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Clinical study

The impacts of masks and disinfectants on migraine patients in the COVID-19 pandemic

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ABSTRACT

Since the onset of the COVID-19 pandemic, the use of personal protective equipment (PPE) and disinfectants has become necessary to prevent transmission of the virus. However, the effects of such pandemic obligations on chronic diseases such as migraine have not been fully elucidated. We aimed to investigate the effects of the COVID-19 pandemic, as well as the use of masks and disinfectants, on migraine patients. A total of 310 migraine patients were included. Demographic data, migraine characteristics, and mask and disinfectant use were obtained through a face-to-face survey. Patients were grouped as worsening, stable, or improving according to pre-pandemic and pandemic migraine characteristics. Migraine worsening was found in 177 (57.1%) patients, stable course in 96 (31%) patients, and improvement in 37 (11.9%) patients. The use of scalp contact masks and double masks and daily mask duration were higher in the worsening group (p:0.005, p:0.005 and p:0.001). In addition, the frequency of personal disinfectant use was higher in this group (p:0.011). In regression analysis, mask type, daily mask duration, presence of allodynia, being a health worker, depression score, and odor were determined as independent risk factors for migraine worsening. We found a worsening of migraines in more than half of patients during the COVID-19 pandemic. We also demonstrated a relationship between migraine worsening and mask type, number of masks, and intensive disinfectant use. Migraine patients should be advised of optimal prevention methods based on individual social and working conditions rather than exaggerated preventative measures.

1. Introduction

The coronavirus disease 2019 (COVID-19) has become a worldwide health problem since its detection in November 2019 [1]. At present, it is not possible to fully predict the impacts and consequences on chronic diseases of either this global threat itself or the pandemic restrictions. However, it is well understood that COVID-19 has significant effects on patients with chronic diseases that require regular follow-up and treatment [2,3].

Migraine is a complex chronic neurovascular disease characterized by a usually episodic throbbing headache accompanied by photophobia, phonophobia, vasomotor symptoms, motor, and visual sensory disturbances [4]. Considering that migraine is one of the five most disability causing diseases in the world, it is essential to clarify the interaction between migraine and the COVID-19 pandemic [5].

A few recent studies have investigated the effects of COVID-19 pandemic restrictions on migraine patients [6–10]. Some authors have reported a decrease in the frequency and severity of the headache and also a decrease in the need for acute medication in migraine patients following the complete lockdown. They suggested that this positive effect may be due to the reduction in stress factors and daily challenges [7,9–11]. Other authors have reported worsening effects of the COVID-19 pandemic on migraine. They claim that this migraine worsening may originate from increased stress, insomnia, and changes in lifestyle habits [6,8,12]. The reasons for these differing results have not been fully revealed yet.

During the COVID-19 pandemic, the widespread use of personal protective equipment and disinfectants has become a standard approach to protect against the transmission of the virus. A few studies involving healthcare providers have demonstrated that PPEs, especially masks, cause de novo headache in persons with and without migraine [13,14]. However, due to the inadequacy of the data in current studies, it remains an interesting issue how the widespread use of PPE and disinfectants within the scope of

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long-lasting pandemic restrictions will affect the clinical course of patients with migraine.

In this study, we thus aimed firstly to determine the changes in migraine severity, attack frequency, and medication use at the end of the first year of the COVID-19 pandemic, and secondly to investigate whether mask types and disinfectant usage frequency had an effect on migraine characteristics.

2. Methods

This study was conducted in Ankara City Hospital, between May 2021 and July 2021. The complete lockdown was applied in the first 15 days of the patient admission period. Pandemic restrictions, including social distance and masks, were applied throughout Turkey in the study's remaining two and a half months. A total of 310 consecutive migraine patients, 280 (90.3%) female and 30 (9.7%) male, in the neurology outpatient clinic, were included in the study during their routine visits. Migraine diagnosis was made by trained neurologists according to the criteria of the International Classification of Headache Disorders, 3rd edition (ICHD-3) [15]. Patients with a diagnosis of migraine less than two years were excluded from the study. Also, patients with organic brain disease, cognitive impairment, and active COVID-19 infection were not included in the study.

All migraine patients participating in the study were questioned face to face by expert neurologists and questionnaire forms were completed during this interview. The following data were obtained from questionnaire forms:

2.1. Demographic data and medical history

Age, gender, education level, comorbidities, medication, smoking, and alcohol habits were recorded.

Beck Depression Inventory (BDI), Beck Anxiety Inventory (BAI), and the 12-item allodynia symptom checklist (ASC-12) were obtained.

2.2. Migraine characteristics

Following information about migraine characteristics was obtained from the patient by an expert neurologist in a single session:

The patients were asked about migraine frequency (per month), the number of migraine days (per month), migraine attack duration (hours), and headache severity (based on visual analog score (VAS) between 0 and 10) in the before pandemic and recorded.

In the same session, the patients were asked about migraine frequency, the number of migraine days, migraine attack duration, and headache severity at the end of the first year of the pandemic.

The following calculations for migraine characteristics were made for each patient:

Difference of migraine frequency = migraine frequency at the end of the first year of the pandemic − migraine frequency before the pandemic.

Difference of migraine days = migraine days at the end of the first year of the pandemic − migraine days before the pandemic.

Difference of migraine attack duration = Migraine attack duration at the end of the first year of the pandemic − attack duration before the pandemic.

Difference of headache severity = Headache severity at the end of the first year of the pandemic − headache severity before the pandemic.

If at least one of these migraine characteristic differences increased, the patient was included in the worsening migraine group.

If there was no or minimal change in any of these migraine characteristic differences, the patient was included in the stable migraine group.

While there was no increase in any of these migraine characteristic differences, if at least one of them decreased, the patient was included in the improving migraine group.

We sought to determine the duration of the disease, migraine trigger, medications used in the acute and preventive migraine treatment, and whether the migraine type was with or without aura.

We sought to determine whether there was an increase in the dose of medications used in acute and preventive migraine treatment compared to the before pandemic.

2.3. Evaluation of used mask types and exposure to disinfectants during the COVID-19 pandemic

We asked whether they had ever had COVID-19 infection.

We recorded their occupation types (unemployed, work from home (home-office), part-time or full-time). They were asked whether they were health workers or not.

We recorded the number of masks and mask types (surgical mask or N95 respirator masks with occipital or pre-auricular elastic head straps) and the daily usage times of this equipment.

They were asked whether they used disinfectant. If they did, the frequency was asked (use or exposure 1–3 times a day was considered moderate, and use or exposure more than three times a day was considered excessive).

This prospective study was approved by the local ethical committee (Ankara City Hospital Ethics Committee).

2.4. Statistical analyses

All statistical analyses were done using IBM SPSS statistic 22.0 (Chicago, IL, USA). Data were expressed as mean ± SD. Since the distribution of the variables in our study was not normal, the Kruskal-Wallis test was used to compare the continuous variables of the three study groups. When a significant p value was determined for any parameter in the Kruskal-Wallis test, the Mann-Whitney *U* test was used for pairwise comparisons. Categorical variables were compared using the Chi-Square test. In order to determine the independent factors associated with worsening of migraine during the pandemic period, binary logistic regression analysis was performed using variables including migraine type, occupation type, odor, frequency of disinfectant usage, allodynia, mask type, duration of mask use, preventive treatment, BDI and BAI scores. A p-value < 0.05 was considered statistically significant.

3. Results

Considering all migraine patients, migraine frequency, the number of days with migraine, duration of attacks, and severity of headache increased significantly in the pandemic period compared to the pre-pandemic period (Table1).

An increase in any of migraine frequency, migraine days per month, migraine attack duration, or headache severity was defined as the worsening migraine group (177 patients, 57.1%), while no or minimal change in any of these parameters was defined as the stable migraine group (96 patients, 31%). On the other hand, while none of these parameters increased, a decrease in at least one of them was accepted as the improving migraine group (37 patients, 11.6%) (Table2). In the worsening migraine group, an increase in the frequency of migraine (153/177) and the number of days with migraine (158/177) was observed most frequently, while prolon-

Table 1
Migraine characteristics at pre-pandemic and pandemic periods.

	Pre-pandemic period n:310	Pandemic period n:310	p
Attack frequency (per month)	3.92±3.39	5.11±4.20	0.001
Migraine days (per month)	5.37±4.42	7.52±5.75	0.001
Attack duration (hours)	31.50±20.80	35.36±22.65	0.001
≤12 h	94 (30.6%)	79 (25.7%)	
13–24 h	116 (37.8%)	105 (34.2%)	
25–48 h	51 (16.6%)	57 (18.6%)	
48–72 h	36 (11.7%)	46 (15.0%)	
>72 h	10 (3.3%)	20 (6.5%)	
Headache severity	7.44±1.74	8.01±1.78	0.001

Table 2
Migraine state by difference between pandemic and pre-pandemic periods.

Worsening migraine group	**n: 177 (57.1%)**
Increased migraine frequency	*n:153 (49.4%)*
Increased migraine days	*n:158 (51.0%)*
Increased migraine attack duration	*n:62 (20.2%)*
Increased headache severity	*n:118 (38.1)*
Stable migraine group	**n: 96 (31.0%)**
Improving migraine group	**n: 37 (11.9%)**

gation in the duration of the attack (62/177) was observed in fewer patients (Table2).

During the pandemic period, 176 (56.8%) patients reported an increase in the consumption of painkillers and 96 (31%) patients in migraine-specific medication.

There were no significant differences between the groups in terms of age, gender, educational status, occupation type, being a health worker, alcohol usage, and smoking habits. The groups were comparable in terms of neurological, psychological, and other comorbidities. The frequency of diagnosis of COVID-19 was similar between groups (Table3).

The BDI score in the worsening migraine group was higher than the stable and improving migraine group, but there was no statistical difference. There was a significant difference between the groups in terms of BAI score (p:0.045). BAI score was significantly higher in the worsening group than in the stable group (p:0.014). Allodynia was more common in the worsening group than in the stable and improving groups (p:0.006 and p:0.090). It was similar in the stable and improving groups (Table3).

The groups were comparable in terms of migraine type, diagnosis age of migraine, and migraine duration. Migraine preventive treatment was more common in the improving group than in the worsening and stable groups (both p:0.006), but there was no difference between the worsening and stable groups (Table4).

While the frequency of odor as a migraine trigger was higher in the worsening group compared to the stable and improving groups (p:0.028 and p:0.038), there was no difference between the stable and improving groups (Table4).

The frequency of disinfectant usage was significantly higher in the worsening group than the stable group (p:0.011), but did not differ between the improving group and either worsening or stable groups. There was no difference between the groups in terms of excessive use of disinfectant at home. Although excessive use of disinfectants in the workplace was more common in the worsening group than in the stable and improving groups, the difference was not significant (Table4).

The use of scalp contact masks and double masks was more common in the worsening group than in the stable (p:0.035 and p:0.007) and improving groups (p:0.004 and p:0.018), but there were no differences between the stable and improving groups (Table4).

While the duration of mask use per day was higher in the worsening group compared to the stable and improving groups (p:0.001 and p:0.027), there was no difference between the stable and improving groups (Table4).

In binary logistic regression analysis, mask type, duration of mask use, presence of allodynia, being a health worker, BDI score, and odor were determined as independent risk factors for migraine worsening in the pandemic period (Table5).

4. Discussion

We identified migraine worsening in more than half of our patients during the pandemic period, and found a reduction in migraine severity in only one-tenth. We determined that migraine worsening was associated with wearing a mask for a long time and using scalp contact masks and double masks. Patients whose migraine was triggered by odor had a higher incidence of migraine worsening. We determined that excessive disinfectant use is one of the causes of migraine worsening. In addition, depression and being a health worker appeared as risk factors for migraine activation in the pandemic period.

The first studies after the COVID-19 pandemic revealed that migraine patients could not regularly go to their follow-up check-ups in hospitals due to pandemic restrictions. There were, however, significant differences between the results of the studies [6,7,10,12]. Some studies have reported that pandemic restrictions affect migraine patients positively and cause a decrease in migraine severity and frequency. They claimed that total lockdown caused an improvement in migraine by reducing stress factors that could trigger a migraine attack, such as heavy working conditions, traffic, and crowded and undesirable social environments [7,9–11].

The impact and consequences of pandemic restrictions are not the same in all societies. The pandemic affects countries differently based on economic, socio-cultural, and existing health systems. In a study in Kuwait, a significant proportion of migraine patients during the pandemic showed an increase in migraine severity and frequency. They also detected anxiety and depression in a large number of their patients. They claimed that migraine worsening was associated with sleep disturbance, changes in eating habits, lack of contact with the neurologist, non-adherence to treatment, work during the pandemic, and increased anxiety and depression [6].

Studies from Japan and Spain have also shown that pandemic lockdown leads to migraine worsening because of an increase in stress. However, the impact of pandemic restrictions does not only differ from country to country [8,12], as even in the same society, they can lead to different effects over time. In a study in Italy, the authors stated that restrictions during the first wave of the pandemic led to a reduction in migraine attacks because of a reduction in stress [7]. However, in the second study conducted by the same authors during the second wave, they found that the prolonged pandemic period increased stress and worsened migraines [16]. In our research, conducted at the end of the first year of pandemic restrictions, we demonstrated that increased depression and anxiety were associated with migraine worsening.

Haghdoost et al. stated that there was an increase in migraine frequency during the pandemic period. However, they claimed that the increase in migraine frequency could not be explained by changes in the most common migraine triggers, such as stress and lack of sleep [17]. Indeed, the COVID-19 pandemic restrictions have brought with them a very broad portfolio of risk factors for migraine activation. Since SARS-CoV-2 spreads mainly through respiratory droplets, the necessity of using PPE, especially masks, came to the fore to prevent transmission [18]. Meanwhile, a wide variety of mask types, face shields, and protective glasses were introduced to the market. Some of the masks make breathing dif-

Table 3
Demographic and clinical parameters in migraine groups.

	Improving group n:37	Stable group n:96	Worsening group n:177	p
Age	40.43±11.88	39.79±10.99	37.50±10.51	0.132
Gender				
Female	33 (89.25%)	88 (91.7%)	159 (89.8%)	0.860
Male	4 (10.8%)	8 (8.3%)	18 (10.2%)	
Education				
Elementary school	8 (21.6%)	28 (29.2%)	33 (18.6%)	
Middle school	3 (8.1%)	7 (7.3%)	14 7.9%)	0.634
High school	10 (27.0%)	24 (25.0%)	46 (26.0%)	
University	16 (43.2%)	37 (38.5%)	84 (47.5%)	
Occupation type				
Unemployed	22 (59.5%)	65 (67.7%)	97 (52.7%)	
Work from home	1 (2.7%)	2 (2.1%)	2 (1.1%)	0.475
Part-time	2 (5.4%)	5 (5.2%)	12 (6.8%)	
Full-time	12 (32.4%)	24 (25.0%)	66 (37.3%)	
Health workers	6 (16.2%)	15 (15.6%)	32 (18.1%)	0.656
Alcohol	1 (2.7%)	3 (3.1%)	8 (4.5%)	0.787
Smoking	9 (24.3%)	23 (24.0%)	36 (20.3%)	0.735
Comorbidities				
Neurological comorbidity	3 (8.1%)	6 (6.3%)	6 (3.4%)	0.353
Psychological comorbidity	7 (18.9%)	5 (5.2%)	13 (7.3%)	0.057
Hypertension	4 (10.8%)	12 (12.5%)	17 (9.6%)	0.760
Hyperlipidemia	4 (10.8%)	5 (5.2%)	11 (6.2%)	0.490
Cardiovascular diseases	1 (2.7%)	7 (7.3%)	3 (1.7%)	0.070
Diabetes mellitus	3 (8.1%)	4 (4.2%)	10 (5.6%)	0.663
Chronic pulmonary disease	1 (2.7%)	2 (2.1%)	5 (2.8%)	0.933
Thyroid disease	2 (5.4%)	5 (5.2%)	5 (2.8%)	0.544
Miscellaneous	2 (5.4%)	4 (4.2%)	8 (4.5%)	0.954
COVID-19 diagnosis	8 (21.6%)	19 (26.4%)	45 (25.4%)	0.558
BDI score	13.51±9.07	12.64±9.11	15.06±9.62	0.086
BAI score	16.92±10.62	15.91±13.33	19.15±12.78	**0.045***
Allodynia (ASC-12)	19 (51.4%)	47 (49.0%)	117 (66.1%)	**0.011***

ASC-12:12-item allodynia symptom checklist, **BDI:** Beck Depression Inventory, **BAI:** Beck Anxiety Inventory, *significant difference between worsening group and stable group, †significant difference between worsening group and improving group, ‡significant difference between stable and improving group

ficult even in normal daily activities, and these effects become more pronounced during periods of effort. Some masks exert pressure on the face and certain points of the scalp, causing discomfort as well as effects on the neural and vascular systems [18–20]. Although the disease has been known since ancient times, the pathophysiology of migraine has not been clearly revealed [4]. Thus, it is not yet known how all these complex effects in COVID-19 will affect migraine activation.

A study involving healthcare workers reported that the use of N95 masks and protective eyewear developed de novo headache in patients. Factors such as mechanical compression, hypoxemia, and hypercarbia triggered by PPEs have been blamed for the pathogenesis of headache. The authors suggested that this equipment could trigger neural activity by stimulating the trigeminal and occipital nerve endings through compression and peripheral sensation [13]. In another study, N95 masks were shown to alter cerebral hemodynamics [21]. Considering the role of activation of the trigeminovascular system in the pathophysiology of migraine [4,22], it can theoretically be suggested that PPEs may lead to migraine activation. The few studies evaluating the effects of PPEs on headache included a limited number of migraine patients, all healthcare providers [13,14]. No studies evaluate the impact of PPEs on patients reflecting the overall migraine population in the COVID-19 pandemic. We found that scalp contact masks, especially N95, worsened migraine in our study group, which was reflective of the general migraine population. We also demonstrated that double mask use and increased daily mask use were associated with increased migraine activation. In addition, the frequency of allodynia was significantly higher in our patients whose migraine worsened. Dos Santos et al. reported that the use of PPE caused refractory headache in a migraine patient with allodynia [23]. Therefore, it should be kept in mind that PPEs may have increased the severity of migraine through allodynia in addition to the previously mentioned mechanisms.

Healthcare providers frequently use disinfectants and antiseptics to prevent the spread of infection. However, before the COVID-19 pandemic, humankind had not witnessed such intense use of these materials by such huge masses of people. Disinfectants are not innocent chemicals free from side effects, and respiratory and skin diseases due to disinfectants have been frequently reported over time. Although the effects on the nervous system have not been studied in detail, headache due to disinfectants has been reported in a handful of studies [24–26]. The lack of studies investigating the relationship between disinfectants and migraine in the literature is an important deficit. Our study revealed that personal intensive use of disinfectants was associated with migraine worsening. We have also determined that patients with worsening migraines are exposed to intense use of disinfectants at their workplace. The design of our study was insufficient to show how disinfectants cause the worsening of migraine. However, disinfectant odors may be one of the possible causes in patients whose migraine is triggered by odor, which is one of the most common migraine triggers [27]. We found that migraine worsening was more common among our patients whose migraine was triggered by odor.

The strengths of our study were as follows; firstly, our study is a face-to-face survey study conducted with a significant number of migraine patients. Secondly, it is one of the first studies to investigate the effect of masks and disinfectant use on the general migraine population. Thirdly, since the study was conducted at the end of the first year of pandemic restrictions, it provides important data on how migraine patients are affected by long-term restrictions.

Table 4
Use of masks and disinfectants in migraine groups and characteristics of migraine.

	Improving group n:37	Stable group n:96	Worsening group n:177	p
Migraine type				
with aura	24 (64.9%)	72 (75.0%)	125 (70.6%)	0.489
without aura	13 (35.1%)	24 (25.0%)	52 (29.4%)	
Diagnosis age of migraine	27.97±4.57	27.45±8.55	26.56±4.60	0.654
Duration of migraine (years)	11.08±8.81	12.37±9.42	11.07±8.85	0.650
Migraine preventive treatment				
Absent	19 (51.4%)	73 (76.0%)	131(74.0%)	0.011†‡
Present	18 (48.6%)	23 (24.0%)	46 (26.0%)	
Propranolol	*3*	*3*	*10*	
Flunarizine	-	*3*	*7*	
Amitriptyline HCL	*2*	*9*	*13*	
Escitalopram	*1*	*1*	*2*	
Sertraline	*3*	-	*4*	
Fluoxetine	*2*	-	-	
Venlafaxine	*1*	*4*	*2*	
Paroxetine	-	*1*	-	
Duloxetine	*4*	*2*	*6*	
Topiramate	*2*	-	*2*	
Odor as a migraine trigger	18 (48.6%)	51 (53.1%)	118 (66.7%)	0.028*†
Type of mask				
Surgical mask with pre-auricular strip	32 (86.5%)	72 (75.0%)	110 (62.1%)	0.005*†
Scalp contact masks	5 (13.5%)	24 (25.0%)	67 (37.9%)	
Surgical mask with occipital strip	*3 (8.1%)*	*19 (19.8%)*	*39 (22.0%)*	
N95 mask	*2(5.4%)*	*5 (5.2%)*	*28 (15.9%)*	
Mask number				
One mask	29 (78.4%)	71 (74.0%)	102 (57.6%)	0.005*†
Double mask	8 (21.6%)	25 (26.0%)	75 (42.4%)	
Duration of mask (per day)	3.81±2.44	3.46±2.69	5.017±3.12	0.001*†
< 4 h	19 (51.4%)	67 (69.8%)	67 (37.9%)	
≥ 4 h	18 (48.6%)	29 (30.2%)	110 (62.1%)	
Frequency of use of disinfectants				
No/Moderate	15 (40.5%)	47 (49.0%)	59 (33.3%)	0.040*
Excessive	22 (59.5%)	49 (51.0%)	118 (66.7%)	
Excessive use of disinfectant at home	16 (43.2%)	25 (26.0%)	65 (36.7%)	0.096
Excessive use of disinfectant at work	9 (56.3%)	16 (41.0%)	56 (64.4%)	0.050

*Significant difference between worsening group and stable group, †: Significant difference between worsening group and improving group, ‡: Significant difference between stable and improving group.

Table 5
Independent factors associated with migraine worsening in binary logistic regression analysis.

	p	Exp(B)	%95 CI
Migraine type	0.972	1.010	0.570–1.790
Health worker	**0.004**	4.222	1.571–11.345
Occupation type	0.912	1.015	0.784–1.314
Odor as a migraine trigger	**0.039**	1.718	1.029–2.871
Frequency of disinfectant usage	0.157	1.459	0.8652.462
Allodynia (ASC-12)	**0.036**	1.750	1.038–2.950
Mask type	**0.005**	2.278	1.280–4.057
Duration of mask use per day	**0.001**	1.334	1.165–1.527
Preventive treatment	0.715	0.715	0.407–1.255
Beck depression inventory score	**0.047**	1.035	1.000–1.070
Beck anxiety inventory score	0.689	1.005	0.979–1.032

The limitation of our study was that the majority of our patients did not have a regular migraine diary. Since our patients answered some questions about migraine characteristics from their memories, these answers may have subjectivity. Another limitation of our study is the high number of female patients in the study population. The first reason for this may be that the frequency of migraine in women is twice as high as in men in our country. The second reason may be that women regularly come to their routine migraine controls due to employment conditions.

In conclusion, long-term pandemic obligations adversely affect patients with migraine. Scalp contact masks, double mask use, and long-term use of masks can cause an increase in migraine frequency and severity. Also, intensive disinfectant exposure is another factor that has worsened migraine during the COVID-19 pandemic. For this reason, migraine patients should be directed to use optimal protection methods in terms of mask type, the number of masks, and disinfectant usage frequency, taking into account their working and social life conditions, rather than exaggerated protection methods. Considering that the COVID-19 pandemic will continue to have an impact in the coming years, a personalized optimal protection approach may increase the quality of life and economic efficiency of migraine sufferers, who constitute a substantial patient population.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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