

Review

The Impact of Lifestyle Factors on Migraine Frequency and Severity in Young People

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Abstract

Migraine is a prevalent and disabling neurological condition, particularly among young populations. It significantly impacts quality of life, with triggers and contributing factors including genetic predispositions, environmental influences, and modifiable lifestyle behaviors. This review examines the role of lifestyle factors in migraine frequency and severity, focusing on hydration, diet, caffeine consumption, physical activity, stress management, sleep, and technology use. Lifestyle interventions, such as maintaining regular sleep schedules, consistent meals, adequate hydration, and physical activity, offer promising non-pharmacological strategies for migraine management. Dietary approaches, including the ketogenic diet and elimination diets, have shown potential, though further research is needed to evaluate their efficacy in pediatric populations. Excessive caffeine intake and screen time, particularly among adolescents, are significant contributors to migraine episodes, underscoring the need for behavioral modifications. Proper sleep hygiene and stress reduction are also key in alleviating migraine burden. Given the limitations of pharmacological treatments in children and adolescents, lifestyle modifications should be prioritized as first-line preventive measures. This review highlights the need for comprehensive educational programs to promote healthier habits, reduce migraine recurrence, and improve long-term outcomes in young individuals.

Keywords: *Migraine, lifestyle factors, young individuals, adolescents*

Introduction

Migraine and other headache disorders contribute significantly to morbidity, particularly among young populations. The Global Burden of Disease (GBD) study in 2016 ranked migraine as the second leading cause of years lived with disability, an increase from its position in 2010. In adolescents, headaches are among the most common neurological conditions, particularly in Europe, where prevalence estimates average 54.4%, especially in females. Migraine ranks as the seventh leading cause of disability-adjusted life years among individuals aged 10–14 years (1).

Migraine, characterized by recurrent headaches often accompanied by sensory disturbances like visual or auditory symptoms, remains a significant global health issue. These headaches may present unilaterally or bilaterally, often with visual disturbances such as flashing lights or sensory phenomena referred to as “aura.” The timing of aura varies, occurring either before or during a headache episode (2).

Research has revealed that migraine pathophysiology is shaped by genetic predispositions, environmental factors, and lifestyle influences. Lifestyle factors, including caffeine intake, poor hydration, irregular meals, physical inactivity, and stress, significantly affect migraine frequency and severity. Emerging evidence links obesity and migraine in young populations, suggesting shared pathophysiological mechanisms like thalamic activation and serotonin modulation. Additionally, interventions such as the ketogenic diet show promise in modulating brain excitability and reducing neuroinflammation in migraines, though the mechanisms remain under investigation (3).

Stress, particularly in adolescence, is a significant trigger due to the biological, psychological, and social transitions during this period. Meal skipping and inadequate lifestyle habits have also been associated with somatic and psychological health complaints in children (4).

Pharmacological management of migraines shows limited success in controlling headache frequency compared to placebo. The Childhood and Adolescent Migraine Prevention (CHAMP) study revealed no significant differences between amitriptyline, topiramate, and placebo for migraine prevention in 8–17-year-olds, attributing the high placebo response to healthy co-interventions, including lifestyle recommendations such as adequate hydration, regular exercise, meal regularity, and consistent sleep patterns (5).

Lifestyle modifications hold significant potential in managing pediatric migraines, especially given the higher placebo responses and adverse effects of pharmacological treatments in this age group. Pediatricians can play a critical role by addressing lifestyle triggers and implementing programs focused on sleep hygiene, physical activity, stress management, and dietary habits. These strategies may not only reduce migraine frequency and severity in childhood but also improve long-term quality of life into adulthood (6).

This review aims to analyze the impact of lifestyle factors on the frequency and severity of migraines in young populations, focusing on modifiable behaviors such as diet, physical activity, stress management, and sleep hygiene. By synthesizing current evidence, it seeks to identify effective non-pharmacological interventions and provide actionable insights for migraine management strategies in young patients.

Methods

This study is based on a comprehensive literature search conducted on 16 November 2024 in the Medline, PubMed, Scopus, and Cochrane databases. Utilizing medical subject headings (MeSH) and relevant keywords, the search aimed to identify pertinent studies on the impact of lifestyle factors on migraine frequency and severity in young populations. To ensure thoroughness, a manual search was also performed through Google Scholar, examining the reference lists of identified papers to locate additional relevant studies. Articles were included if they discussed lifestyle factors such as diet, physical activity, stress management, and sleep

hygiene in relation to migraine triggers, frequency, severity, or management. No restrictions were applied regarding publication date, language, or type of publication, allowing for a comprehensive review of existing literature.

Discussion

Migraine and hydration

Clinical practice guidelines for managing migraines often emphasize lifestyle interventions, including consistent hydration. For adolescents, the recommended fluid intake is 8–10 cups of non-caffeinated beverages daily. While no studies directly examine the effects of increased water intake on migraine frequency in pediatric populations, evidence from adult studies suggests potential benefits. For instance, a randomized clinical trial evaluating 102 adult migraine patients using the Migraine-Specific Quality of Life (MSQOL) test found a statistically significant improvement of 4.5 points in MSQOL scores with increased water intake. Additionally, 47% of patients reported a 6-point improvement on a 10-point scale compared to the control group (7).

Short-term increases in water intake could serve as a non-invasive and easily implemented strategy to assess potential improvements in migraine management. Systematic evaluations of hydration in adolescents with migraines, such as Kenney et al.'s study, reveal that most adolescents are inadequately hydrated. Among 4,134 participants aged 6–19 years, the prevalence of inadequate hydration, defined as urine osmolality >800 mOsm/kg, was 54.5%. Other reviews have corroborated these findings, indicating that insufficient hydration is common among children and adolescents (8).

The association between water deprivation and migraine is further supported by observational data from adult migraineurs, where 36% of 95 subjects identified insufficient fluid intake as a migraine trigger (9). From a physiological perspective, adequate hydration supports increased blood volume and improved oxygen delivery to the brain. Additionally, it helps maintain proper plasma

osmolality and sodium concentrations, which are critical for cellular ion balance.

These findings highlight the importance of hydration in migraine management. While further research is needed to confirm these effects in pediatric populations, promoting adequate fluid intake is a practical and potentially effective component of migraine prevention and management strategies (10).

Migraine and caffeine

Caffeine abuse is a growing issue among adolescents, contributing to the onset and exacerbation of headaches. Many adolescents consume large amounts of caffeine through soft drinks, with diet colas often being used by girls as meal substitutes, increasing the risk of caffeine dependency (11). Approximately 55% of caffeine consumed by young American schoolchildren comes from soft drinks. The International Headache Society recognizes caffeine withdrawal as a cause of headaches. Even moderate habitual consumption, equivalent to one cup of coffee daily, can lead to withdrawal headaches (12).

Excessive caffeine consumption, particularly from coffee, tea, and soft drinks, remains an underrecognized contributor to migraines and headaches. For example, a study by Hering-Hanit and Gadot examined 36 children and adolescents with daily or near-daily headaches linked to cola consumption. These participants consumed an average of 11 liters of cola per week (1,414.5 mg of caffeine). Gradual cola withdrawal resulted in complete headache cessation in 33 subjects over 24 weeks, emphasizing the value of controlled withdrawal as part of lifestyle management (13).

Similarly, a large cross-sectional study among high-school students revealed a strong correlation between coffee consumption and headache types, showing a twofold increase in the risk of migraine and tension-type headaches. Migraine risk was even higher, with an odds ratio (OR) of 3.4 (14).

These findings underscore the importance of moderating caffeine intake in adolescents to reduce migraine frequency and severity. Gradual

withdrawal strategies, supported by parental involvement and lifestyle guidelines, can effectively reduce caffeine-related migraines without causing withdrawal symptoms. Addressing caffeine overuse, as part of broader lifestyle interventions, offers a practical approach to managing migraines and headaches in this population (15).

Migraine and physical exercise

Physical activity, particularly aerobic exercise, offers a promising non-pharmacological approach to migraine management, influencing pain modulation through mechanisms involving opioids, serotonin, and N-methyl-D-aspartate (NMDA) receptors in the rostral ventromedial medulla (16). This effect promotes analgesia and reduces pain perception. Additionally, exercise positively impacts stress, depression, anxiety, and overall mental health—factors commonly associated with chronic pain conditions (17).

Large-scale studies have identified reduced physical activity, lower fitness levels, and overweight status as lifestyle-related risk factors for migraines. These factors correlate with increased migraine prevalence and frequency. Among school-aged children, those with migraines are more likely to prefer sedentary activities and engage less in physical exercise than their peers. Similarly, cross-sectional studies report that adolescents with headaches lead more sedentary lifestyles than those without migraines (18).

Evidence suggests that aerobic physical therapy can reduce the frequency of migraine episodes, along with a tendency to lower pain intensity and attack duration. For instance, a randomized controlled trial by Varkey et al. compared the effects of the prophylactic use of topiramate with non-pharmacological interventions such as relaxation techniques and aerobic exercise. The study found no significant differences in episode frequency between groups, supporting exercise as an effective preventive option, particularly for patients who prefer to avoid daily medication (19).

However, the relationship between exercise and migraines is complex. While regular physical

activity has long-term benefits, it can sometimes trigger migraine attacks. A study by Koppen et al. reported that approximately 38% of migraine sufferers had exercise-induced attacks, leading many to abandon sports. Varkey et al. observed that while maximal aerobic exercise may trigger migraines in some individuals, it does not consistently provoke attacks, even among those prone to exercise-induced migraines. For individuals who experience worsening pain associated with physical activity, tailored interventions focusing on gradual increases in exercise intensity and duration may be necessary. These adjustments aim to facilitate chronic adaptation, allowing patients to mitigate triggers and ultimately benefit from the long-term advantages of an active lifestyle (20, 21).

In a comparative study conducted by Hanssen et al., different exercise regimens, such as mild continuous training and high-intensity interval training (HIIT), have shown benefits in reducing migraine days. HIIT, however, appears more effective than continuous training in some cases.

To maximize the benefits of physical activity, migraine patients should be encouraged to adopt cautiously progressive exercise routines. This involves personalized adjustments to intensity, frequency, and duration, ensuring that the training program aligns with individual needs and limitations. Over time, these adaptations can help prevent migraines while improving overall physical and mental well-being (22).

Migraine and stress

Research consistently links stress responses to the development and exacerbation of headaches, particularly migraines. Stress-induced hyperalgesia, mediated by NMDA and μ -opioid receptors, reduces the efficacy of pain-inhibitory pathways and activates inflammatory processes at the neuronal level through cytokines. Acute stress is a well-documented migraine trigger, with studies indicating that 50–80% of migraine episodes are associated with stressful events in both adults and children (23).

Stress has also been implicated in the progression to chronic headache disorders. Retrospective and prospective studies show a higher prevalence of stressful events preceding the onset of migraines and chronic headaches compared to periods without migraines. In pediatric populations, school-related stress—stemming from academic pressures, peer conflicts, and demanding parents—plays a major role in triggering headaches. Similarly, family dysfunction, punitive parenting, frequent arguments, and parental depressive symptoms are strongly associated with migraines and tension-type headaches (TTH) in children and adolescents (24).

These findings are significant for understanding the bidirectional relationship between stress and headache types. For instance, unhappy family environments and poor parental relationships are more commonly linked to TTH than migraines. Stress also contributes to comorbid conditions like dysthymic disorders, where migraines often coexist with other headache types.

For pediatric migraine management, non-pharmacological treatments like relaxation therapy and biofeedback should be prioritized, especially for patients struggling with stress. These approaches can complement pharmacological treatments or serve as alternatives for those with poor medication adherence, ineffectiveness, or contraindications. Incorporating structured stress-reduction programs into headache management plans could significantly improve outcomes for children and adolescents prone to stress-induced headaches (25).

Migraine and diet

Diet is a crucial lifestyle factor in managing migraines, though there is no universally prescribed diet for sufferers. For obese individuals, a weight-loss diet is particularly recommended, with caloric intake adjusted to 1,200–1,500 calories per day for women and 1,500–1,800 calories per day for men. Various dietary strategies, including elimination diets, nutrient-specific approaches, ketogenic diets, and epigenetic diets, have demonstrated potential in alleviating migraine symptoms through diverse mechanisms (26).

Elimination diets aim to identify and exclude dietary triggers that provoke migraines. For instance, a gluten-free diet in individuals with celiac disease has been shown to reduce headache or migraine frequency by 51.6% to 100%. Other elimination diets, such as those targeting immunoglobulin G-reactive foods, tyramine, histamine, and high-fat intake, have yielded inconsistent results. Despite their potential, strict elimination diets may lead to nutritional deficiencies if not carefully managed. Therefore, such diets should be implemented under medical supervision to avoid malnutrition, especially in cases of complete avoidance of specific food groups (27).

Low-glycemic index (GI) diets have shown promise in reducing migraine frequency. A study comparing a low-GI diet group with a control group on standard migraine-preventive medication found similar improvements, suggesting dietary interventions can complement pharmacological treatment. Additionally, diets high in omega-3 fatty acids and low in omega-6 fatty acids have been linked to significant reductions in migraine duration and frequency. These diets modulate inflammation and may help regulate neurotransmitter activity, providing a natural adjunct to traditional therapies (28).

The ketogenic diet (KD), traditionally used for pharmaco-resistant epilepsy, has emerged as a potential strategy for migraine management, particularly in overweight patients. KD promotes neuroprotection, improves mitochondrial function, and reduces neuroinflammation. These mechanisms contribute to decreased migraine frequency and severity. Low-sodium diets are beneficial for pre-hypertensive individuals and the elderly, while high-sodium diets may benefit young women with low-to-normal BMI and postural tachycardia syndrome. These specialized diets require precise medical oversight to ensure safety and efficacy (29).

Epigenetic diets, which influence gene expression through dietary components, offer another promising approach. Folate-rich diets, modified Atkins, and Mediterranean diets have been explored for their ability to target DNA methylation and other

epigenetic pathways. These diets not only address migraine symptoms but also promote overall health, making them suitable for long-term management (30).

Skipping meals, particularly breakfast, is a well-established migraine trigger. Studies have shown that irregular eating patterns correlate with more frequent and severe migraine attacks. Patients are encouraged to eat at consistent intervals to maintain stable blood glucose levels and avoid triggering premonitory migraine symptoms, such as yawning, fatigue, or mood changes (31).

Alcohol and smoking

Alcohol is reported as a migraine trigger in approximately 75% of sufferers. Its effects are mediated through inflammatory pathophysiological mechanisms, as well as additional factors such as vasodilation, dehydration, toxicity, and the presence of histamine, tyramine, sulfites, flavonoids, and serotonin (5-HT) release. While red wine is frequently identified as a specific trigger, all types of alcohol have been implicated in migraine onset. The variability in individual responses suggests that alcohol may exacerbate pre-existing susceptibilities in migraine-prone individuals (32).

The role of smoking and nicotine in migraine pathogenesis is less clear and remains controversial. Smoking directly affects the central nervous system and has been noted to trigger migraine attacks in some individuals (33). The daily consumption of more than five cigarettes is particularly associated with an increased likelihood of migraine attacks. For former smokers, cessation of smoking is strongly advised, as it can reduce the frequency and severity of migraine episodes over time (34).

Migraine and sleep disorders

Migraine sufferers with sleep disorders often experience lower quality of life, heightened stress levels, and a greater likelihood of psychiatric comorbidities. Additionally, adults with sleep-related breathing disorders face an increased risk of developing migraines. Poor sleep, including conditions such as sleep apnea and insomnia, is a recognized migraine trigger and significantly

contributes to the migraine burden, warranting routine screening. Other sleep issues commonly linked to migraines include short sleep duration, snoring, sleep-related breathing disorders, and restless leg syndrome (35).

Insomnia is more prevalent among individuals with probable migraines compared to non-headache controls, and migraine sufferers with insomnia tend to score higher on the Headache Impact Test-6, indicating a greater impact on daily life (36). Sleep is also recognized as a natural remedy for migraines, and proper sleep hygiene can be beneficial for managing chronic migraines (37). Recommendations include maintaining a quiet, dark, and cool bedroom, reserving the bed for sleep only, avoiding electronic devices in the bedroom, and adhering to a regular sleep schedule (38).

Migraine and technology

The increasing exposure of children to technological devices, including smartphones, television, and video games, has coincided with a decline in physical activity over recent decades (39). A large epidemiological study involving 1.5 million adolescents (aged 11–15) reported that 23% of mobile phone users experienced migraines (40).

In children and adolescents, videogame overuse was identified as the fourth most common migraine trigger in a study involving 102 participants. Additionally, Xavier et al. reported that 19.3% of adolescents with excessive screen time experienced migraines, with digital device overuse being a significant risk factor (OR \geq 1.84). Adolescents facing academic stress during high school years were also more likely to develop migraines.

These findings underscore the relationship between increased screen exposure and migraine frequency, emphasizing the need for moderated use of technological devices in younger populations (41).

Conclusion

Homeostasis and regularity are vital for managing migraines in children and adolescents. Lifestyle modifications, including regular sleep, consistent meals, adequate hydration, moderated caffeine,

avoidance of smoking and alcohol, and regular physical activity, should be prioritized as first-line preventive strategies. Pharmacological treatments often have limited efficacy in this population, highlighting the importance of non-pharmacological approaches. Emerging evidence suggests potential benefits of dietary interventions like the ketogenic diet, though further research in pediatric populations is needed. Promoting educational programs on lifestyle changes can reduce migraine recurrence, enhance well-being, and prevent chronic migraines, fostering healthier futures for young individuals.

Disclosure

Conflict of interest

There is no conflict of interest

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Data availability

Data that support the findings of this study are embedded within the manuscript.

Author contribution

All authors contributed to conceptualizing, data drafting, collection and final writing of the manuscript.

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