prevencije infekcije kako bi smanjili rizik od bolesti. Maska za lice štiti od virusnih, bakterijskih i gljivičnih bolesti. Ona je primarni dio zaštitne opreme kojom se stomatolozi koriste u sprječavanju prijenosa bolesti tijekom korištenja mehaničkih instrumenata (prema Centrima za kontrolu i prevenciju bolesti COVID-19). Vlasti u Wuhanu u Kini upozorile su Svjetsku zdravstvenu organizaciju (SZO) na pojavu virusne upale pluća 31. prosinca 2019. godine. Genomska sekvencija novoga koronavirusa iz 2019. (SARS-CoV-2) otkrivena je do siječnja 2020. SZO je u ožujku 2020. klasificirao bolest COVID-19 kao globalnu pandemiju (20, 21). SZO i američki CDC preporučili su mnogobrojne preventivne mjere, uključujući zaštitnu opremu za medicinsko osoblje koje se skrbi o pacijentima sa sumnjom na bolest COVID -19 ili s potvrđenim bolešću, a maske su jedna od najučinkovitijih mjera (22). Dok su maske za lice kao zaštitna mjera postale dio svakodnevice, njihovo nošenje proglašeno je obveznim za zdravstvene radnike, a uvedena je i nuspojava dugotrajnog korištenja maski za lice na površini oka. Otkako je cjelodnevna upotreba maske za lice postala bitan dio našega svakodnevnog života zbog pandemije, zabilježen je znatan porast simptoma DED-a. Kirurške maske i respiracijske maske za čestice N95 koje filtriraju čestice iz zraka, dvije su glavne vrste maski za lice. Oba ta proizvoda (kirurška maska i N95) znatno smanjuju parametar suznog filma (24, 25). I dalje postoji dvojba u vezi s patofiziološkim elementima koji mogu pogoršati simptome DED-a tijekom dulje upotrebe maske za lice. U mnogim su istraživanjima autori otkrili da konvekcija zraka oko očiju prouzročena nepravilno postavljenom maskom može utjecati na površinu oka. Maske za lice znatno smanjuju protok zraka prema van, a ako su postavljene labavo uz lice, zrak koji se izdahne vjerojatno će putovati prema gore, što povećava isparavanje suza i pogoršava simptome bolesti površine oka (10). Maska za lice s razmakom na gornjem rubu može rezultirati nestabilnim suznim filmom, povišenom temperaturom rožnice i bulbarne konjunktive te povećanim protokom krvi u bulbarnoj konjunktivi (26). U nedavnoj studiji izvijestili su Shalaby i suradnici (25) o većem riziku od simptoma DED-a s kirurškim maskama nego s respiracijskim maskama za čestice N95. Suprotno tomu, Motwani je u svojoj studiji istaknuo značajno veći rizik s maskom N95 nego s kirurškom (27). Prema istraživanju Azzama i suradnika, korištenje maske N95 povezano je s izraženijim simptomima suhih očiju od korištenja kirurške maske (24). S obzirom na to da maske N95 bolje zatvaraju protok zraka od onih kirurških, taj je rezultat bio neočekivan. To se može objasniti načinom na koji je pričvršćena žica za nos, što može rezultirati pomicanjem vjeđe niže i posljedično utjecati na proces treptanja očiju. Pravilno postavljene maske za lice mogu smanjiti rizik od MADE-a, a li-

be explained by the way the nose wire is fitted, which may lead to lower lid displacement and subsequently influence the eye-blinking process. Face masks fitted properly may lower the risk of MADE, and taping the upper border of the mask could prevent MADE (26). American ophthalmologist D.E. White first described this condition and named it "mask-associated dry eye" (MADE). Moshirfar et al. reported increased ocular irritation and dryness among regular mask users during the COVID-19 pandemic (9). Krolo et al. (14) confirmed the existence of MADE, and Boccardo (28) reported the prevalence of MADE of 18.3% in the general population, age ranging from 11 to 88 years. Itokawa et al. (26) reported the prevalence of MADE in 21.7% of young participants (mean age 27.1± 5.1 years). A higher prevalence in the deterioration of DED symptoms (57.6%) was found among the healthcare professionals in an ophthalmology department after prolonged surgical mask wearing (29). It was found that 70% of healthcare workers in the COVID-19 outpatient and intensive care units in a tertiary hospital self-reported having MADE (30). MADE was recorded in the general population during COVID-19, however healthcare workers who wear masks for extended periods of time have a significantly higher prevalence of MADE (29-32). To our knowledge, the present study is the only study which evaluated the effect of prolonged mask wear on dentists' self-reported MADE (mask-related dry eye symptoms. The prevalence of self-reported MADE was 29.1%. The prevalence of MADE was 78.8% and 21.2% for females and males respectively, i.e. women had a higher prevalence than men. The relationship between female gender and DED has been shown in a large number of studies (15, 27). In this study, 68.6% of dentists who reported MADE symptoms wore a face mask over 6 hours a day at work, and the duration of face mask wearing was statistically longer compared to previous DED and non-DED participants. Among the participants, 77.1% of them reported wearing a face mask for more than 6 hours a day, which means that the overall time dentists spent wearing a face mask during the whole day, was prolonged. Furthermore, the time period was longer compared to the non-healthcare population (14). Dentists as professionals are predisposed to a number of occupational hazards, including exposure to aerosols, and they were using a face mask more than the general population, thus only 13 (3.2%) dentists were using a face mask < 3 hours during their working hours, while 16 (4%) dentists were using a face mask < 3 hours during the whole day. To the extent that we are aware, this is the first study that demonstrated a statistically higher OSDI score among dentists who used masks for more than six hours per day. In comparison to dentists who wore masks for fewer than 6 hours per day at work, those who used masks for more than 6 hours per day at work had statistically higher OSDI scores. However, when comparing instances where a mask was worn all day, we could not detect a statistically significant difference regarding the OSDI score, which may be because of an uneven distribution (only 95 dentists wore a mask less than 6 hours in one whole day, while the majority, 312 of them, wore it more than 6 hours during one whole day). In a recent study, Motwani et al. (27) found that

jepljenje gornjega ruba maske može spriječiti MADE (26). Američki oftalmolog D. E. White prvi je opisao to stanje i nazvao ga „suho oko povezano s maskom" (MADE). Moshirfar i suradnici prijavili su povećanu iritaciju i suhoću oka među redovitim korisnicima maski tijekom pandemije bolesti COVID-19 (9). Krolo i suradnici (14) potvrdili su postojanje MADE-a, a Boccardo (28) je izvijestio o prevalenciji MADE-a od 18,3 % u općoj populaciji u dobi od 11 do 88 godina. Itokawa i suradnici (26) izvijestili su o prevalenciji MADE-a kod 21,7 % mladih sudionika (srednja dob 27,1 ± 5,1 godina). Veća učestalost pogoršanja simptoma DED-a (57,6 %) utvrđena je među zdravstvenim radnicima na oftalmološkom odjelu nakon produljenog nošenja kirurške maske (29). Otkriveno je da je 70 % zaposlenih u ambulantama i jedinicama intenzivne skrbi za bolest COVID-19 u tercijarnoj bolnici izjavilo da ima MADE (30). MADE je zabilježen u općoj populaciji tijekom pandemije, međutim zdravstveni radnici koji nose maske dulje imaju znatno veću prevalenciju MADE-a (29 – 32). Koliko nam je poznato, ovo je prva studija koja je procijenila utjecaj dugotrajnog korištenja maske na simptome suhoga oka povezane s maskom, ili samoprijavljeni MADE među doktorima dentalne medicine. Prevalencija samoprijavljenoga MADE-a bila je 29,1 %. Prevalencija MADE-a bila je 78,8 % i 21,2 % za žene, odnosno muškarce, tj. žene su imale veću prevalenciju od muškaraca. Odnos između ženskoga spola i DED-a opisan je u mnogim studijama (15, 27). U ovoj studiji je 68,6 % stomatologa koji su prijavili simptome MADE-a nosilo masku za lice dulje od 6 sati na dan na poslu, a trajanje nošenja maske bilo je statistički dulje u usporedbi s prethodnim sudionicima DED-a i onima koji nisu imali DED. Među sudionicima njih 77,1 % prijavilo je nošenje maske za lice dulje od 6 sati na dan, što znači da je produljeno ukupno vrijeme koje su stomatolozi proveli noseći masku tijekom cijelog dana. Nadalje, bilo je dulje u usporedbi s nezdravstvenom populacijom (14). Stomatolozi kao profesionalci izloženi su brojnim profesionalnim opasnostima, uključujući izloženost aerosolu, te su se koristili maskom za lice više nego opća populacija. Tako se samo 13 (3,2 %) stomatologa koristilo maskom za lice < 3 sata tijekom radnog vremena, a 16 (4 %) upotrebljavalo ju je < 3 sata tijekom cijelog dana. Koliko nam je poznato, ovo je prva studija koja je pokazala statistički viši OSDI rezultat među stomatolozima koji su se koristili maskom dulje od šest sati na dan. U usporedbi sa stomatolozima koji su nosili maske kraće od 6 sati na dan na poslu, oni koji su se koristili maskama dulje od 6 sati na dan imali su statistički više OSDI rezultate. Međutim, uspoređujući slučajeve u kojima se maska nosila cijeli dan, nismo mogli otkriti statistički značajnu razliku u vezi s OSDI rezultatima, što može biti zbog neravnomjerne raspodjele (samo 95 stomatologa nosilo je masku kraće od 6 sati u jednom danu, a većina je, njih 312, nosila dulje od 6 sati tijekom cijelog dana). U nedavnoj studiji otkrili su Motwani i suradnici (27) da bi nošenje maske za lice dulje od tri do šest sati na dan moglo pogoršati ili pojačati simptome DED-a među zdravstvenim radnicima koji su prethodno imali to stanje i bili su mlađi od 40 godina. Prema istraživanju Alsulamija i suradnika (31), među medicinskim sestrama je nošenje maske dulje od šest sati na dan bilo značajno poveza-

wearing a face mask for more than three to six hours per day could exacerbate or increase the symptoms of DED among healthcare professionals who had previously had the condition and were under the age of 40. According to research by Alsulami et al. (31) among female nursing staff, wearing a mask for more than six hours per day was substantially related to moderate to severe DED. In addition, Shalaby et al. (25) study discovered a substantial positive link between the OSDI, corneal staining, and the amount of hours per day spent wearing a face mask, as well as a strong negative correlation with the Schirmer test. According to Alsulami et al. (31) among female nursing personnel, wearing a face mask for more than six hours per day was substantially related with moderate to severe DED. Boccardo documented that in the general population, retailers were a possible risk factor for MADE; they reported more MADE compared to the other professionals. Retailers as professionals had considerable exposure to the potential impacts of COVID-19, and perhaps they were wearing a face mask more than other professionals with less social contact (28). In our study, females had a statistically higher OSDI score compared to males, and the oldest age group had statistically the highest OSDI score, which is in line with previous studies (15, 33).

This study revealed the following as risk factors associated with self-reported MADE: age (older than 61 years), wearing a face mask more than 6 hours at work, wearing a face mask more than 6 hours during the day, and using the antihypertensive therapy. Smidt et al. concluded that ocular dryness is associated with antihypertensive therapy (ACE inhibitors, beta blockers, Angiotensin receptor blockers, calcium channel blockers) (34). The mechanisms by which antihypertensive drugs may result in dry eye symptoms are multidimensional; drugs may lead to ocular dryness, perhaps by lacrimal gland malfunction (35). We did not find the use of contact lenses or the use of any eye protective equipment (glasses or visor) to be a risk factor for MADE, which is consistent with the Dag study (30). During the COVID-19 epidemic, university students who wore contact lenses had a greater rate of symptomatic DED (36, 37). Hence, it has been established that contact lens usage time decreased during the COVID-19 epidemic (38, 39). In our study, there were more contact lens wearers in the previous DED group and many of them were applying lubricating therapy. The use of artificial tears reduces self-reported MADE symptoms.

We are aware of the limitations of our study, considering the fact that we did not analyse the type of the face mask used. Since in Croatia there was no obligatory type of masks to be worn for the healthcare workers who were not working in COVID-19 high-risk areas, most of the participants during the COVID-19 pandemic used both types of face masks, and sometimes they were both combined (respiratory masks were used together with surgical masks). Besides, in this study we analysed only self-reported dry eye symptoms. The results could have been biased due to the subjective nature of the OSDI score. Although the OSDI questionnaire is a trustworthy tool for evaluating DED symptoms in clinical treatment trials to distinguish between healthy adults and those with DED, it is not without limitations (40). So,

no s umjerenim do teškim DED-om. Osim toga, Shalaby i suradnici (25) uočili su značajnu pozitivnu vezu između OSDI-ja, bojenja rožnice i količine sati na dan provedenih s maskom za lice, te veoma negativnu korelaciju sa Schirmerovim testom. Prema Alsulami i suradnicima (31), među medicinskim sestrama je nošenje maske za lice dulje od šest sati na dan bilo značajno povezano s umjerenim do teškim DED-om. Boccardo je dokumentirao da u općoj populaciji trgovci imaju mogući čimbenik rizika za MADE – prijavili su viši MADE u usporedbi s drugim zanimanjima. Trgovci u maloprodaji, kao profesija, bili su znatno izloženi potencijalnim utjecajima bolesti COVID-19 i možda su nosili masku za lice dulje od ostalih profesija s manje društvenih kontakata (28). Žene su u našem istraživanju imale statistički viši OSDI zbroj u odnosu prema muškarcima, a najstarija skupina imala je statistički najviši zbroj, što je u skladu s prethodnim istraživanjima (15, 33).

Ova studija otkrila je sljedeće čimbenike rizika povezane sa samoprijavljenim MADE-om: dob (stariji od 61 godine), nošenje maske za lice dulje od 6 sati na poslu, nošenje maske za lice dulje od 6 sati tijekom dana i uporaba antihipertenzivne terapije. Smidt i suradnici zaključili da je suhoća oka povezana s antihipertenzivnom terapijom (ACE inhibitori, beta-blokatori, blokatori angiotenzinskih receptora, blokatori kalcijevih kanala) (34). Višedimenzionalni su mehanizmi kojima antihipertenzivi mogu prouzročiti simptome suhog oka – tako lijekovi mogu potaknuti suhoću oka možda zbog disfunkcije suzne žlijezde (35). Nismo uočili da bi uporaba kontaktnih leća ili bilo koje opreme za zaštitu očiju (naočala ili vizira) bila čimbenik rizika za MADE, što je u skladu s Dagovom studijom (30).

Tijekom epidemije bolesti COVID-19 studenti koji su nosili kontaktne leće imali su veću stopu simptomatskoga DED-a (36, 37). Stoga je utvrđeno da se vrijeme korištenja kontaktnih leća smanjilo tijekom epidemije te bolesti (38, 39). U našoj studiji bilo je više nositelja kontaktnih leća u prethodnoj grupi s DED-om i mnogi od njih primjenjivali su lubrikantnu terapiju. Korištenje umjetnih suza smanjuje simptome MADE-a koje sami prijavljuju pri nošenju maske za lice. Kako u Hrvatskoj nije postojala obvezna vrsta maski za zdravstvene radnike koji nisu radili u područjima visokoga rizika od bolesti COVID-19, svjesni smo ograničenja naše studije, uključujući i činjenicu da nismo analizirali to što se većina sudionika tijekom pandemije koristila objema vrstama maski, a katkad su bile i kombinirane (respiracijske maske zajedno s kirurškim maskama). Uz to, u ovoj smo studiji analizirali samo simptome suhoga oka koje su sudionici sami prijavili. Rezultati su mogli biti pristrani zbog subjektivne prirode OSDI rezultata. Iako je upitnik pouzdan način za procjenu simptoma DED-a u kliničkim ispitivanjima liječenja za razlikovanje zdravih odraslih osoba od onih s DED-om, nije bez ograničenja (40). Dakle, za potvrdu DED-a, kliničke testove treba kombinirati s upitnikom. Buduće studije mogle bi riješiti te nedostatke.

for the confirmation of DED, clinical tests should be combined with the OSDI questionnaire. Future studies may address these shortcomings.

Conclusions

In conclusion, there seems to be a sizable frequency of self-reported MADE among dentists. A longer duration of time spent using a face mask is consistently linked to greater OSDI scores. In their daily practice, dentists are advised to wear face masks as part of their personal protective equipment, regardless of the presence of the COVID-19 disease. Our research may contribute to greater understanding of the possible risk that improperly fitted face masks pose to ocular surface health.

Conflict of interest

The authors report no conflict of interest.

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Zaključak

Ukratko, čini se da je prevalencija samoprijavljenoga MADE-a među stomatolozima znatna. Dosljedno korištenje maske za lice tijekom duljeg razdoblja povezano je s višim OSDI rezultatima. Stomatolozima se u svakodnevnoj praksi savjetuje nošenje maski za lice kao dijela osobne zaštitne opreme, bez obzira na prisutnost bolesti COVID-19. Naše istraživanje može pridonijeti boljem razumijevanju mogućeg rizika zato što su nepropisno postavljene maske za lice opasne za zdravlje površine oka.

Sukob interesa

Autori nisu bili u sukobu interesa.

Doprinos autora: I. P. V., M. V., I. K. – nadzor projekta; I. P. V. – konceptualizacija i metodologija; L. Š. – validacija; I. P. V., L. Š., B. Š., L. P., B. O. – istraživanje; L. Š. – formalna analiza; L. P., B. O., A. M. – provjera podataka; I. P. V., L. Š. – pisanje teksta, izvorni nacrt; I. P. V., L. Š., B. Š. – pisanje teksta, recenziranje i uređivanje; Svi su autori odobrili konačnu verziju.

Sažetak

Cilj: Željelo se procijeniti samoprijavljeni MADE kod stomatologa tijekom pandemije bolesti COVID-19 i identificirati moguće čimbenike rizika. **Materijal i metode:** Anonimni upitnik poslan je doktorima dentalne medicine u razdoblju od veljače 2022. do kolovoza iste godine. Postavljena pitanja obuhvaćala su demografske i kliničke podatke: prisutnost i pogoršanje simptoma DED-a tijekom nošenja maske za lice, osobne zaštitne opreme za lice, korištenje kontaktnih leća, povijest operacija oka, trenutačnu upotrebu lijekova, broj sati nošenja maske za lice i procjenu subjektivnih simptoma DED-a s pomoću modificiranog indeksa za bolesti očne površine (OSDI). **Rezultati:** U studiju je bilo uključeno ukupno 405 sudionika, a ukupna prevalencija MADE-a bila je 29,1 % (95 % CI: 24,7 – 33,6). Sudionici koji su se koristili maskama više od 6 sati na dan tijekom cijelog dana prijavili su viši OSDI rezultat (12,5 (IQR = 2,6 – 29,2)) u usporedbi s onima koji su nosili maske kraće od 6 sati na dan (6,25 (IQR = 0 – 22,92); Mann-Whitneyjev U test, p = 0,066) Multivarijabilna logistička regresija otkrila je sljedeće moguće čimbenike rizika za samoprijavljeni MADE: dob (stariji od 61 godine) OR:3,522 (95 % CI 1,448 – 8,563); p = 0,05 i nošenje maske za lice dulje od 6 sati na poslu OR: 1,779 (95 % CI 1,017 – 3,113); p = 0,044. **Zaključak:** Čini se da je prevalencija samoprijavljenog MADE-a među stomatolozima značajna. Dulje korištenje maske za lice tijekom rada povećava OSDI rezultate.

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References

1. Daniel Nelson JD, Craig JP, Akpek EK, Azar DT, Belmonte C, Bron AJ, et al. TFOS DEWS II introduction. Ocul Surf. 2017 Jul;15(3):269-275.
2. Stapleton F, Alves M, Bunya VY. TFOS DEWS II Epidemiology Report. Ocul Surf. 2017 Jul;15(3):334-365.
3. Uchino M, Dogru M, Uchino Y, Fukagawa K, Shimmura S, Takebayashi T, et al. Japan Ministry of Health study on prevalence of dry eye disease among Japanese high school students. Am J Ophthalmol. 2008 Dec;146(6):925-9.e2.
4. Zhang Y, Chen H, Wu X. Prevalence and risk factors associated with dry eye syndrome among senior high school students in a county of Shandong Province, China. Ophthalmic Epidemiol. 2012 Aug;19(4):226-30.
5. World Health Organization. Modes of transmission of virus causing COVID-19: implications for IPC precaution recommendations. [Internet]. 2020 Apr 3.Available from: https://www.who.int/news-room/commentaries/detail/modes-of-transmission-of-virus-causing-covid-19-implications-for-ipc-precaution-recommendations
6. Adam M, Urbančič-Rak T, Crnić T. Dental Students' Discomfort and Anxiety During the First and the Second Lockdown Due to COVID-19 Pandemic at the School of Dental Medicine, University of Zagreb. Acta Stomatol Croat. 2021 Jun;55(2):186-197.
7. Brkić H. Dental medicine and COVID-19 pandemic. Acta Stomatol Croat. 2020 Jun;54(2):118-120.
8. https://civilnazastita.gov.hr/UserDocsImages/CIVILNA%20ZA%C5%A0TITA/PDF_ZA%20WEB/Odluka%20maske%20-%20za%20RCZ.pdf
9. Moshirfar M, West WB, Marx DP. Face mask-associated ocular irritation and dryness. Ophthalmol Ther. 2020;9:397–400.
10. White DE. MADE: A new coronavirus-associated eye disease. Healio.com. [Internet]. 2020 Jun 22. Available from: https://www.healio.com/news/ophthalmology/20200622/blog-a-new-coronavirus-associated-eye-disease
11. Practitioners Should Be Aware of Mask-Associated Dry Eye (MADE). [Internet]. 2020 Jun 22. Available from: https://eyewire.news/articles/core-alerts-practitioners-to-mask-associated-dry-eye-made/
12. Craig JP, Nichols KK, Akpek EK, Caffery B, Dua HS, Joo CK, et al. TFOS DEWS II Definition and Classification Report. Ocul Surf. 2017 Jul;15(3):276-283.

13. Okumura Y, Inomata T, Iwata N, Sung J, Fujimoto K, Fujio K, et al. A Review of Dry Eye Questionnaires: Measuring Patient-Reported Outcomes and Health-Related Quality of Life. Diagnostics (Basel). 2020 Aug 5;10(8):559
14. Krolo I, Blazeka M, Merdzo I, Vrtar I, Sabol I, Petric-Vickovic I. Mask-Associated Dry Eye During COVID-19 Pandemic-How Face Masks Contribute to Dry Eye Disease Symptoms Med Arch. 2021 Apr;75(2):144-148.
15. Stapleton F, Alves M, Bunya VY, Jalbert I, Lekhanont K, Malet F, et al. TFOS DEWS II Epidemiology Report. Ocul Surf. 2017 Jul;15(3):334-365.
16. https://www.hkdm.hr/pic_news/files/pdf/2019/strategija-dent-medicine-2017-2025.pdf
17. Liu X, Zhang S. COVID-19: Face masks and human-to-human transmission. Influenza Other Respir Viruses. 2020 Jul;14(4):472-473.
18. Xerez J, Neto H, Lopes F. Profile of dental students about biosafety. Rev Fac Odontol Porto Alegre. 2012;53(1):11-15.
19. CDC. Recommended infection-control practices for dentistry. MMWR 2003;1-61
20. World Health Organization. Novel Coronavirus (2019-nCoV) Situation Report-1. . [Internet]. 2020 Jul 20. Available from: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200121-sitrep-1-2019-ncov.pdf?sfvrsn=20a99c10_4
21. World Health Organization. Report of the WHO-China Joint Mission on Coronavirus Disease 2019 (COVID-19). [Internet]. 2020 Jul 22. Available from: fihttps://www.who.int/docs/default-source/coronaviruse/who-china-joint-mission-on-covid-19-nal-report.pdf
22. Benitez J. On the use or not of masks, as uncertain as the new coronavirus. Rev Exp Med. 2019;5(3):120-121.
23. Isaacs D, Britton P, Howard-Jones A, et al. Do facemasks protect against COVID-19? J Paediatr Child Health. 2020 Jun;56(6):976-977.
24. Azzam SH, Nama A, Badarni H, Asael H, Dahoud WA, Mimouni M, Zayyad H. Assessment of dry eye disease in N95 versus surgical face mask wearers during COVID-19. Indian J Ophthalmol. 2022 Mar;70(3):995-999.
25. Shalaby HS, Eldesouky MEE. Effect of facemasks on the tear film during the COVID-19 pandemic. PLoS One. 2022 Nov 16;17(11):e0277803.
26. Itokawa T, Okajima Y, Iwashita H, Koji K , Suzuki T, Hori Y. Association between mask-associated dry eye (MADE) and corneal sensations. Sci Rep. 2023;13:1625.
27. Motwani R, Janti SS, Ganji V, Mali KR, Yadav K, Patnaik N, Morya AK. Face Mask in COVID-19 and Its Association With Dry Eye Disease: A Cross-Sectional Study. Cureus. 2022;14:e32937.
28. Boccardo L. Self-reported symptoms of mask-associated dry eye: A survey study of 3,605 people. Cont Lens Anterior Eye. 2002;45(2):101408
29. Esen Baris M, Guven Yilmaz S, Palamar M. Impact of prolonged face mask wearing on tear break-up time and dry eye symptoms in health care professionals Int Ophthalmol. 2022 Jul;42(7):2141-2144.
30. Dag U, Çaglayan M, Öncül H, Vardar S, Alaus MF. Mask-associated Dry Eye Syndrome in Healthcare Professionals as a New Complication Caused by the Prolonged Use of Masks during Covid-19 Pandemic Period. Ophthalmic Epidemiol. 2022 Mar 18;1-6.
31. Alsulami RA, Alotaibi R, Alsulami G, Alharbi R, Alamoudi R, Badeeb NO, Al Kadi H. Effects of Face-Mask Use on Dry Eye Disease Evaluated Using Self-Reported Ocular Surface Disease Index Scores: A Cross-Sectional Study on Nurses in Saudi Arabia. Cureus. 2022 Dec 28;14(12):e33071.
32. Truong S, Cole N, Stapketon F, Golebiowski B. Seks hormones and the dry eye. Clin Exp Optom. 2014 Jul;97(4):324-36.
33. Farrand KF, Fridman M, Stillman IO, Schaumberg DA. Prevalence of Diagnosed Dry Eye Disease in the United States among Adults Aged 18 Years and Older. Am J Ophthalmol 2017;182:90–98.
34. Smidt D, Torpet LA, Nauntofte B, et al. Associations between oral and ocular dryness, labial and whole salivary flow rates, systemic diseases and medications in a sample of older people. Community Dent Oral Epidemiol. 2011 Jun;39(3):276-88.
35. Kalkan Akcay E, Akcay M. The effect of antihypertensive therapy on dry eye disease. Cutam Ocul Toxicol. 2015;34:117-23.
36. Garcia Ayuso D, Di Pierdomenico J.Assessment of dry eye symptoms among university students during the COVID-19 pandemic. Clin Exp Optom. 2022 Jul;105(5):507-513.
37. Hyon JY, Yang HK, Han SB. Dry Eye Symptoms May Have Association With Psychological Stress in Medical Students. Eye Contact Lens. 2019 Sep;45(5):310-314.
38. García-Ayuso D, Escámez-Torrecilla M. Influence of the COVID-19 pandemic on contact lens wear in Spain. Cont Lens Anterior Eye. 2021 Jun;44(3):101351
39. Vianya-Estopa M, Garcia-Porta N. Contact lens wear and care in Spain during the COVID-19 pandemic. Cont Lens Anterior Eye. 2021 Oct;44(5):101381
40. Stapleton TFOS II, Schiffman RM, Christianson MD. Reliability and validity of the Ocular Surface Disease Indeks. Arch Ophthalmol. 2000 May;118(5):615-21.