

The Impact of the COVID-19 Pandemic on Primary Headache Disorders with Particular Focus on Migraine Disorders

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Introduction

In December 2019, the first cases of the novel coronavirus “severe acute respiratory syndrome coronavirus 2” (SARS-CoV-2) were recorded in Wuhan, China (Chan et al., 2020). Due to the rapid global spread of SARS-CoV-2, the World Health Organization announced the COVID-19 Pandemic on March 11, 2020. A pandemic on this scale was an exceptional situation. Quarantine and/or lockdown regulations influenced everyday life, routines and living situations of the entire population. This led to widespread isolation, physical separation and the closure of educational institutions, workplaces, and leisure activities (Javed et al., 2020).

Migraine is the second most common causes of global disability (expressed as years lived with disability) in all age groups, and for females aged 15-45 years it remains the most common cause of disability (Steiner et al., 2020). In Germany, the overall headache prevalence is 60.2% with migraine with and without aura around 10.6%, with the number of adult women three times that of adult men (women 15.6%; men 5.3%) (Radtke and Neuhauser, 2009).

Headache disorders mean a recognizable burden for those affected with sometimes considerable personal suffering, reduced quality of life and financial costs. Repeated headache attacks and the constant fear of the next event damage family life, social life and employment. Relevant live events have major influence on the course of disease.

Aim of this study

The COVID-19 pandemic has led to unprecedented professional, societal, and social changes in the daily lives of many individuals in Germany. The aim of this study was to investigate the impact of the COVID-19 pandemic on patients with migraine in Germany. Specifically, changes in headache days and headache intensity were examined in relation to the personal, societal, occupational, physical, and psychological well-being of patients in the context of the COVID-19 pandemic. Additionally, changes in migraine days and the use of acute medication during the pandemic period were analysed. Furthermore, the study aimed to determine whether previously known trigger factors from the literature were confirmed or if new migraine and headache triggers emerged as a result of the pandemic. By separately analysing the data from the first and second waves of the pandemic, insights into wave-specific headache and migraine triggers that could contribute to clinical deterioration were obtained.

Materials and methods

The patient data were collected via a pen-paper questionnaire in the waiting rooms of the west-german headache centre in the University hospital Essen/Germany.

All patients (n=222) were in ongoing treatment and completed the questionnaires during the COVID-19 pandemic. This enabled a prospective insight into the headache situation during the pandemic, as well as a retrospective insight before the pandemic.

Inclusion Criteria were episodic or chronic migraine with at least 4 migraine days per month according to the current International Headache Classification (ICHD-3) diagnostic guidelines, available full clinical data, headache diaries and the completed questionnaires on psychosocial stressors directly related to the COVID-19 pandemic. As well as the absence of Symptoms pointing to a COVID-19 Infection and a negative polymerase chain reaction test (PCR) for the SARS-CoV-2 antigen. Additionally, the sufficient comprehension of the German language was an inclusion criterion. Excluded were questionnaires with deliberate false answers and insufficiently completed questionnaires. Informed consent was obtained from all participants involved in the study. The study was conducted in accordance to the guidelines of the Declaration of Helsinki and approved by the local Ethics Committees of the University Hospital Essen (19-9004-BO).

The socio-demographic data included gender, age, marital status, education level/work/retired status, diagnosis, COVID-19 risk profile, and questions related to known COVID-19 infections in personal or work environment. Other questions were about the impact of the Pandemic; this included information about the impact on the patient's physical and intellectual performance, mental/psychological state, social contacts, financial situation, mobility and future plans. This part of the questionnaire contained dichotomic (Yes/No) questions and Likert-Scales.

The German version of the Perceived Stress Scale -10 (PSS-10) by Schneider et al., assesses the patients' feelings and thoughts during the last month. A classification is then made as to how unpredictable, uncontrollable and overloaded the subjects feel their lives are in the defined period of time. The 10 questions are answered on a scale from 1 to 5 and are defined as follows: 1=never, 2=almost never, 3=sometimes, 4=quite often, 5=very often. The total score is calculated from the sum of the items on the helplessness scale and the sum of the inverted items on the self-reality scale. The maximum achievable score is therefore 40 points, and defines the highest possible stress level.

The paper-and-pencil questionnaire took about 10-20 min to complete. The questionnaire was given to the patients and answered in the waiting rooms prior to the doctor's appointment. After completion, the questionnaire was collected by the staff of the west-german headache centre. The questionnaires were first issued on May 4th, 2020. The goal of n= >200 was reached on June 14, 2021, so the survey was discontinued after about a year.

Data analysis

After the data collection was completed, they were entered into the statistical software "IBM Corp. SPSS Statistics 27" and analysed.

The Kolmogorov-Smirnov test was used to check the normal distribution of our data. It was further checked visually using histograms and bar and scatter plots. Since the data were not normally distributed, only non-parametric tests were used. The ordinal variables were compared using the Spearman rank correlation coefficient (rs). The following applied here: A significance (2-sided) = $p < \text{or} = 0.05$ was interpreted as a statistically significant correlation. A significance (2-sided) = $p > 0.05$ resulted in a non-statistically significant correlation.

Results

A total of 222 registered patients of the west-german headache center of the university hospital Essen participated in this study. A total of 173 female and 49 males were included. The average age of the patients was 39.5 ± 14.4 years with an age range of 14 to 81 years. The participants have a life partner in 52.5% of cases, and the household size averages 2.47 ± 1.35 individuals. 17.6% of all patients live alone. All relevant demographic data, including patient diagnosis and COVID-19 related data are displayed in table 1.

Table 1. Demographic Data

Diagnosis	Patients (n)	Percent (%)
Episodic migraine without aura	58	26.90%
Episodic migraine with aura	29	13.40%
Chronic migraine without aura	82	38.00%
Chronic migraine with aura	47	21.80%
Part of COVID-19 risk group		
Yes	44	21.80%
No	158	78.20%
COVID-19 cases in private environment		
No known cases	188	86.60%
Light course of infection	27	12.40%
Severe course of infection	1	0.50%
COVID-19 infection that led to death	1	0.50%
COVID-19 cases in work environment		
No known cases	169	83.70%
Light course of infection	30	14.90%
Severe course of infection	3	1.50%
COVID-19 infection that led to death	0	0.00%
Work/Education		
University	19	8.80%
School	16	7.40%
Working/ employed	126	58.60%
Unemployed/ other	41	19.10%
Retired	13	6.00%

The monthly headache days (MHD) significantly increased from 14.2 ± 10.1 before the pandemic to 15.3 ± 10.0 during the pandemic ($p < .001$). Monthly migraine days (MMD) increased from 8.5 ± 7.7 to 8.8 ± 8.0 and the intake days of acute medication (MAM) increased from 8.1 ± 7.2 to 8.9 ± 7.5 days per month. Both changes in MMD and MAM were not significant.

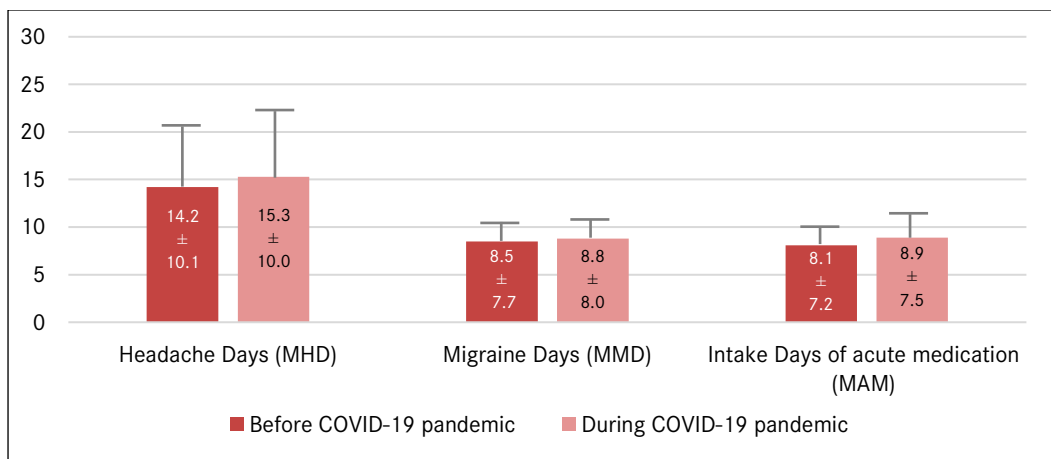


Figure 1. Changes of Monthly Headache Days (MHD), Monthly Migraine Days (MMD) and Intake Days of acute medication (MAM) before and during the COVID-19 Pandemic. (Y-Axis: Days per month)

As shown in table 2, 55.2% of the patients reported no change in the number of monthly headache days before and during the COVID-19 pandemic. An increase in headache days was reported by 36.3% of the patients, while only 8.5% reported a reduction in headache days. The headache intensity remained the same for 59.7% of the patients before and during the COVID-19 pandemic. An increase in headache intensity was observed in 35.9% of the patients, while a reduction was noticed in only 4.4% of all patients.

Table 2. Changes of MHD and headache intensity before and during the COVID-19 pandemic (24.04.2020 until 14.06.2021)

Changes of monthly headache days (MHD)	Patients (n)	Percent (%)
Less	18	8.50%
No changes	117	55.20%
More	77	36.30%
Changes of headache intensity	Patients (n)	Percent (%)
Less	9	4.40%
No changes	123	59.70%
More	74	35.90%

Perceived Stress Scale:

Our migraine patients gave an average score of 29.1 ± 6.6 points. Respectively, EM-patients gave 28.9 ± 6.5 points and CM-patients 29.4 ± 6.8 points.

Correlations:

All migraine patients in younger age groups, especially those with episodic migraine, experienced higher headache intensity. Patients without a spouse/partner showed higher headache intensity compared to patients with a partner. Patients living alone with chronic migraine had more headache days compared to patients living in shared households. Patients with chronic migraine and known COVID-19 cases in their professional environment experienced increased headache days and headache intensity. All migraine patients with COVID-19 cases in their private environment suffered from more frequent headache days. All migraine patients with reduced physical performance had increased headache days. The same applies to patients with chronic migraine and reduced physical performance. Patients with chronic migraine and reduced intellectual performance experienced stronger headaches. Patients with chronic migraine and

reduced psychological well-being had increased headache days and higher headache intensity. Patients with episodic migraine and more social contacts during the pandemic had increased headache intensity. While patients with chronic migraine and worsening of social contacts had increased headache days and stronger headache intensity. Patients with chronic migraine and less time for physical activity experienced headaches more frequently. Patients with chronic migraine and limited mobility during the pandemic had higher headache intensity. More detailed correlation data is shown in table 3.

Table 3. Correlations

		Headache:	Correlation Coefficient (rs)	Sig. (p)	n
Age	All Patients	Days			
		Intensity	-.168*	.016	206
	Episodic Migraine	Days			
		Intensity	-.259*	.019	81
	Chronic Migraine	Days			
		Intensity			
Patients with spouse	All Patients	Days			
		Intensity	-.138*	.049	205
	Episodic Migraine	Days			
		Intensity			
	Chronic Migraine	Days			
		Intensity			
Patients living alone	All Patients	Days			
		Intensity			
	Episodic Migraine	Days			
		Intensity			
	Chronic Migraine	Days	.178*	.048	124
		Intensity			
COVID-19 cases in work environment	All Patients	Days			
		Intensity			
	Episodic Migraine	Days			
		Intensity			
	Chronic Migraine	Days	.229*	.013	117
		Intensity	.197*	.038	112
COVID-19 cases in private environment	All Patients	Days			
		Intensity	-.146*	.035	209
	Episodic Migraine	Days			
		Intensity			
	Chronic Migraine	Days			
		Intensity			
Impact of the COVID-19 pandemic on: Physical capability	All Patients	Days	-.161*	.023	198
		Intensity			
	Episodic Migraine	Days			
		Intensity			
	Chronic Migraine	Days	-.285**	.002	119
		Intensity	-.315**	.001	114
Impact of the COVID-19 pandemic on: Intellectual capability	All Patients	Days			
		Intensity			
	Episodic Migraine	Days			
		Intensity			
	Chronic Migraine	Days			
		Intensity	-.196*	.037	114

Table 3 continued

		Headache:	Correlation Coefficient (rs)	Sig. (p)	n
Impact of the COVID-19 pandemic on: Psychological state/wellbeing	All Patients	Days			
		Intensity			
	Episodic Migraine	Days			
		Intensity			
	Chronic Migraine	Days	-.224*	.014	120
		Intensity	-.219*	.019	115
Impact of the COVID-19 pandemic on: Social contacts	All Patients	Days			
		Intensity			
	Episodic Migraine	Days			
		Intensity	.228*	.044	79
	Chronic Migraine	Days	-.229*	.012	120
		Intensity	-.313**	.001	115
More time for sports	All Patients	Days			
		Intensity			
	Episodic Migraine	Days			
		Intensity			
	Chronic Migraine	Days	-.211*	.021	120
		Intensity			
Impact of the COVID-19 pandemic on: Mobility	All Patients	Days			
		Intensity			
	Episodic Migraine	Days			
		Intensity			
	Chronic Migraine	Days			
		Intensity	-.226*	.015	115

Patients who had their work hours reduced due to the COVID-19 pandemic experienced an increase in headache days. Patients with episodic migraine and reduced work hours also had increased headache days. All migraine patients who provided home-schooling for their children during the pandemic experienced an elevated number of headache days. Patients with chronic migraine in the same situation had an increase in headache days and higher headache intensity.

All patients who provided home-schooling for their children during the pandemic had more frequent headache days and greater intensity. In the same situation, patients with chronic migraine also experienced increased headache days and stronger headache intensity. More detailed correlation data is shown in table 4.

Table 4. Work and Family Environment

		Headache:	Correlation Coefficient (rs)	Sig. (p)	n
Forced work reduction	All Patients	Days	-.170*	.023	179
		Intensity			
	Episodic Migraine	Days	-.353**	.002	71
		Intensity			
	Chronic Migraine	Days			
		Intensity			
Home-schooling of children	All Patients	Days	.220*	.013	126
		Intensity			
	Episodic Migraine	Days			
		Intensity			
	Chronic Migraine	Days	.453**	<.001	69
		Intensity	.322**	.007	70

Table 4 continued

		Headache:	Correlation Coefficient (rs)	Sig. (p)	n
Childcare at home	All Patients	Days	.240**	.007	123
		Intensity	.227**	.011	124
	Episodic Migraine	Days			
		Intensity			
	Chronic Migraine	Days	.389**	.001	66
		Intensity	.330**	.006	67

Migraine patients who had fear of own severe COVID-19 infection suffered from more headache days and higher headache intensity. Patients with episodic migraine and the same concerns experienced increased headache days. While patients with chronic migraine had more headache days and stronger headache intensity.

All migraine patients, and patients with EM who were afraid that someone else would become severely ill with COVID-19 suffered from more frequent headaches. All migraine patients who were concerned about financial difficulties experienced increased headache days and higher headache intensity. Patients with chronic migraine and the same concern also had stronger headache intensity.

All participants, especially patients with chronic migraine who had fear of loneliness, suffered from stronger headache intensity. All patients who had fear of being among people (fear of social contacts) during the pandemic reported increased headache days and stronger headache intensity. The same pattern was observed in patients with chronic migraine, while patients with episodic migraine had more headache days. Patients with chronic migraine and more conflicts with their partners experienced more frequent headache days. Patients with episodic migraine who spent more time with their partners had stronger headaches. Patients who had more conflicts with their children reported increased headache days and stronger headaches. Chronic migraine and increased conflicts with children also resulted in more headache days and stronger headache intensity.

All Patients and patients with CM who perceived higher levels of stress (measured by the PSS-10) experienced stronger headache intensity. Only patients who had the optimistic feeling of being capable of dealing with the pandemic had fewer headache days. More detailed correlation data is shown in table 5.

Table 5. Fears and concerns during the COVID-19 Pandemic

		Headache:	Correlation Coefficient (rs)	Sig. (p)	n
Fear of own severe COVID-19 infection	All Patients	Days	.267**	<.001	209
		Intensity	.217**	.002	203
	Episodic Migraine	Days	.356**	.001	80
		Intensity			
	Chronic Migraine	Days	.205*	.023	123
		Intensity	.246**	.007	118
Fear of severe COVID-19 infection of others	All Patients	Days	.140*	.042	210
		Intensity			
	Episodic Migraine	Days	.266*	.017	80
		Intensity			
	Chronic Migraine	Days			
		Intensity			
Financial concerns	All Patients	Days	.170**	.016	202
		Intensity	.177**	.013	196
	Episodic Migraine	Days			
		Intensity			

Table 5 continued

		Headache:	Correlation Coefficient (rs)	Sig. (p)	n
Financial concerns	Chronic Migraine	Days			
		Intensity	.188*	.045	114
Fear of loneliness	All Patients	Days			
		Intensity	.198**	.005	202
	Episodic Migraine	Days			
		Intensity			
Chronic Migraine	Days				
	Intensity	.331**	<.001	117	
Fear of being around people during the pandemic	All Patients	Days	.248**	<.001	209
		Intensity	.205**	.003	203
	Episodic Migraine	Days	.283*	.010	81
		Intensity			
	Chronic Migraine	Days	.237**	.009	122
		Intensity	.254**	.006	117
Optimistic feeling of coping well with the pandemic	All Patients	Days			
		Intensity	-.158*	.024	204
	Episodic Migraine	Days			
		Intensity			
	Chronic Migraine	Days			
		Intensity			
More conflicts with partner/spouse	All Patients	Days			
		Intensity			
	Episodic Migraine	Days			
		Intensity			
	Chronic Migraine	Days			
		Intensity	.214*	.034	99
More time with partner/spouse	All Patients	Days			
		Intensity			
	Episodic Migraine	Days			
		Intensity	.265*	.028	69
	Chronic Migraine	Days			
		Intensity			
More conflicts with own children	All Patients	Days	.216*	.013	130
		Intensity	.251**	.004	130
	Episodic Migraine	Days			
		Intensity			
	Chronic Migraine	Days	.293*	.011	75
		Intensity	.342**	.003	75
Perceived stress (PSS-10)	All Patients	Days			
		Intensity	.222**	.003	175
	Episodic Migraine	Days			
		Intensity			
	Chronic Migraine	Days			
		Intensity	.234*	.018	102

Isolated analysis of first and second COVID-19 pandemic wave:

During the first wave of the pandemic, there were no significant differences in headache days, headache intensity, migraine days, and days of acute medication intake compared to the overall study period. Furthermore, Spearman correlation analysis did not reveal any additional

significant correlations between the assessed life circumstances (or potential headache triggers) and increased headache days or headache intensity.

During the second wave of the pandemic (from November 2, 2020, to January 28, 2021), patients reported either stable or increasing headache days and higher headache intensity compared to the overall study period. Additionally, higher stress levels were measured using the Perceived Stress Scale during the second wave compared to the entire study period with all patients (30.3 ± 6.4 during the second wave versus 28.8 ± 6.8 for the entire study duration).

Patients who experienced a positive financial development due to the COVID-19 pandemic had more frequent and severe migraine headaches. Patients whose employment was reduced due to the COVID-19 pandemic experienced more frequent and severe headaches. More detailed correlation data about the second wave is shown in table 4.0

Table 6. Correlations of isolated second COVID-19 wave

		Headache:	Correlation Coefficient (rs)	Sig. (p)	n
Impact of COVID-19 pandemic on: Financial situation	All Patients	Days	.327*	.030	44
		Intensity	.340*	.027	42
Forced work reduction	All Patients	Days	-.513**	.001	39
		Intensity	-.503**	.002	37

Discussion

This study aimed to examine the impact of the COVID-19 pandemic on individuals with migraine and headache disorders. The findings revealed an overall negative effect, with approximately one-third of patients experiencing a significant increase in headache days and intensity during the pandemic. However, two-thirds of the patients reported no changes in these aspects. There was no significant increase in migraine days or intake of acute medication among the study population.

A study by Al-Hashel and Ismail (2020) found a higher prevalence of severe migraine headaches and increased migraine frequency during the pandemic. They also observed a significant increase in migraine days and the overuse of analgesics. Possible reasons for these findings include inadequate communication with neurologists and a lack of therapy adjustment. In contrast, studies by Ma et al. (2021) and Kato et al. (2021) reported similar worsening of migraine headache days and intensity.

Various factors were detected to have a statistically significant correlation with increased headache days and intensity, including younger age, living alone, reduced physical and intellectual capability, psychological state, reduced social contacts, less time for sports, forced work reduction, home-schooling of kids, fear of infection, financial concerns, conflicts with partners and children, increased stress, and loneliness. On the other hand, having an optimistic feeling of coping well with the pandemic was associated with a significant decrease in headache days.

Loneliness and isolation, which have been amplified by the pandemic, were found to negatively impact headache outcomes, particularly in patients with chronic migraine. Good social support, on the other hand, was associated with less stress, better health, and reduced medication abuse among migraineurs.

Pandemic-related fears and concerns, such as the fear of severe COVID-19 infection, were identified as significant headache triggers. Patients with chronic migraine and reduced physical

performance during the pandemic experienced more frequent and severe headache days. Lack of physical activity due to lockdowns and curfews was associated with reduced physical performance and increased migraine frequency.

In conclusion, the COVID-19 pandemic had a detrimental effect on individuals with migraine and headache disorders, with increased headache days, intensity, and triggers. Factors such as loneliness, pandemic-related fears, reduced physical activity, and stress played significant roles in exacerbating migraine symptoms. Maintaining social support and engaging in regular physical activity may help mitigate the impact of the pandemic on headache outcomes.

The negative impact of the COVID-19 pandemic on the intellectual performance of patients with chronic migraines was found to be associated with a stronger migraine headache in the surveyed individuals.

Younger people seem to be particularly susceptible to these effects (Henneghan et al., 2022). Cognitive impairment is also known to occur in migraine patients outside of the COVID-19 pandemic. However, it is uncertain whether this impairment of intellectual performance is due to the pathophysiological process of migraines, interfering factors such as the use of medications, or comorbidities such as depression (De-Araujo et al., 2021; Vuralli et al., 2018). Whether this tendency is solely attributable to the pandemic or, as Araujo et al. and Vuralli et al. explain, is a result of numerous trigger factors, cannot be determined.

Stress is already known as a major migraine trigger. The impact of the COVID-19 Pandemic on stress has been documented in several studies. Our results fall in line with the literature consensus.

The analysis of the Perceived Stress Scale-10 (PSS-10) demonstrated an increased level of subjective stress throughout the study period of our participants, with even higher levels during the second wave of COVID-19. The increased stress levels also significantly correlated with greater headache intensity in our patients.

Compared to pre-pandemic norms of a representative German population by Klein et al., our migraineurs showed significantly higher levels of subjective stress in the PSS-10 (Klein et al., 2016). A Japanese study also reported elevated stress levels in 56.8% of migraine patients during the COVID-19 pandemic. In 38.3% of patients, the stress levels remained unchanged, and only 5% reported a reduction in stress (Suzuki et al., 2021). Increased stress levels can also be measured in migraine patients outside the COVID-19 pandemic. Thus, stress does not seem to be an exclusive phenomenon of the pandemic but may be exacerbated by pandemic-induced worries, fears, and changes in daily life (Stubberud et al., 2021). Therefore, it is highly likely that migraine patients are particularly exposed to stressors during a pandemic. The pandemic appears to exacerbate the already existing stress experienced by migraine patients.

The separate analysis of the first and second COVID-19 waves revealed a noticeable difference. During the first pandemic wave, no significant differences were observed in headache days, headache intensity, migraine days, and acute medication use compared to the data of the entire study period. No additional correlations were registered between reported headache triggers and increased headache days or headache intensity. Interestingly, the isolated evaluation of the second COVID-19 wave showed a significant increase in headache days and headache intensity. Patients with reduced working hours during the second pandemic wave also experienced stronger and more frequent headaches. Surprisingly, a better financial situation during the pandemic led to more frequent and stronger migraine headaches in our participants. The analysis of the Perceived Stress Scale-10 revealed increased stress levels during the second pandemic wave compared to the entire study period.

The evidence regarding the first wave of COVID-19 does not appear to be conclusive. Some studies, similar to this study, showed no significant effects of the first wave of COVID-19 on headache days and headache intensity (Suzuki et al., 2021; Verhagen et al., 2021). During

the early stages of the pandemic, other studies have reported a significant increase in migraine frequency and intensity among most patients (Al-Hashel and Ismail, 2020). However, a telephone interview study conducted in Italy during the same period found a slight decrease in headache frequency and intensity, contrary to previous studies (Delussi et al., 2020). Differences in study conditions, populations, and social/political situations of the countries involved may explain the significant variations between these four studies and our study.

During the second wave of COVID-19, Gentile et al. found a worsening of headache days, medication use, and headache intensity compared to the first wave and pre-pandemic period. Migraine management did not influence the clinical outcome (Gentile et al., 2021). In contrast, Aleyeidi et al. reported a reduction in headache intensity during the second wave of the pandemic, but elevated stress levels were observed in migraine patients. However, the improvement in headaches does not appear to be significant (Aleyeidi et al., 2021). These findings support the increase in headache days and intensity observed in our study during the second wave. The impact of migraine management on the severity of migraines remains inconclusive. Factors such as lockdowns, financial concerns, and school closures during the second wave may explain the worsening migraine situation (Clemens et al., 2020).

Conclusion

In the context of the COVID-19 pandemic, approximately two-thirds of the participants reported unchanged headache days, while around one-third experienced a significant increase. Migraine days and acute medication intake did not change significantly. Stress, fears, and various physical and psychological factors were associated with worsening of migraine headaches. These findings highlight the negative impact of the pandemic on individuals with migraine disorders. The study emphasizes the diversity of migraine triggers during the pandemic and the continued relevance of stress as a trigger. Consideration of these factors in prevention therapies and patient education is important.

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