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Beyond Pills: A Comprehensive Approach to Primary Headaches through Physical Activity, Physiotherapy, and Diet

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ABSTRACT

Introduction: Headaches represent a significant global health issue in terms of both prevalence and the complexity of the disorder. The etiology remains unclear, with numerous factors contributing to their development. Pharmacotherapy represents the primary method of treatment, although the influence of physical activity on headache occurrence is a topic of considerable interest in the scientific literature.

Materials and Methods: Conducted study involved review of the literature using databases such as PubMed, NCBI, and Google Scholar. In the searching process the terms "headache", "physical activity", "diet" and "migraine" were used.

State of knowledge: Given the highly heterogenous nature of headaches, it is important to recognise that treatment, symptoms, the influence of physical activity, physiotherapy and diet will differ depending on the subtype. It was demonstrated that they have a markedly adverse effect on the quality of life of patients. A number of studies demonstrated that physical activity can be as effective as medication in the treatment of headaches. Additionally, physiotherapy was shown to alleviate the symptoms of tension-type headaches, while specific dietary patterns,

such as the introduction of Tanacetum parthenium L, can have an anti-migraine effect and can be used as an additional form of treatment.

Conclusions: Physical activity, specific diet and physiotherapy can be useful in prevention, treatment and management of headaches. However physical activity should be used with caution as it can induce the condition among susceptible patients.

Keywords: headache**,** primary headache**,** physical activity**,** diet**,** migraine

INTRODUCTION

Primary headaches constitute a significant health problem, affecting a substantial portion of the population worldwide [1,2]. The etiology of these disorders is complex and not fully understood and includes a range of factors [3,4]. Primary headaches have a significant impact on patients' quality of life (QoL), limiting their daily functioning, overall well-being, and life satisfaction [5,6]. They also contribute to considerable disruption in the ability to perform daily household duties, reducing productivity or completely preventing their completion [7,8]. Furthermore, primary headaches generate significant economic costs, both direct (related to healthcare) and indirect (resulting from loss of productivity) [9,10].

Pharmacotherapy remains a key method in the treatment of primary headaches. Pharmacological treatment of primary headaches includes both acute and prophylactic therapy. In the case of migraine, for patients unresponsive to analgesics, especially with moderate or severe pain intensity, the introduction of triptans is recommended [11]. For patients with frequent or prolonged migraine attacks, prophylactic treatment is recommended, which may include the use of topiramate, valproic acid, or amitriptyline [11,12]. In the treatment of tension-type headache (TTH), both pharmacological and non-pharmacological methods are used, with the key being to exclude underlying pathology . In patients with cluster headache, although rare but causing significant pain and disability, oxygen therapy or triptans are recommended for acute treatment, and in some cases prophylaxis is indicated [11,13].

In the context of treatment and prevention of primary headaches, increasing attention is being paid to the role of physical activity, physiotherapy, and dietary patterns [14,15,16].

Studies suggest that low physical activity is associated with a higher prevalence of both migraine and non-migraine headaches. In turn, regular aerobic exercise may lead to a reduction in the frequency, intensity, and duration of migraine attacks [14,17,18].

Physiotherapy, including manual therapy, exercises, and invasive techniques, is becoming a valuable element in the management of primary headaches [19]. Moreover, non-invasive and

invasive neurostimulation techniques are gaining increasing interest, showing promising results in the treatment of chronic primary headaches [16,20].

MATERIALS AND METHODS:

A comprehensive review was conducted using databases such as PubMed, NCBI, and Google Scholar. The search process involved the use of keywords such as "headache," "primary headache," "physical activity," "diet," and "migraine" to identify relevant data. The data sourced from the searched articles was subjected to a detailed analysis in terms of methodology, results and importance to the topic to ensure the reliability of the study. Furthermore, only studies available in full-text format were utilized.

STATE OF KNOWLEDGE

1. Primary headaches - a great burden to be carried

Primary headaches constitute a clinically heterogeneous group of disorders with an incompletely understood pathophysiology and no identifiable association with underlying systemic diseases or structural abnormalities within the body [21,22]. Primary headaches are among the most common causes of pain in the general population. It is estimated that over 52% of adults have experienced a headache at least once, while on a monthly basis, 4.6% of the global population suffers from headaches lasting more than 15 days, and daily headaches affect as much as 15.8% of people worldwide [23]. The overall prevalence of primary headaches in children and adolescents is 62%, with the prevalence rates being 38% in girls and 27% in boys, respectively [24].

According to the third edition of the International Classification of Headache Disorders (ICHD-3) [25], primary headaches are classified into several main categories: migraine, tension-type headache (TTH), trigeminal autonomic cephalalgias (TACs), and other primary headache disorders.

The etiology of primary headaches is diverse and not fully understood, but it points to a range of factors that may contribute to their development. In the case of migraine, significant risk factors include chronic use of suboptimal acute treatment, the presence of cutaneous allodynia (sensitivity to touch), and overuse of analgesics. Comorbid conditions such as psychiatric disorders (e.g., depression, anxiety), chronic pain syndromes outside the head area, metabolic disorders, sleep disturbances, and respiratory diseases also increase the risk of

migraine progression. Lifestyle factors also play a major role in the development of migraine. Excessive caffeine consumption, both current and past, lack of physical activity, tobacco use, and financial difficulties can exacerbate the condition. Additionally, individual triggers, such as stress or hormonal changes, can affect the frequency and intensity of migraine attacks [26,27]. TTH is closely associated with factors that lead to excessive muscle tension in the neck, face, scalp, and jaw areas. One of the main triggers is emotional stress, which causes increased muscle tension. Other commonly occurring risk factors include mental strain, insufficient or poor-quality sleep, and improper body posture, especially during prolonged reading, computer work, or using a mobile phone. Additionally, alcohol consumption, dehydration resulting from insufficient fluid intake, and exposure to sunlight are also considered significant risk factors [28,29].

Avoiding these risk factors can significantly reduce the frequency and severity of primary headache attacks, leading to an overall improvement in the QoL for patients. Strategies such as minimizing stress exposure, optimizing sleep hygiene, maintaining proper posture, and moderating the use of substances like alcohol and caffeine can have a substantial impact on symptom management. Furthermore, these measures may reduce the reliance on acute pain medications, thereby mitigating the risk of medication overuse and preventing disease progression. Ultimately, such interventions can enhance patients' overall well-being, improve their ability to perform daily activities, and foster better social and professional engagement.

2. Migraine

Migraine is a chronic neurological disorder with multifactorial causes, which may include genetic, environmental, and neurological factors. It is defined as a spontaneous, recurring headache that occurs in attacks, lasting from 4 to 72 hours. The pain is characteristic - unilateral, pulsating, and may be accompanied by nausea, vomiting, or photophobia. The nature of the pain varies with age, in children, it is more often bilateral and lasts from 2 to 72 hours. The pain may change location even during the attack [30].

A characteristic feature of migraine is the possibility of focal symptoms preceding the attack, known as aura, which divides this condition into migraine with aura and migraine without aura. These focal symptoms are most commonly bilateral visual aura—such as blind spots or flashes, which may appear as zigzags. Other focal symptoms include sensory aura and speech disturbances (usually in the form of aphasia). A serious symptom is brainstem aura, which manifests as dysarthria, dizziness, ataxia, and altered consciousness [30].

Migraine affects approximately 12% of the population, although this figure is likely underestimated. Chronic migraine affects 1-2% of the global population. Migraine is a common condition and is the second leading cause of disability, significantly reducing patients' QoL. It affects women three times more often, with the first attacks usually occurring in childhood or adolescence [31,32].

In migraine, whether with or without aura, prodromal symptoms may occur. These symptoms include weakness, mood changes ranging from depression to excitement, and gastrointestinal disturbances such as reduced appetite [33]. The exact mechanism behind these symptoms is not fully understood, but it is likely that the basal ganglia and hypothalamus play an important role, as shown in a study by F. Maniyar et al. Patients who experienced prodromal symptoms had increased blood flow, as observed using PET scans [34].

Migraine attacks in many people occur without any obvious cause. However, in some patients, they may be triggered by factors such as certain foods (e.g., coffee), medications, stress, sudden weather changes, loud noises, strong scents, a low-calorie diet, starvation, poor sleep hygiene, and sleep disturbances [35]. The pathophysiology of the disease is not fully understood. There are several hypotheses, but it seems that the most important factors influencing the development of the disease are synaptic transmission disorders and vascular factors, triggered by episodic changes in the central nervous system. In the course of migraine, activation of the trigeminovascular system can occur, which is strongly linked to the formation of the migraine aura. Vascular changes initially include vasoconstriction of intracranial vessels, followed by excessive vasodilation, which manifests as a pulsating headache, and then secondary edema causing dull pain. It seems that the molecule CGRP - calcitonin gene-related peptide - may be involved in migraine, as elevated CGRP levels have been found in the jugular vein during a migraine attack, and a CGRP receptor antagonist has proven effective in treating the pain attack. Changes in neurotransmitters during the disease include a rapid increase in serotonin during the migraine attack, and before and during the attack, there is overactivity of postsynaptic dopaminergic receptors [36].

3. Other types of primary headaches

In addition to migraine, there are also other types of primary headaches that have been classified in the International Classification of Headache Disorders (ICHD-3) [25,37].
Tension-type headaches (TTH) are the most common type of primary headaches, with a global annual prevalence of about 26.8% in the general population [37].

TTH is characterized by bilateral pain of a pressing or tightening quality, of mild to moderate intensity, which does not worsen with routine physical activity [38].

Unlike migraine, TTH is less often accompanied by autonomic symptoms such as nausea or vomiting. However, in the case of chronic TTH, mild nausea may occur. TTH can be divided into episodic and chronic [38].

A significantly less common group classified as primary headaches are trigeminal autonomic cephalalgias (TACs). TACs are a group of primary headaches characterized by unilateral pain and ipsilateral autonomic symptoms within the skull, such as conjunctival injection, lacrimation, and nasal discharge [39,40].

TACs include cluster headache, paroxysmal hemicrania, short-lasting unilateral neuralgiform headache attacks with conjunctival injection and tearing or with cranial autonomic symptoms, and hemicrania continua [39,40]. Epidemiologically, TACs are rare - cluster headache, the most common among them, has an annual incidence of about 53 per 100,000 people [39]. TACs differ from each other in the duration and frequency of attacks and response to treatment [40].

A characteristic feature of TACs is the presence of autonomic symptoms on the same side as the pain, which results from the activation of the trigeminoautonomic reflex. The differential diagnosis of TACs includes other short-lasting pains, such as trigeminal neuralgia or primary stabbing headache [40].

The most common among TACs, cluster headache, is a primary pain disorder characterized by extremely severe, unilateral pain that typically localizes in the orbital, supraorbital, or temporal region and lasts from 15 to 180 minutes [39]. Attacks can occur from once every two days to eight times a day, and their intensity is so great that they are often referred to as "suicide headaches". They are accompanied by autonomic symptoms on the same side of the body, such as lacrimation, conjunctival injection, eyelid edema, and nasal congestion. Cluster headache shows a distinct circadian rhythm, with attacks most commonly occurring between 21:00 and 03:00. Cluster headache affects about 0.12% of the population during their lifetime, with a predominance in men at a ratio of 2.5:1 to 3.5:1. It typically begins in the third to fifth decade of life and tends to run in families, increasing the risk in first-degree relatives from 14 to 48 times [39].

Other primary headaches cover a wide spectrum of disease entities of a heterogeneous nature. The etiology of these headache disorders remains largely unknown, and current treatment approaches are primarily based on anecdotal evidence or uncontrolled studies. It's important to note that headaches with similar presentations can be secondary to other

underlying conditions. Therefore, when these headaches first manifest, thorough evaluation including imaging and other appropriate tests is essential [25].

Some of these headaches, such as primary exercise headache, primary headache associated with sexual activity, and primary thunderclap headache, can have an abrupt onset. As a result, patients experiencing these may seek care in emergency settings. In such cases, comprehensive investigation, particularly neuroimaging, is absolutely necessary to rule out secondary causes [25].

4. The impact of primary headaches on patients' quality of life.

Quality of life (QoL) has been defined by the World Health Organization (WHO) as *"a person's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns."* The QoL of patients with primary headaches, including migraines and TTHs, is strongly dependent on the frequency and severity of symptoms. These conditions can significantly impair daily functioning, overall well-being, and life satisfaction [41,42].

As noted, migraine headaches significantly reduce the QoL of affected individuals. A study conducted by Awaki E et al. revealed that migraine symptoms significantly disrupted the ability to perform daily household tasks, either reducing productivity or making them completely unmanageable. Among the study group of 17,071 individuals with migraines, 43.4% reported that they had to abstain from household duties for ≥24 hours, and a similar period of reduced productivity was observed in 49.2% of respondents. Moreover, migraine symptoms interfered with sports activities in 51.8% of participants [43].

Another study by Ataya J. et al. demonstrated that anxiety and fatigue, which are more common in individuals with migraines than in healthy individuals, are major contributors to the decreased health-related quality of life [44].

In a separate study, 1,268 banking sector employees were surveyed, among whom 598 were diagnosed with migraines using the ID-Migraine™ test. The average percentage productivity loss was found to be 39.1%, while work absence accounted for only 1.9%, indicating a nearly 20-fold difference. Additionally, the study observed that the average annual financial loss due to work absence was $3,000 among individuals with the highest scores on the MIDAS (Migraine Disability Assessment) questionnaire, with higher MIDAS scores correlating with greater financial losses due to absenteeism [45].

It is estimated that a patient with migraines incurs annual expenses of €1,657.96 (chronic migraines) and €878.04 (episodic migraines). Including financial losses from reduced work capacity and healthcare costs, the total annual cost per patient amounts to €12,970.08 for chronic migraines and €5,041.38 for episodic migraines [46].

Primary headaches can also affect children. Among this population, headaches are one of the most common causes of pain and the third leading disease-related cause of school absenteeism. Primary headaches limit learning abilities and increase the risk of developing depression [47]. A study involving 119 children with epilepsy, 46 of whom reported coexisting migraines, TTHs, trigeminal-autonomic headaches, or a combination of these, revealed a significant deterioration in QoL. The most notable declines were observed in physical and emotional health and school functioning [48].

TTHs, like migraines, also contribute to a reduced QoL. Patients often prefer isolation, avoiding stimuli such as stress that may trigger this type of headache. Furthermore, individuals with TTHs frequently experience sleep disturbances, including insomnia, poor sleep quality, and daytime drowsiness [37,49].

5. Positive effect of physical activity on primary headaches

Physical activity is one of the key factors influencing primary headaches. The HUNT study conducted by Varkey et al.[14] examined this correlation. In the prospective component (1984–1986), 22,397 participants who were presumably headache-free were assessed, while in the cross-sectional component (1995–1997), 46,648 participants were analyzed. The cross-sectional analyses revealed that low physical activity was associated with a higher prevalence of both migraines and non-migraine headaches. In both headache groups, a strong linear trend was observed: lower levels of physical activity correlated with increasing headache frequency. Furthermore, the study demonstrated that a lack of physical activity among individuals without headaches served as a risk factor for the development of non-migraine headaches.

Engaging in physical exercise may serve as a valuable strategy for assisting patients experiencing primary headaches. In a randomized trial carried out by Krøll et al.[18], Danish participants experiencing a minimum of two migraine attacks, at least one day of TTH, and one day of neck pain per month were examined. The participants were randomly and independently assigned to two groups: a control group, which only completed a questionnaire related to their headache symptoms, and an experimental group, which engaged in aerobic training for 45 minutes, three times a week.

Significant improvements were observed in the exercise group, including enhanced physical fitness, increased levels of physical activity, reduced migraine burden, and improved ability to engage in physical activity due to diminished effects of TTHs and neck pain. Additionally, the exercise group demonstrated a notable reduction in migraine frequency, intensity, and duration, as well as decreased neck pain intensity and migraine burden. Participants also experienced improved physical fitness and overall well-being. [18]

An intriguing meta-analysis by Varangot-Reille et al. [50] reviewed 19 studies involving 2,776 participants, 85% of whom were women. Their findings indicated that aerobic exercise had a small to moderate clinical effect on reducing pain intensity and medication use in patients with migraines. In contrast, strength training demonstrated a moderate clinical effect, particularly in patients with TTHs. However, a significant limitation of the analysis was the low quality of evidence, as well as issues with transparency and reproducibility.

In Turin, the capital of Piedmont, Mongini et al.[51] conducted a noteworthy cluster-randomized controlled trial. Volunteers were divided into two groups: a control group consisting of 990 participants and an intervention group with 923 participants. The intervention group was instructed to engage in a specific training program designed to reduce headaches and neck/shoulder pain in the workplace. The primary objectives were to alleviate muscle tension, particularly in the craniofacial-cervical region, and to enhance awareness of excessive muscle contraction.

One component of the program [51] involved relaxation exercises performed once or twice daily. Participants were instructed to sit comfortably in a quiet room, allowing their jaw to fully relax for 10–15 minutes. Following this, they were to apply warm compresses to their cheeks and shoulders. Additionally, the intervention group performed postural exercises with the following instructions:

1) Stand upright with your heels, hips, and neck against a wall. Without moving the rest of your body, bring your shoulders into contact with the wall, then rhythmically relax them.

2) With your body and head resting against the wall, perform horizontal movements of the head, moving it forward and backward.

3) Place your hands behind your neck. Push your head backward against the resistance of your hands, then relax after 2–3 seconds.

Each exercise was performed 8–10 times per session, with sessions conducted every 2–3 hours.

To improve participants' [51]awareness of muscle tension, they were instructed to place red stickers in strategic locations as reminders to avoid excessive contraction of the head and neck muscles.

After six months, the intervention group [51] experienced a reduction in the frequency of headaches, an absolute decrease in the number of headache days per month, and diminished neck/shoulder pain. These findings highlight the potential of targeted exercises and awareness techniques in mitigating workplace-related musculoskeletal discomfort and headaches.

In a randomized controlled trial, Varkey et al. [52] compared the effects of physical exercise, relaxation exercises, and pharmacological treatment over three months in 91 adults with migraines. Participants were divided into three groups:

- Exercise Group: This group engaged in stationary cycling sessions for 40 minutes, three times per week. Each session consisted of a 15-minute warm-up, a 20-minute exercise period, and a 5-minute cool-down phase.
- Relaxation Group: Participants in this group performed a series of six progressive relaxation exercises, with each exercise building upon the previous one. The duration of each exercise ranged from 5 to 20 minutes.
- Pharmacological Group: Participants in this group were treated with topiramate, starting at 25 mg per week and titrated to the highest tolerable dose for each individual, with a maximum dosage of 200 mg per day.

The study demonstrated an average reduction of 0.93 migraine attacks in the exercise group, 0.83 attacks in the relaxation group, and 0.97 attacks in the topiramate group. No statistically significant differences were observed between the groups ($p = 0.95$). These findings suggest that physical exercise could serve as a potential preventive strategy for migraine attacks, particularly for patients who either do not benefit from or prefer to avoid daily medication use.

A similar study was conducted, this time not in Sweden but in Brazil. Santiago et al. [17] recruited 60 adult patients of both sexes with chronic migraines, who were randomized into two groups: one receiving amitriptyline combined with aerobic exercise and the other receiving amitriptyline as monotherapy. Amitriptyline was administered at a dose of 25 mg per week, while the exercise intervention consisted of a 40-minute brisk walk outdoors, performed three times per week. After three months, results showed a reduction in both the frequency and duration of headaches in all patients. However, the group that incorporated physical exercise demonstrated significantly better outcomes compared to the monotherapy group.

What mechanisms underlie the beneficial effects of physical activity on headache symptoms? In a study by Köseoglu et al.[53], forty patients with migraine without aura initially exercised on a treadmill and were then asked to continue an aerobic exercise program at home for six weeks. Plasma beta-endorphin levels were measured throughout the study. It was observed that exercise increased beta-endorphin levels following physical activity; however, no changes in headache parameters were directly correlated with alterations in beta-endorphin levels. Interestingly, baseline beta-endorphin levels before exercise were found to be negatively correlated with changes in the frequency and total duration of migraine attacks, as well as with exercise-induced alterations in beta-endorphin levels.

It is also important to note that menstruation is one of the key factors that increase the risk of onset and persistence of headache and migraine.[54]. Intense physical exertion can lead to hypoestrogenism [55]. Women participating in strength-based sports (such as swimming or rowing), which are not associated with restrictive dieting, exhibit mildly elevated levels of LH, an increased LH/FSH ratio, and mild hyperandrogenism [55].

Regarding psychological mechanisms, improvements in aerobic fitness enhance self-efficacy beliefs and outcome expectations, both for participation in exercise and for the self-management of migraines.[56]

There is also a hypothesis that migraine is a syndrome of self-limited neurogenic inflammation [57,58]. Additionally, there is substantial evidence supporting an inverse relationship between inflammatory markers and physical activity [59].

6. Possible physical activity limitations associated with primary headaches

Physical activity and exercise, while generally beneficial for health, can present significant limitations and challenges for individuals suffering from primary headaches. Research indicates that physical exertion may act as a trigger for headache attacks in susceptible individuals [60]. In migraine sufferers, physical activity during attacks often leads to pain exacerbation, requiring temporary cessation of exercise [61]. Studies have shown that TTH intensity demonstrates significant associations with physical exercise patterns, suggesting careful consideration of exercise routines is necessary [62].

Primary exercise headache (PEH), a distinct type of primary headache disorder, specifically occurs during or after strenuous physical activity. This condition is characterized by sudden onset of head pain during or immediately following physical exertion, typically presenting as a pulsating headache lasting from 5 minutes to 48 hours. The pain is often bilateral

and can be accompanied by migrainous features [60]. The exact pathophysiology remains unclear, but it is believed to involve alterations in cerebrovascular regulation during exercise.

Other exercise-related primary headache disorders include primary cough headache, primary headache associated with sexual activity, and primary thunderclap headache. These conditions share some common features with PEH but are triggered by specific types of exertion. Primary cough headache occurs suddenly with coughing or Valsalva maneuver, while sexual activity headache develops during sexual activity, typically intensifying during orgasm [60]. Primary thunderclap headache is characterized by explosive, severe head pain reaching maximum intensity within 1 minute.

Clinical observations indicate that exertion-related headaches can be either primary or secondary in nature, necessitating careful diagnostic evaluation. These headaches typically respond to specific interventions, with beta-blockers showing effectiveness in exercise-related cases, particularly among younger male patients [63]. In cases of cardiac cephalalgia, approximately two-thirds of patients experience symptoms during physical exertion, with episodes typically lasting less than 30 minutes [63].

For individuals experiencing these conditions, careful monitoring and modification of physical activity patterns is essential. Studies suggest that a gradual approach to exercise, proper warm-up procedures, and maintaining adequate hydration may help reduce the risk of exercise-induced headaches [61,62]. Additionally, healthcare providers should consider prophylactic measures to prevent headache attacks during important physical activities, particularly those requiring high levels of exertion or precision [61].

7. The role of physiotherapy in the management of primary headaches

Physiotherapy is a valuable component in managing primary headaches, addressing associated musculoskeletal dysfunctions like cervical spine impairments and myofascial trigger points. Interventions such as manual therapy, exercise, and invasive techniques aim to reduce headache frequency and intensity while improving QoL.

Manual therapy has been identified as a promising and effective physiotherapeutic approach for the treatment of TTHs, offering significant improvements in pain frequency, intensity, and duration, as well as enhancements in related factors such as QoL and functional outcomes. Various techniques, including myofascial release, cervical traction, and postural correction, have demonstrated positive effects, suggesting that manual therapy can play a crucial role in addressing both the symptomatic and functional impairments associated with

TTHs [64]. De-la-Puente-Ranea Let al. [65] investigated impact of manual therapy in 7 patients of which 2 had chronic cluster headaches and 5 an episodic cluster headaches. The intervention consisted of eight sessions over four weeks, focusing on cervical mobilization, neural mobilization, and motor control exercises. Results indicated that two participants experienced a reduction in headache frequency exceeding 50%, and one participant had a 16.67% decrease, while others showed no significant change in remission phases. Pressure pain thresholds (PPT) of the first trigeminal branch (V1) increased from 0.53 ± 0.21 kg/cm² pre-treatment to 0.63 ± 0.27 kg/cm² at three months. Headache Impact Test-6 (HIT-6) scores decreased from 60.43 to 50.57, and Pain Catastrophizing Scale (PCS) scores improved from 32.86 to 21.14. Psychological measures and disability scores also improved, particularly in cases with significant frequency reduction.

While manual therapy may improve pain-related outcomes in short term, some patients may prefer invasive techniques in managing primary headaches. Lonzar G et al. [66] included nine RCTs with 1,054 participants and evaluated invasive physiotherapy techniques for migraine prophylaxis, such as acupuncture, dry needling (DN), and percutaneous electrostimulation (PES) in a systematic review. Acupuncture reduced migraine days by 50% in 4 to 20 weeks, with effects persisting for up to six months, and showed superiority over sham and parity with pharmacotherapy. DN decreased migraine frequency and acute medication use with just three sessions in one week, maintaining effects for one month. PES demonstrated significant short-term benefits but required 60 sessions over 12 weeks, with an 11% dropout rate. All techniques showed promise, but direct comparisons were limited due to varied methodologies.

Renner T et al. [67] investigated the effect of repetitive peripheral magnetic stimulation (rPMS) applied to myofascial trigger points in the trapezius and deltoid muscles. Over six sessions rPMS significantly reduced headache frequency and disability in 37 high-frequency episodic migraine patients (36 females, mean age 25.0 ± 4.1 years) who completed a randomized trial; headache days decreased by 34.8% in the trapezius group (23 to 16 days, $p = 0.005$) and by 32.5% in the deltoid group (20 to 14 days, $p = 0.003$), while MIDAS scores improved from 29 to 13 ($p = 0.0004$) and from 31 to 15 ($p = 0.002$) respectively, with a notable reduction in work and household productivity impairment (trapezius: 40.0%, $p = 0.001$; 60.0%, $p = 0.002$; deltoid: 53.3%, $p = 0.005$; 30.0%, $p = 0.077$), highlighting rPMS as an effective, well-tolerated non-invasive physiotherapeutic intervention targeting peripheral and central migraine-related mechanisms through the trigemino-cervical complex.

Invasive and non-invasive neurostimulation techniques for chronic primary headaches have shown varying efficacy: invasive occipital nerve stimulation (iONS) studies reported a 50% responder rate, with a 68% reduction in cluster headache attacks and 7.7 fewer headache days in chronic migraine patients after 12 months. Non-invasive transcutaneous stimulation of the trigeminal nerve (tSNS) reduced migraine days by 30% with a 50% responder rate of 38% in episodic migraine, while transcutaneous vagus nerve stimulation (nVNS) decreased chronic cluster headache attacks by 5.9/week (50% responder rate = 40%) and achieved pain freedom in 22% of acute migraine attacks within 2 hours and pain relief in 43%. Adverse events include infections or lead migration in invasive methods (up to 40%) and mild local effects in non-invasive approaches, demonstrating the need for patient-specific treatment consideration [68].

Multidisciplinary treatment strategies for primary headaches are significant. Gaul C et al. [69] highlights the effectiveness of combining physical therapy, psychological support, and patient education to reduce headache frequency and burden. The Headache School in Copenhagen showed that 81% of patients were satisfied or very satisfied with the program, which included six sessions over three months. These sessions significantly reduced headache frequency and its impact on daily life. Relaxation training, supported by biofeedback, demonstrated a 42% responder rate for reducing migraine attacks, with a mean attack reduction of 23% and an effect size of 0.6. Additionally, cervical spinal manipulation was found to have short-term efficacy comparable to amitriptyline for migraine prevention. Physical therapy, particularly when combining manual therapy and exercise, led to improvements in pain, function, QoL, and patient satisfaction in both the short and long term.

8. Diet, supplementation, and primary headaches

The food we eat supplies the nutrients essential for powering our bodies, repairing tissues, and supporting vital bodily functions. In addition to physical health, a well-balanced diet plays a key role in shaping mood, energy levels, and long-term wellness, helping to lower the risk of chronic conditions such as diabetes, heart disease, and obesity. By making conscious dietary choices, people can boost their immune system, maintain a healthy weight, and enhance their overall QoL. Additionally, dietary habits can significantly impact those who experience primary headaches like migraines. Identifying food triggers is crucial, as these substances can influence different stages of the migraine process by affecting serotonin and norepinephrine release, altering blood vessel constriction or dilation, or directly stimulating the trigeminal ganglia, brainstem, and cortical neural pathways[70].

Alcoholic beverages are recognized as migraine triggers in approximately one-third of migraine patients, according to retrospective studies [71]. They are linked to various types of headaches, including migraine without aura, migraine with aura, cluster headaches, and TTHs [71]. Red wine is particularly notable, as it not only contains alcohol but also flavonoids and biogenic amines, which further contribute to the onset of primary headaches [72]. Other compounds implicated in food intolerance-related headaches include tyramine, phenylethylamine, histamine, nitrites, sulfites, and the commonly used artificial sweetener aspartame[70,73]. Jacob SE et al. suggested that migraines might represent an allergic response to formaldehyde. This hypothesis emerged after five patients with a history of migraines triggered by aspartame were found to have positive patch-test reactions to formaldehyde, a byproduct of aspartame metabolism [73].

Conversely, there are "anti-migraine" factors that can help in prevention and management. Feverfew (Tanacetum parthenium L.) is one of the most extensively studied plants for migraine prevention in adults. Its primary active compound, parthenolide, is known for its multiple beneficial effects, including relaxation of vascular smooth muscles, inhibition of serotonin release from platelets, and anti-inflammatory properties[74]. Another noteworthy finding comes from a study involving 1,550 children and adolescents with migraines, where approximately one-third were found to have coenzyme Q10 levels below the reference range. Supplementation with coenzyme Q10 (1 to 3 mg/kg daily for three months) in this subgroup improved their coenzyme Q10 levels, reduced headache frequency, and decreased disability[75]. Coenzyme Q10 also helps combat endothelial dysfunction by promoting nitric oxide release and exhibits anti-inflammatory effects[74]. Rajapakse T et al. highlighted that magnesium deficiency in individuals with migraines might play a role in the condition's development[74]. Supporting this, Peikert A conducted a randomized, placebo-controlled study demonstrating that daily supplementation with 600 mg of magnesium taken orally for three months markedly decreased the frequency of migraine attacks in adults [76]. Furthermore, Guilbot A et al. combined the previously mentioned factors in a study that yielded noteworthy results. An observational study involving 68 patients evaluated the effects of a 3-month supplementation with a formula containing feverfew, coenzyme Q10, and magnesium. After three months, 75% of participants (51 out of 68) experienced a reduction of at least 50% in the number of migraine headache days per month [77]. Caffeine has also been studied for its analgesic properties in managing TTHs, though its effectiveness was found to be less pronounced compared to the combination of caffeine and ibuprofen [78].

These findings reinforce the conclusion that dietary strategies can help reduce the frequency and severity of primary headaches, including migraines. Avoiding the aforementioned headache triggers—such as alcohol, artificial sweeteners, chocolate, aged cheeses, and processed meats—through dietary adjustments can enhance headache management. Moreover, these items can be replaced with anti-migraine alternatives. Consuming herbal teas, fatty fish, spinach, broccoli, coffee, whole grains, nuts, and seeds can contribute to headache prevention and overall better management of the condition.

At last, the ketogenic diet (KD) has recently gained significant popularity and has also been found to possess anti-migraine properties. In a specific case report by Strahlman RS et al., a woman with chronic headaches followed a modified fasting diet consisting of 3–4 high-protein, low-carbohydrate (200 kcal) shakes per day. Once ketosis was established, her headache attacks ceased, and this effect persisted for seven months after discontinuing the fasting protocol[79]. Additionally, KD is an effective tool for weight loss, which is particularly relevant as obesity and headaches, including migraines, are linked through mechanisms such as inflammation and impaired hypothalamic function. In a prospective population-based study with an 11-month follow-up, 3% of controls developed chronic daily headaches (CDH). Obese individuals (BMI $\geq$ 30) had a five times higher risk of developing CDH compared to those of normal weight, while overweight individuals (BMI 25–29) had a threefold increase in risk[80]. Thus, dietary strategies targeting weight loss may also improve headache and migraine outcomes [81]. Highlighting the KD's advantages, another study comparing ketogenic and low-calorie (1200–1500 kcal/day) diets among 108 migraine sufferers found KD significantly more effective, with a 90% responder rate, whereas the low-calorie diet showed no effectiveness [82].

CONCLUSIONS

The high prevalence and negative impact on quality of life associated with headaches highlight the need for further research for solutions to prevent and manage the disease. Reviewed studies revealed that physical activity, specific diet, and physiotherapy can be useful tool in a prevention and reduction of the headaches, however it comes with limitations. Many studies showed that physical exercises, particularly those that are highly demanding, can induce headaches, therefore workout should be introduced with caution among patients susceptible to this condition. In summary, presented lifestyle changes pose promising form of treatment and could revolutionize the approach to the disease, hence the topic should be further investigated by scientists.

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