

Pediatric Headache Experience During the COVID-19 Pandemic

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Abstract

Objective: Headache disorders are exceedingly common in children and adolescents. The association between headaches, emotional stress, and disruptions in daily routines are well established. The goal of this study is to compare the experiences of patients with a preexisting diagnosis of a primary headache disorder in terms of headache frequency and severity, lifestyle techniques for headache prevention, screen use, and mood from before and after the onset of the COVID-19 pandemic.

Methods: Patients evaluated by the Headache Clinic at Children's National Hospital between Summer 2020 and Winter 2021 were enrolled in a patient registry. Patients completed a questionnaire examining changes in headache characteristics and lifestyle factors since the onset of the COVID-19 pandemic.

Results: A total of 107 patients completed the survey. Since the pandemic's onset, patients reported decreased physical activity ($n = 59$, 55%), increased frequency of chronic headaches from 40% ($N = 42$) to 50% ($N = 54$), and increased constant daily headaches from 22% ($n = 24$) to 36% ($n = 38$). Patients reported worsened anxiety ($n = 58$, 54%), mood ($n = 50$, 47%), and workload ($n = 49$, 46%). Sixty-one percent ($n = 65$) of patients reported using screens for school for more than 6 hours per day. The majority ($n = 67$, 63%) of patients indicated that they would prefer attending in-person school, with 14% ($n = 15$) responding that they preferred online school.

Conclusion: Since the COVID-19 pandemic's onset, pediatric headache patients have experienced increasing headache frequency, worsening anxiety and mood, decreased physical activity, and increased screen usage. Although this study is limited by sample size and observational design, future population-based studies will further elucidate the impact of this pandemic on pediatric headache.

Keywords

pediatric, youth, headache, migraine, psychological functioning, coronavirus-19

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Introduction

Since November 2019, Coronavirus-2019 (COVID-19) has become pervasive in every aspect of human life given its rapid dissemination across the world, and its relatively high mortality rate. Similarly, headache disorders are exceedingly common in the population, and the association between headaches, emotional stress, and disruptions in daily routines has been well established. Youth across the world have experienced significant changes in their day-to-day lives in the face of COVID-19, including social distancing, quarantines, and reliance on home-based virtual schooling.

Headache is the most common neurologic symptom and one of the most prevalent chronic health conditions in the entire population, with migraine affecting the same number of patients as diabetes and asthma combined.¹ Nearly 90% of the population is affected by headache during their lives, with headaches in females being more prevalent throughout the life span.

Specifically, migraine affects approximately one-quarter of females in adolescence² and chronic daily headaches affect nearly 5% of adolescents.³ As exemplified by the National Health and Nutritional Examination Survey data from 1999-2004, 17% of children between 4 and 18 years of age experienced frequent or severe headaches in the prior 12 months. In the Centers for Disease Control and Prevention-sponsored National Health Inventory Study, the annual

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prevalence of pediatric patients with severe and frequent headaches remained around 6% between 2007 and 2015, whereas the disability due to headache increased nearly 50% in this same time period.⁴

The environmental and psychosocial changes related to quarantine and COVID-19 disease mitigation is likely to have significant effects on headache. As is true during school holidays, weekends, and summer breaks, changes to daily schedule, reduced social interactions, and decreased opportunities for exercise and movement are risk factors for disrupted healthy lifestyle habits, which may contribute to changes in headache frequency for pediatric patients.⁵ Similar to other major stressful life events, the impact of COVID-19 may exacerbate headaches and worsen psychological strain.⁶

The goal of this study is to compare the experiences of patients with a preexisting diagnosis of a primary headache disorder in terms of headache frequency and severity, lifestyle techniques for headache prevention, screen use, and mood from before and after the onset of the COVID-19 pandemic.

Methods

Participants evaluated in the Headache Clinic at Children's National Hospital between Summer 2020 and Winter 2021 and were enrolled in an IRB-approved patient registry. Patients obtain an appointment in the Headache Clinic by calling or emailing a scheduling line and do not require prior evaluation by a neurologist or referral from a pediatrician. Patients seen in the clinic therefore are a mix of new and established patients and carry a wide variety of diagnoses based on their presenting clinical symptoms. Participants were asked to complete the internally designed survey "Impacts of the COVID-19 Pandemic on Headaches, Stressors, and Anxiety Questionnaire," which examined the changes in headache characteristics and lifestyle factors following the onset of the COVID-19 pandemic (Table 1). Specifically, patients were asked 30 questions detailing changes in their sleep, screen time, and lifestyle habits as well as their stress, anxiety, and mood before and during the COVID-19 pandemic.

The survey was distributed using a Research Electronic Data Capture (REDCap), a secure online data collection system. The information collected from the REDCap surveys was then de-identified. Data were analyzed by question, reporting demographics, diagnoses, and the frequencies each participant answered, to understand the impact of the COVID-19 pandemic on patients with pediatric headache.

Results

Of the 153 patients invited to participate in the survey, 107 completed the questionnaire. Of the 107 participants, the majority ($n = 64$, 60%) of patients self-identified as female. Among these patients, 23% ($n = 25$) were younger than 12 years, 63% ($n = 67$) were between 12 and 17 years old, and 16% ($n = 15$) were older than 17 years (Table 2).

The most common headache diagnoses were chronic migraine ($n = 40$, 37%), migraine with aura ($n = 26$, 24%), migraine without aura ($n = 18$, 17%), and new daily persistent headache ($n = 18$, 17%). In regard to headache frequency before the pandemic, 60% ($n = 65$) of patients reported having headache <15 days of the month compared to 40% ($n = 42$) reporting chronic headaches (Figure 1). This is in contrast to headache frequency after the start of the pandemic, in which half of patients reported having headache <15 days of the month ($n = 54$, 50%) and ≥ 15 days per month ($n = 53$, 50%). Patients reporting constant daily headaches increased from 22% ($n = 24$) to 36% ($n = 38$) since the start of the pandemic. When surveyed qualitatively on how patients felt their headaches had changed since the onset of the pandemic, 49% ($n = 52$) reported feeling that their headaches had worsened (Figure 2).

When asked about screen use during the pandemic, 40% of patients ($n = 42$) reported spending ≥ 4 hours/d using screens for just schoolwork, and 61% ($n = 65$) of patients reported using screens for any reason for >6 hours/d (Figure 3). When patients were asked about their preferences of learning, 63% ($n = 67$) of patients reported that they would prefer to attend school in person, whereas 14% ($n = 15$) acknowledged that they preferred online and web-based learning over in-person learning (Figure 4). Patients reported that their anxiety ($n = 58$, 54%), mood ($n = 50$, 47%), and workload ($n = 49$, 46%) worsened during the pandemic (Figure 5). Many lifestyle factors were reported to have stayed the same or improved as compared to prepandemic, including hydration ($n = 91$, 85%) and sleep ($n = 84$, 79%). This contrasts with physical activity, which was reported to have decreased during the pandemic in 55% ($n = 59$) of patients (Figure 6).

Discussion

Migraine and other headache disorders are exceedingly common in adolescents and children. Since November 2019, COVID-19 has become a major illness across the world along with its impact on daily living. Despite the relatively low mortality of pediatric COVID-19 infections at the time of this publication, elevated stress associated with disruptions to daily life, social distancing practices, and anxiety about the threat of illness to oneself and others is likely to impact the quality of life in youth with headache. Mental health conditions including anxiety and depression have been shown to worsen since the start of the pandemic, and this is likely to affect headache patients given their elevated rates of these disorders.⁶

In our study of patient experience with headache during the COVID-19 pandemic, the most common headache diagnoses on enrollment were chronic migraine in 37%, migraine with and without aura in 41%, and new daily persistent headache in 17% of our total studied patients. This is in comparison to previous studies that have shown 17% to 25% of children and adolescents were affected with migraine,² and 1% to 4% were affected with chronic migraine.^{7,8} These differences in the frequency of chronic migraine may be related to our relatively small sample size and differences in enrollment, with the

Table 1. Impacts of the COVID-19 Pandemic on Headaches, Stressors, and Anxiety Questionnaire.

Survey questions (number of questions = 30)	
Patient information	
What is your age?	6 years or younger 7-8 9-11 12-14 years 15-17 years 18 years or older
What is your gender?	Male Female Prefer Not to Say Other
What type of headache have you been diagnosed with?	Chronic Migraine Episodic Migraine Migraine with Aura Migraine without Aura Tension Type Headache Medication Overuse Headache New Daily Persistent Headache Post Concussive Headache Chronic Daily Headache Status Migrainous Basilar Type Migraine Cluster Headache Trigeminal Neuralgia Other
Lifestyle	
I have a regular sleep schedule, such as going to bed and waking up around the same time each day.	True False
Compared to before the COVID-19 pandemic, my sleep is:	The same as before More than before Less than before
I drink the recommended amount of water per day.	True False
Compared to before the COVID-19 pandemic, my water consumption is:	The same as before More than before Less than before
I have three meals per day.	True False
Compared to before the COVID-19 pandemic, my food consumption is:	The same as before More than before Less than before
How many days per week do you perform physical activity lasting 60 minutes or longer?	0 1 2 3 4 5 6 7
Compared to before the COVID-19 pandemic, my physical activity is:	The same as before More than before Less than before
Headache description	
What is your average monthly headache frequency AFTER the onset of the COVID-19 pandemic (March 2020-present)?	<5 headache days/month 5-10 headache days/month 10-15 headache days/month 15 or more headache days/month I have a constant daily headache that never goes away.
What was your average monthly headache frequency PRIOR to the onset of the COVID-19 pandemic (before March 2020)?	<5 headache days/month 5-10 headache days/month 10-15 headache days/month 15 or more headache days/month I have a constant daily headache that never goes away.
Do you feel your headaches have changed since the onset of the COVID-19 pandemic?	My headaches have improved since the onset of the pandemic. My headaches have stayed the same since the onset of the pandemic.

(continued)

Table 1. (continued)

Survey questions (number of questions = 30)

Do you feel your level of stress has changed since the onset of the COVID-19 pandemic?	My headaches have worsened since the onset of the pandemic. I am more stressed since the onset of the pandemic. I am less stressed since the onset of the pandemic. My stress level has not changed since the onset of the pandemic.
Screen use	
How many TOTAL hours per day do you use screen-based technology (i.e., TV, computer, cell phone, gaming, tablet) for any reason	0 hours per day 1-2 hours per day 3-4 hours per day 4-6 hours per day >6 hours per day
How many TOTAL hours per day do you use screen-based technology (i.e., TV, computer, cell phone, gaming, tablet) for school or homework?	0 hours per day 1-2 hours per day 3-4 hours per day 4-6 hours per day >6 hours per day
If you are participating in online and web-based learning for school, how do you like it?	I prefer online and web-based learning to attending school. I prefer attending school to online and web-based learning. I like both equally. I don't know.
Do you feel the duration of your screen use causes or worsens your headaches? For example, do you get a headache or headache worsening if you use screens continuously for a long time?	Yes No
Do you feel the light from the screens on technology devices causes or worsens your headaches?	Yes No
How often do you need to take rest breaks when using screen-based technology due to a headache or headache worsening?	Never Rarely Sometimes Very often Always
HIT-6	
When you have headaches, how often is the pain severe?	Never Rarely Sometimes Very often Always
How often do headaches limit your ability to do usual daily activities including household work, work, school, or social activities?	Never Rarely Sometimes Very often Always
When you have a headache, how often do you wish you could lie down?	Never Rarely Sometimes Very often Always
In the past 4 weeks, how often have you felt too tired to do work or daily activities because of your headaches?	Never Rarely Sometimes Very often Always
In the past 4 weeks, how often have you felt fed up or irritated because of your headaches?	Never Rarely Sometimes Very often Always
In the past 4 weeks, how often did headaches limit your ability to concentrate on work or daily activities	Never Rarely Sometimes

(continued)

Table 1. (continued)

Survey questions (number of questions = 30)	
Psychosocial	Very often
Since COVID-pandemic, my anxiety/distress is	Always
	A lot better
	A little better
	No better/unchanged A little worse
	A lot worse
Since COVID-pandemic, my mood is:	A lot better
	A little better
	No better/unchanged A little worse
	A lot worse
Since COVID-pandemic, my school/academic workload is:	A lot better
	A little better
	No better/unchanged A little worse
	A lot worse

Table 2. Demographics (N = 107).

Characteristic	% (n)
Gender	
Male	38.0 (41)
Female	60.0 (64)
Prefer not to say	1.0 (1)
Other	1.0 (1)
Age, y	
≤6	5.0 (5)
7-8	2.0 (2)
9-11	17.0 (18)
12-14	21.0 (23)
15-17	41.0 (44)
≥18	14.0 (15)
Headache diagnosis	
Chronic migraine	37.0 (40)
Episodic migraine	11.0 (12)
Migraine with aura	24.0 (26)
Migraine without aura	17.0 (18)
Tension type headache	8.0 (9)
Medication overuse headache	1.0 (1)
New daily persistent headache	17.0 (18)
Postconcussive headache	7.0 (7)
Chronic daily headache	13.0 (14)
Status migrainous	2.0 (2)
Cluster headache	3.0 (3)
Other	5.0 (5)

most affected patients being more likely to complete the survey or be referred to our tertiary headache program. It is also possible these differences were related to the effects of quarantine and social distancing and isolation created by pandemic life.

Patients with chronic headaches increased 10% when comparing their reports from before to during the pandemic, and their overall headaches were felt to have worsened in nearly half (49%). Patients reported an increase of 1.5-fold in constant daily headaches from 22% to 36% since the start of the pandemic. This is in comparison to prior studies showing chronic

daily headaches affecting 2% to 4% of adolescent girls and 1% to 2% of adolescent boys.⁹ This dramatic increase in constant daily headache frequency may be related to the increase in perceived stress, in addition to changes in lifestyle habits such as reduced physical activity. Interestingly, episodic migraine was shown to be reduced since the onset of the pandemic and suggests that chronic and episodic migraine may have differing mechanisms or are impacted differently by environmental changes like reduced physical activity and socialization and stress.

The pandemic has had many adverse effects on children’s lifestyles and mental health, particularly with changes to stress, remote school, canceled activities, and lack of routine. More than half of our patients surveyed reported experiencing worsening of anxiety, mood, and stress since the start of the pandemic. The loss and uncertainty that so many children have experienced during the pandemic has likely contributed to our patients’ worsening mental health and increasing headaches. Because of jobs lost with the economic shutdown, many families have faced food and housing insecurity. Some children have lost parents, guardians, or other loved ones. These types of major losses and stressors, known as Adverse Childhood Events (ACEs), have been shown to have a negative effect on headaches in children.¹⁰ Additionally, mental health concerns have been shown to increase the risk of headaches in patients. Children with anxiety are more likely than children without anxiety to have headaches.¹¹ Emotional stressors, such as anxiety and depression, have been found to trigger migraines in nearly 80% of patients.¹² Given the emerging literature on the potential psychological impact of this pandemic, patients with mental health complaints may be more likely to experience exacerbation of their symptoms, further amplified by lack of mood-boosting activities like positive social interactions.^{6,13-17}

School also provided a new stress, with most children abruptly changing from in-person school to remote school. More than 60% of our patients reported that they prefer in-person school to remote school. We hypothesize that students prefer

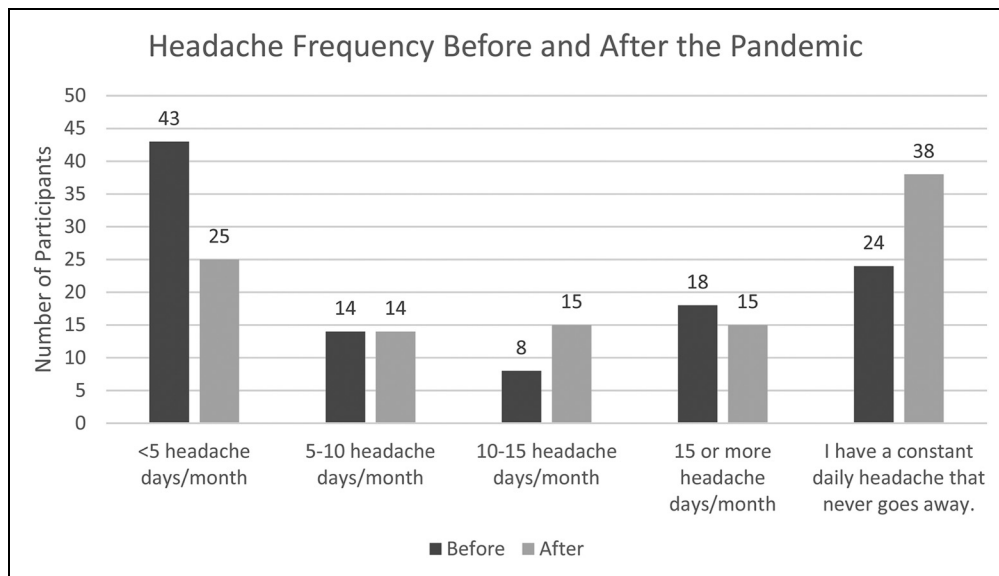


Figure 1. Headache frequency before and after the pandemic. The data depicts the frequency of headaches from before the pandemic (dark bar) to after the start of the pandemic (light bar).

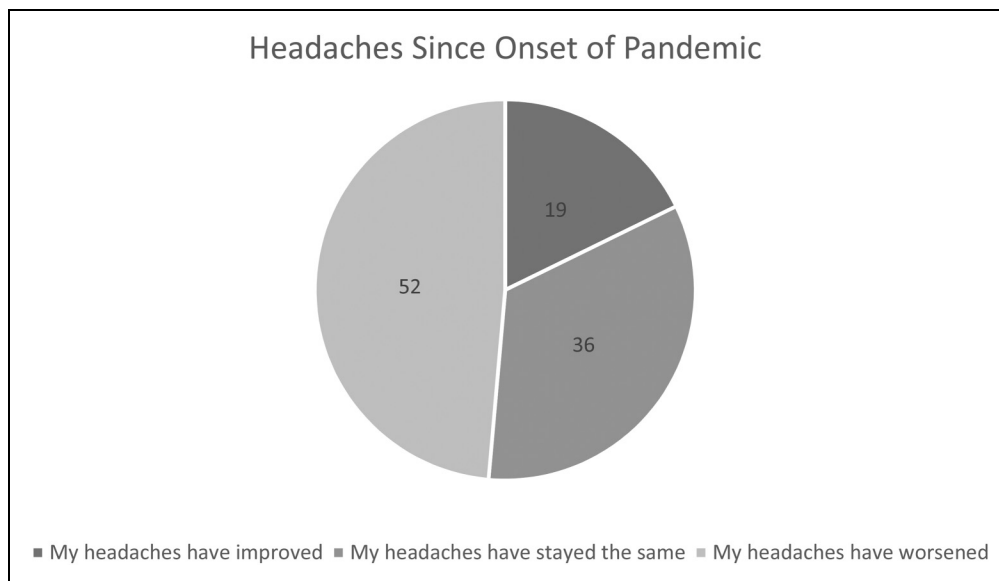


Figure 2. Headaches since onset of pandemic. The chart shows the distribution of headache intensity prior to the pandemic compared to after the onset of the pandemic. The chart is separated into 3 categories: headaches have improved since the start of the pandemic, headaches have stayed the same, and headaches have worsened.

in-person school because it provides interactions with peers, regular meals, and respite from their personal and home lives. Moreover, the stress of online school can be exacerbated for students who have learning disorders, as the remote learning environment cannot always accommodate their needs.¹⁷

With school online, we found that patients' screen time was excessive during the pandemic. More than two-thirds of patients reported using screens for 4-6 hours/d for school alone, and 61% of our patients reported using screens for at least 6 hours/d for any reason. Schoolwork moved from the

whiteboard to the screen, and without being able to socialize in person, children were forced to connect with their friends through social media and electronics. Whether or not increased screen time worsens headaches has not yet been clearly seen in literature; however, patients and families routinely cite screen use as a headache trigger. The reasons for this are complex: screens are bright, require repeated and rapid eye movements, and depict complex images for a child's brain to decipher. Although technology advances enable youth to maintain communication with their peers and maintain some virtual

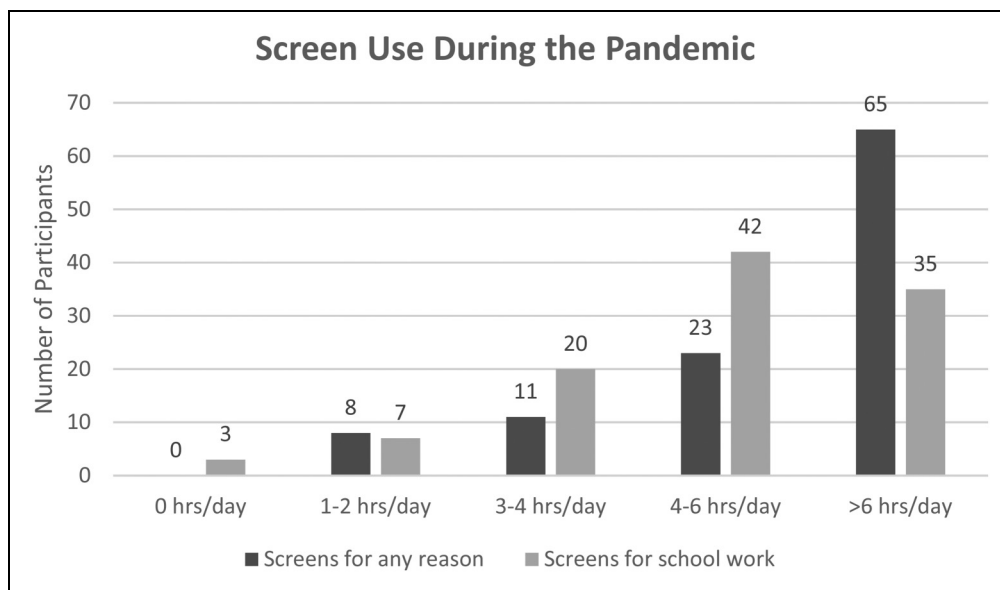


Figure 3. Screen use during the pandemic. The chart shows the distribution of screen use from prior to the pandemic compared to after the onset of the pandemic. The chart is separated into the use of screens for any reason (dark bar) and the use of screens for schoolwork specifically (light bar).

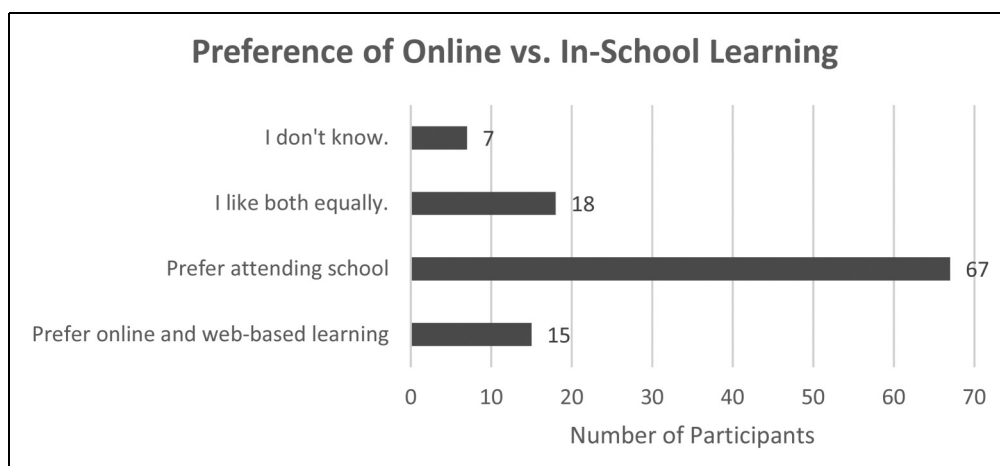


Figure 4. Preference of online vs in-school learning. The chart shows how patients ranked their preference of learning based on 4 categories, including preference for online and web-based learning, preference for attending school in person, preference for a combination of both web-based and in-person learning, and not having a preference.

schooling, it is likely to significantly increase overall screen time. Many patients with primary headache disorders appear to have increased sensitivity to handheld electronic screens.^{18,19}

There are reasons beyond the physical screen itself that can worsen headaches. Screen time is shown to influence sleep duration and quality through modified circadian rhythm, melatonin suppression, and shortened sleep duration.^{19,20} Disrupted school schedules, reduction in daily expectations, and elimination of early wake times may also contribute to altered sleep schedules for all youth,⁵ which is concerning as poor sleep quality and duration is a risk factor for chronic pain through elevated pain habituation and sensitization.²¹ A meta-analysis of studies from 1999 to 2014 showed that in 90% of studies, increased screen time was

associated with poorer sleep outcomes,¹⁹ which is a headache trigger for nearly 50% of patients.¹²

Conversely, for some youth with elevated perfectionistic tendencies or socially prescribed perfectionism, the transition to home-based learning and the associated reduction of coursework, relaxed schedules, and limited social interaction, may instead contribute to improved stress and anxiety during the COVID-19 pandemic.^{22,23} For patients who were subjected to in-person bullying or other forms of peer victimization, headache patterns may have improved as they went from in-person to home schooling.²⁴

More time spent on screens and less ability to go outside and participate in sports may have resulted in less time for physical

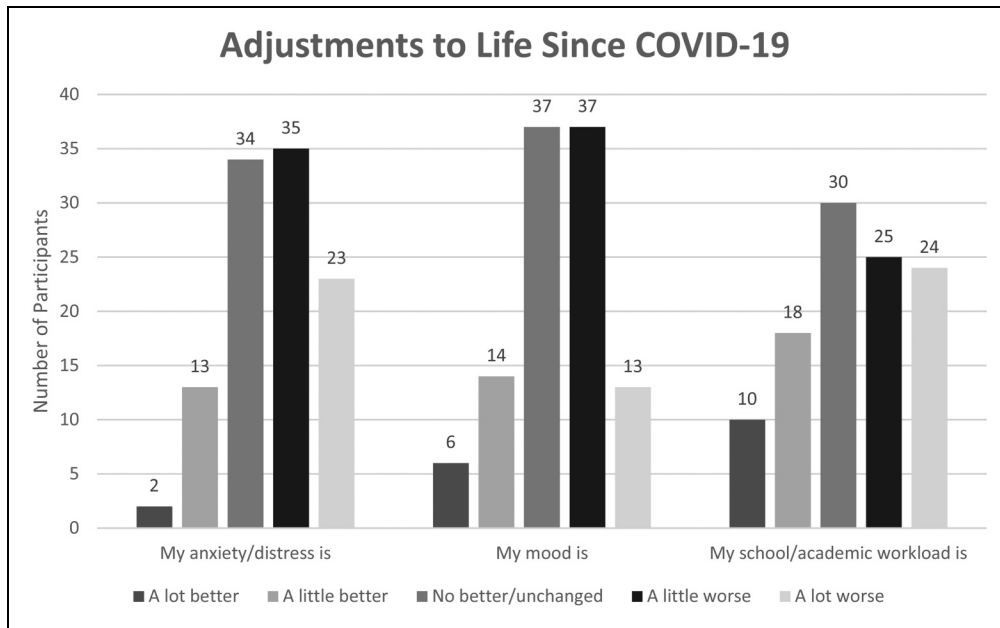


Figure 5. Adjustments of life since COVID-19. The chart shows how patients ranked their anxiety/distress, mood, and school/academic workload from before the pandemic to after the onset of the pandemic. The measures were ranked as follows: a lot better, a little better, no better/unchanged, a little worse, and a lot worse.

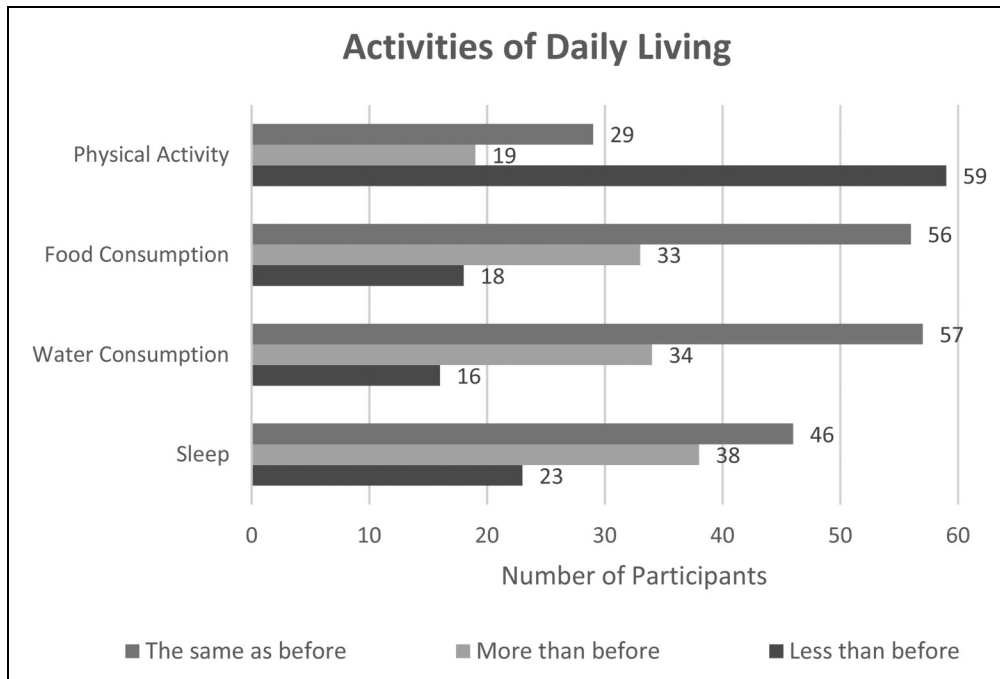


Figure 6. Activities of daily living. The chart shows how frequently patients completed activities of daily living from before the pandemic to after the onset of the pandemic, separated into 4 groups: physical activity, food consumption, water consumption, and sleep. Patients were asked to rank these lifestyle habits from more than before, the same as before, or less than before the pandemic.

activity: 54% of our patients reported that their physical activity levels decreased with the onset of COVID-19. This is most likely due to the cancellation of organized sports and activities in the pandemic, thereby removing a large piece of physical activity from children’s everyday lives. Furthermore, many

students in online school no longer had regular gym class, and pools, gyms, and other sports and recreation centers were closed. Children may not have had safe spaces or adequate supervision to play outside. Decreased physical activity has led to the doubling of the monthly rate of increase in body

Table 3. Behavioral Recommendations and Interventions During the COVID-19 Pandemic.

The following are evidence-based nonpharmacologic considerations to help prevent exacerbation of headaches and comorbid psychological conditions during the COVID-19 pandemic.

1. Create daily routines with times outlined for meals, sleep, exercise, academic tasks, and pleasurable or relaxing activities.
2. Maintain recommended nutrition and hydration routines. Specifically, youth should drink at least 64 ounces of noncaffeinated fluids per day, and eat 3 healthy meals per day.
3. Maintain adequate and consistent sleep schedules. Follow a sleep schedule for age-appropriate amounts of sleep. Adolescents should achieve 8-10 h of sleep per day with a regular sleep schedule between weekdays and weekends. Patients are encouraged to keep their bedroom or sleep environment free of all news, school, and technology, and use it only for sleep.²⁹
4. Maintain regular exercise. Encourage youth and families to find opportunities for physical activity while maintaining social distancing guidelines. Youth are recommended to exercise 7 times per week for 60 min. Simple physical tasks including long walks or hikes can be very therapeutic.
5. Engage in pleasurable and purposeful activities. Try to engage in activities they enjoy as part of their daily routine (ie, crafting, hobbies, art, puzzles, games) as they will have mood boosting benefits.
6. Take rest breaks when using screens and technology. Built-in rest breaks to engage in alternative activities away from screens may help to mitigate this.
7. Maintain regular social contact. Loneliness can lower our mood and be very anxiety producing. Identify creative ways to safely connect with other people.
8. Manage stress and anxiety. First, limit exposure to news, viewing it a maximum of once daily and avoid watching the news too close to bedtime. Take time every day to calm the nervous system. Patients who practice relaxation exercises for 10-20 min daily have been found to experience less impairment due to headaches.

mass index (BMI) during the pandemic, with the greatest increases in children and adolescents whose prepandemic BMIs were in the overweight or obese categories.²⁵ Lack of physical exercise is often cited as a migraine trigger, and a healthy lifestyle including regular physical activity has been shown to decrease headaches.^{8,26,27} Given this reduction in regular physical activity, it appears that a more sedentary lifestyle in our patients is likely to contribute to their worsening headache experience.

Despite all of these negative effects of the pandemic, there is good news. Patients reported that their diet, hydration, and sleep all stayed the same or improved compared with their habits prepandemic. We hypothesize that more unstructured time may have helped patients maintain or improve these habits. Families may have had more time to prepare healthy meals while isolating at home. Easier access to drinking water at home compared to school may have maintained patients' hydration. And less structured time in the mornings and evenings may mean more time for patients to sleep. As shown in the

Childhood and Adolescent Migraine Prevention trial (CHAMP) in 2007, regular meals, hydration, and sleep were effective in preventing headaches in children when combined with the effect of a placebo or drug.^{8,26,27} Adherence to evidence-based lifestyle behaviors is a core component of headache and migraine management in youth, as sufficient hydration, sleep duration, and exercise have demonstrated efficacy in pediatric migraine management.^{26,28} Migraineurs tend to function best when sleep and daytime routines are consistent.²⁹ However, major disruptions to schedules and the closing of schools are likely to impact these routines, as youth may encounter inconsistent virtual class times, and the elimination of regular commitments such as athletics, clubs, and other extracurricular activities. The variable schedule may be especially difficult for those who tend to have perfectionist personality traits.²²

There are several limitations to our study, most of which are related to using surveys in general. Patients that completed the survey may be those who are least or most affected by headache, or instead least or most motivated to participate or complete the tool itself. As a tertiary headache referral center, our patient population carries a referral bias, with many patients having more severe or chronic headaches. This may influence the results of questions about the underlying diagnoses, reported disability, and impact the pandemic had on their headaches and life. The results are not generalizable to the general population given the survey was distributed to patients presenting to a headache program. By using a survey and directly asking the patients about their experiences, comparing before and after the onset of the pandemic, there is inherent recall biases, which further may interfere with the results' reliability.

Based on data from the CHAMP study, patients in the placebo group who were instructed to drink at least 64 ounces of noncaffeinated fluids per day, get 8-10 hours of sleep per day with a regular sleep schedule, eat 3 healthy meals per day, and exercise 7 times per week for 60 minutes per session, had a 61% chance of reducing migraine frequency by at least half when taking placebo.²⁶ Given the current increase of time spent at home during which patients can be compliant with these lifestyle habits, specific instructions and enforcement of these parameters should be provided to reduce patient headache frequency. For patients who do not respond to these lifestyle changes despite adequate compliance, it may be easier to start preventive medications with possible side effects. The reduced pressure to wake up early on a potentially sedating medication like amitriptyline, or to have less need for prolonged focus given the potential for cognitive slowing on topiramate may be more tolerable with a more flexible school schedule at home. The authors' recommendations for behavioral interventions for headache prevention and management during the pandemic are included in Table 3.

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Author Contributions

MD contributed to conception and design, contributed to acquisition, analysis, and interpretation, drafted manuscript, critically revised manuscript, gave final approval. Agrees to be accountable for all aspects of work ensuring integrity and accuracy. AR contributed to analysis and interpretation, drafted manuscript, gave final approval. Agrees to be accountable for all aspects of work ensuring integrity and accuracy. EM contributed to analysis and interpretation, drafted manuscript, gave final approval. Agrees to be accountable for all aspects of work ensuring integrity and accuracy. LV contributed to analysis and interpretation, drafted manuscript, gave final approval. Agrees to be accountable for all aspects of work ensuring integrity and accuracy. KB contributed to conception and design, contributed to acquisition, analysis, and interpretation, drafted manuscript, critically revised manuscript, gave final approval. Agrees to be accountable for all aspects of work ensuring integrity and accuracy. RL contributed to conception and design, contributed to acquisition, analysis, and interpretation, drafted manuscript, critically revised manuscript, gave final approval. Agrees to be accountable for all aspects of work ensuring integrity and accuracy. AAF contributed to conception and design, contributed to acquisition, analysis, and interpretation, drafted manuscript, critically revised manuscript, gave final approval. Agrees to be accountable for all aspects of work ensuring integrity and accuracy. EP contributed to design, contributed to acquisition, analysis, and interpretation, drafted manuscript, gave final approval. Agrees to be accountable for all aspects of work ensuring integrity and accuracy.

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Ethical Approval

This research was approved by the Children's National Medical Center Institutional Review Board; Pro00008962: Pediatric Headache Patient Registry Database.

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