Hilla University College Journal For Medical Science

Manuscript 1053

A Review of the Persistent Burden of Post-COVID Headaches in Children

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REVIEW

Hilla Univ Coll J Med Sci

A Review of the Persistent Burden of Post-COVID Headaches in Children

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Abstract

This review focuses on the problem of the headache occurrence in children after COVID. Studies indicated that headaches and fatigue are common long-term symptoms in school-age children following COVID-19 infection. The prevalence of persistent post-COVID headaches in children varies between 5% and 25.4%, often lasting for at least 3 months. Exploration of potential pathophysiological mechanisms of post-COVID headaches in children includes the trigemino-vascular system, viral-induced inflammation, immune system dysregulation, and compromised cerebral blood flow. Age-related immune responses and the expression of receptors like ACE2 may also play a role in pediatric headache development. The features of post-COVID headaches in children encompass increased episode frequency, heightened levels of anxiety and depression, and the use of preventive medications. Headaches are commonly associated with additional symptoms such as fatigue, sleep disturbances, neurological issues, and concentration difficulties. The intensity and duration of these headaches can vary, with some children experiencing persistent symptoms for over 18 weeks. Comprehending the prevalence, duration, and underlying pathophysiology of post-COVID headaches in children is essential for formulating effective management and treatment approaches to enhance the well-being of this demographic. Possible causes of post-COVID headaches in children in relation to the trigemino-vascular system, inflammation initiated by the virus, as well as immune dysfunction and poor blood circulation to the head are also discussed. Age-related changes in immunity and the level of receptors, including ACE2, could also be the cause of headaches in children with COVID-19. Given the information about the incidence, length, and etiology of post-COVID headaches in children, the aim of this article is to provide a comprehensive overview of the persistent burden of post-COVID headaches in children to create strategies and approaches for improving the quality of life of those affected.

Keywords: Post-COVID headaches, Persistent headaches in children, Pediatric post-COVID, COVID-19 long-term effects

1. Introduction

The World Health Organization WHO classified coronavirus disease 19 COVID-19 as a pandemic in March 2020 and the influence on the life of every child, either direct or indirect, is still profound. SARS-CoV-2 is well reported to cause mild to moderate illnesses like the common flu and uncomplicated upper respiratory tract infections to severe multisystem disorders [1]. The initial COVID-19 child patient was reported on 20 January, 2020 in Shenzhen City, China while the first official case of COVID-19 in the paedriatic population in the Kingdom of Saudi Arabia was recorded on 2 March, 2020. COVID-19's after-effects as described by some authors after the acute phase are mild to severe and collectively known as long COVID [2].

2. Prevalence and duration

Research performed on children showed that headaches and fatigue were the most prevalent symptoms among school-age children with long-term COVID-19 (Ha). Persistent post-COVID-19 headache in children lasting over a year is a noteworthy concern, with various studies indicating differing prevalence rates and related factors.

Received 8 August 2024; accepted 8 March 2025.
Available online 3 June 2025

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https://doi.org/10.62445/2958-4515.1053

Investigations have demonstrated that children may endure prolonged symptoms following COVID-19, with common issues including fatigue, headache, coughing, and alterations in taste or smell [3–5]. A cross sectional study in England concluded that, Headache emerged as a prevalent and enduring symptom following COVID-19 infection in children and adolescents, as evidenced by a prevalence rate of 25.4% among 5–11 year-olds and 5% among 12–17 year-olds. The investigation revealed that headache stood out as a commonly experienced symptom persisting for three months or more after COVID-19, impacting a considerable portion of the pediatric and adolescent population [4].

A cohort study carried out in Turkey aimed to examine the continuity of COVID-19 symptoms among children for a duration of 12 weeks or longer showed that, approximately 10% of children manifested symptoms associated with COVID-19 for a duration of six months, among which headache emerged as a prominent symptom, accompanied by fatigue, joint pain, and anosmia/dysgeusia. Within the cohort of children examined in the research, the duration of symptomatology varied from a minimum of 84 days to a maximum of 344 days, with a mean duration of 160 days [5].

Comprehending the duration and consequences of persistent post-COVID-19 symptoms in children is essential for effective management and support.

3. Pathophysiology

Prolonged post-COVID-19 headache in children is a significant concern, with several potential pathophysiological mechanisms being suggested. Research has given attention to the involvement of the trigeminovascular system as a probable contributor to post-COVID headache [6]. Prolonged COVID-19, which is characterized by long lasting symptoms, specifically headache, could result from viral-triggered inflammation, immune system dysregulation, and organ damage, essentially in the brain [7].

Understanding the pathophysiology of post-COVID headache in children is critical for the establishing of effective guide for management and treatment, with the goal of prohibiting the impaction of this persistent symptom on the health of children [8]. The pathogen owns the ability to trigger an inflammatory response in the host, affecting both the vasculature and neurons presented in the central nervous system, probably resulting in the triggering of headache symptoms. Changes in blood circulation, variations in neurotransmitter levels, or retardations in the pain controlling pathways as consequences of inflammation activated by the virus and the immune system's reactions could trigger the symptom of headaches in children. Function defect of the endothelium and the occurance of tiny blood clots related to long-lasting COVID-19 may affect the blood supply to the brain, thus probably worsening symptoms associated with headaches [7, 9].

A study concluded that headaches occurred in pediatric patients with post-COVID syndrome may be associated with various pathophysiological mechanisms, like age-dependent immune reactions and the action of angiotensin-converting enzyme 2 (ACE2). The expression of ACE2 receptor and transmembrane protease serine 2 (TMPRSS2) tends to be less in children in comprising to adults, which may affect the occurrence of headaches [10]. In addition, there is a potential that headaches experienced by children consequent to the COVID-19 pandemic may be associated with other symptoms that develop post-infection, such as fatigue and respiratory problems. The complex link among these symptoms and their effect on the human body may have a role in the beginning of headaches in children subsequent to SARS-CoV-2 infection [11].

Headaches in pediatric patients can probably triggered by several underlying factors, including infections like COVID-19. Some studies believed that, headaches manifestation in children could be attributed to the immunopathological characteristics showed in affected patients. The pathophysiological mechanisms implicated in headaches among pediatric patients with COVID-19 could attribute to the immune response triggered by the virus, resulting in variations in cytokines and cells number in the blood. Pediatric patients with acute SARS-CoV-2 infection or long COVID may show altered T and B cell number, probably implicated with the appearance of symptoms like headaches. The dysfunction of adaptive immune reactions, including variations in B cells and regulatory T lymphocytes, may affect the prolongation of symptoms like headaches in pediatric patients recovered from COVID-19 [12].

A study encompass a report on two cases of vestibular migraine after COVID-19, concerning two pediatric patients who manifested symptoms of vestibular migraine consequent to their COVID-19 infection. Headaches in children, specifically those diagnosed with vestibular migraine subsequent a COVID-19 infection, can be attributed to several factors such as dysfunction of blood vessel, inflammation in the nervous system, and modulation in the pathways that control pain. variations in blood flow to the brain, known as vascular changes, have the probability to trigger headaches in the pediatric population. These modifications could be affected by factors such as stress, inadequate hydration, or fluctuations in

hormone levels [13]. Neuroinflammation, described by inflammation within the nervous system, is also involved in the onset of headaches among children [14]. In disorders include, vestibular migraine, inflammation within the vestibular system might be implicated in the beginning of headaches. The modulation of pain controlling pathways in the brain can result in an improved sensitivity to pain signals, making children more susceptible to experiencing headaches. Genetic predispositions, environmental stimuli, or underlying medical conditions can affect this alteration in perception of pain [13].

4. Characteristics of headache

The long term headache features observed in children following a COVID-19 infection encompass an increased frequency of episodes, elevated levels of anxiety and depression, and the utilization of preventative medications [15, 16]. Headaches in children and adolescents might occur alongside other symptoms including fatigue, sleep disorders, neurological disorders, and difficulty focusing [17, 18]. Young headache sufferers have revealed an alteration in mood, reduced physical activity, and heightened screen usage [19].

Headache was noted as a symptom at various intervals; for example, some patients reported having headaches 12 weeks after infection [17]. It is important to take into account how often children have headaches since some children may only get migraines sometimes, while others may get headaches more regularly [20]. In a study, it was noted that children affected with post COVID-19 condition might encounter headache as a persistent symptom, influencing the total duration of the condition, which was documented to have a median duration of 18 weeks [16]. The severity of a headache can vary, ranging from moderate to severe which can negatively affect their everyday activities and quality of life [17, 20, 21]. Children's headaches can manifest in a variety of ways, such as throbbing pain, photophobia (sensitivity to light), or phonophobia (sensitivity to sound), nausea, vomiting, and dizziness. It is frequently reported as a headache or upper neck pain or discomfort [17, 20].

Some children with headaches could also suffer from migraine-like symptoms, especially if they've had migraines in the past [21]. In order to distinguish between unique brain alterations that may aid in differentiating between chronic COVID-19 headaches and primary headaches, a study employed machine learning techniques on structural MRI images. The findings showed that certain thalamic connectivity abnormalities and gray matter alterations in the orbitofrontal and medial temporal lobes were indicative of the cause of headaches in teenagers with prolonged COVID [22]. A recent study discovered that children who tested positive for SARS-CoV-2 were more likely than those who tested negative to have three or more persistent symptoms 12 weeks following testing. This suggests that PCR-positive children are more likely to experience headaches [8].

5. Assessment and diagnosis

Assessing and diagnosing prolonged headaches in children following COVID-19 infection necessitates a comprehensive methodology that takes into account clinical manifestations as well as sophisticated diagnostic techniques. The occurrence of persistent headaches in pediatric patients post-COVID-19 is noteworthy, as a research suggests that a considerable number of children continue to endure headaches even after 90 days from the initial infection [23]. Headaches often present with manifestations that mimic migraines, including pulsating pain, nausea, and photophobia, and occasionally reach a level of intensity that requires visits to the emergency department [24]. An interdisciplinary approach involving historical investigation, physical examination, psychological assessment, and advanced imaging techniques is crucial in precisely diagnosing and managing prolonged post-COVID-19 headaches in children [25]. The coexistence of a persistent headache in conjunction with additional signs suggestive of a prolonged COVID-19 infection, including but not limited to fatigue, disturbed sleep, cognitive impairments, abdominal pain, myalgia, arthralgia, thoracic unease, gastric discomfort, bowel irregularities, cardiac arrhythmias, and skin-related presentations, may be employed in the assessment and recognition of pediatric individuals undergoing prolonged post-COVID-19 headache [26].

The application of headache diaries and questionnaires, such as the Pediatric Migraine Disability Assessment (PedMIDAS), holds substantial importance in the surveillance of headache frequency, severity, and triggers, all of which are crucial for the effective management [27]. Advanced diagnostic techniques, like structural MRI and connectome-based predictive modeling, demonstrate promise in differentiating long COVID headaches from primary headaches by identifying unique gray matter changes and altered thalamic connectivity [22].

Emotional stress, increased screen time, and decreased physical activity during the pandemic have also shown connections with worsening headache symptoms, emphasizing the significance of a thorough assessment involving various lifestyle factors

[19]. Psychological assessments employing measures like the Patient Health Questionnaire-9 (PHQ-9) and General Anxiety Disorder-7 (GAD-7) scales are essential, given the documented high rates of anxiety and depression among adolescents with persistent COVID-related headaches [15]. Persistent symptoms like fatigue, muscle pain, and respiratory problems pose a challenge to the clinical presentation, necessitating a comprehensive evaluation by pediatric experts and mental health professionals [28]. Given the variability in symptom manifestation and potential long-term effects, there is a critical need for meticulous, controlled clinical research to improve diagnostic accuracy and ensure efficient resource allocation for impacted children [29].

A thorough evaluation is crucial for children exhibiting enduring post-COVID-19 headache symptoms, involving clinical assessments, laboratory examinations, and, when necessary, radiographic assessments to rule out other causes and confirm the diagnosis [26].

6. Management

A multidisciplinary strategy is necessary for the management of post-COVID-19 headache in children, taking into account both pharmacological and non-pharmacological treatments [30, 31]. The non-pharmacological methods like modifications in lifestyle include, sufficient hydration, a well-rounded diet, appropriate sleep habits and regular physical activity may potentially diminish both the frequency and intensity of headaches [30–32].

Ensuring adequate hydration and a well-balanced dietary intake are paramount as the onset of headaches can be precipitated by dehydration and inadequate nutrition. Consumption of ample water and adherence to regular, balanced meals can serve as preventive measures against the occurrence of headaches. Sufficient rest and sleep are imperative for the management of headaches. Inadequate sleep has the potential to worsen headaches; hence, adhering to a consistent sleep pattern and creating a conducive sleeping environment can prove to be advantageous. Engaging in regular physical exercise can contribute to a reduction in headache frequency. Physical activity facilitates the release of endorphins, which act as natural pain alleviators, and can concurrently lower stress levels [9, 33].

Neuropsychological support can help children improve focus and cognitive functions to indirectly reduce headache occurrences. School accommodations like extended time for assignments, reduced homework load, and frequent breaks can help manage headaches and reduce stress for pediatric patients [32].

Stress serves as a recognized catalyst for headaches, hence integrating stress management strategies like mindfulness, meditation, or cognitive-behavioral therapy can prove advantageous for individuals grappling with post-COVID headaches [30, 33].

Given the absence of specific interventions for post-COVID headaches, many healthcare providers tend to utilize treatments employed for various primary headaches, like migraines or tension-type headaches, predicated on the resemblance of clinical manifestations.

The management of Mild to moderate headaches with medication can be addressed with over-the-counter analgesics such as acetaminophen or ibuprofen. In instances of more severe headaches, prescription drugs like triptans or preventive medications such as beta-blockers might be contemplated [30–32].

Monitoring and Follow-Up: Regular consultations with healthcare providers are indispensable for monitoring the child's progress and adjusting management approaches as necessary. This practice ensures prompt attention to any symptom changes and facilitates the delivery of appropriate care [9].

Governments and health authorities should approach pediatric long COVID as a public health concern, arranging appropriate psychosocial support and guaranteeing access to essential medical treatment [26]. The goals should continue to be symptom relief, frequent follow-ups, and multidisciplinary care delivery until more targeted medicines are created [34]. In addition to treating the acute symptoms, this approach promotes the general health and recuperation of children with prolonged COVID.

7. Prognosis and long-term outcomes

The prognosis and long-term consequences of post-COVID headache in pediatric patients are complicated and impacted by a variable of factors, such as the severity of the primary infection, pre-existing medical conditions, and alterations in daily activities attributed to the global health pandemic. While the majority of children demonstrate notable enhancements over time, there exists a wide range of variability in both the duration and severity of headaches among different individuals. Typically, the overall long-term outlook is hopeful, as a significant portion of patients observe a decrease in symptoms and eventually regain their pre-COVID level of health [35]. For children who encountered headaches, the symptoms typically disappeared within a three-month

timeframe, suggesting that long-lasting consequences are uncommon, with the majority of children making a complete recovery during this specific period [36].

Specifically, long-term studies stated that, although most children achieve the resolution of persistent symptoms in 90 days, the minority still remains to have neurologic sequelae, which include headache [23]. Review of structural MRI data revealed changes in the adolescents' brain related to long COVID headaches, particularly in the orbitofrontal and medial temporal lobes and reduced thalamic connectivity, that may enable one to distinguish these headache from primary headache disorders [22].

Finally, there is adequate evidence to state that majority of children with long post COVID-19 headaches would recover within few months; however, a significant percentage will continue with the complaints and may require further medical intervention and follow up. However, future research should be based on describing the principles regulating the development of disturbed and healthy children and the development of severity criteria for young patients, as well as identifying the methods of psychosocial rehabilitation for children with COVID-19 and their families [5, 9, 27, 37].

8. Conclusion

The growing data reveals the considerable role of persistent headaches experienced by children after COVID-19 pandemic. Among all the symptoms, headaches have considered the most frequent long-term manifestations with studies pointing to prolonged cases that persist for months. The nature of headaches that occur following the COVID infection can be multi-factorial, which includes the direct effects of inflammation caused by the virus, immunological disturbances, and probable vascular and neurological adjustments.

Fewer children presented post-COVID headaches than in adults, but the chronicity, prevalence, and severity shown in children reveal these results obligate the necessity of heightened consideration, comprehensive assessment, and individualized management.

More investigations are needed to understand the causes of these impairing symptoms and continue to identify and design treatments that will aid the enhancement of the health and quality of life for children who contracted COVID-19. Prohibiting the effects of headaches persisting following the period is critical for the future well-being of children who have started experiencing the pandemic's effects at a young age.

Ethical issue

Not applicable.

Financial funding

This research received no external funding.

Conflicts of interest

No conficts of interest exist to declare.

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