JOURNAL OF MULTIDISCIPLINARY SCIENCES AND INNOVATIONS
VOLUME 05, ISSUE 01
MOPNTHLY JOURNALS
ISSN NUMBER: 2751-4390
IMPACT FACTOR: 9,08

EFFECTIVENESS OF NON-PHARMACOLOGICAL METHODS IN CHRONIC TENSION-TYPE HEADACHE SYNDROME ACCOMPANIED BY DEPRESSION

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Abstract

The aim of this study was to evaluate the clinical effectiveness of various non-pharmacological therapeutic interventions in patients with chronic tension-type headache (TTH) accompanied by comorbid depression, and to explore their impact on pain intensity, psycho-emotional well-being, and overall quality of life. Chronic TTH is a prevalent primary headache disorder frequently associated with depressive symptoms, which exacerbate headache severity, impair daily functioning, and reduce psychosocial resilience. Pharmacological treatments, while effective, are often limited by adverse effects and the risk of medication-overuse headache, highlighting the importance of adjunctive or alternative non-pharmacological approaches.

This study investigated multiple therapeutic modalities, including transcranial magnetic stimulation (TMS), cognitive-behavioral therapy (CBT), acupuncture, electromyographic biofeedback, structured relaxation techniques, and targeted physical exercises. Each intervention was examined for its mechanism of action and clinical efficacy. TMS modulates cortical excitability and regulates trigeminovascular and somatosensory pathways, thereby reducing headache frequency and alleviating depressive symptoms. CBT and mindfulness-based approaches target maladaptive cognitive patterns and stress responses, improving coping strategies and psycho-emotional stability. Acupuncture and dry needling stimulate endogenous analgesic systems and modulate peripheral and central pain pathways. EMG-biofeedback facilitates voluntary control of muscle tension, particularly in cranio-cervical muscles implicated in TTH pathophysiology, while relaxation and coordinated physical exercises reduce sympathetic overactivity, improve musculoskeletal function, and enhance central pain modulation.

Conclusion: The results indicate that non-pharmacological interventions effectively reduce headache intensity and frequency, alleviate depressive symptoms, and enhance functional capacity and quality of life. Importantly, a comprehensive multimodal approach allows for reduced reliance on pharmacotherapy or even its temporary avoidance, while maintaining high therapeutic efficacy. These findings support the integration of non-pharmacological strategies as a core component of holistic management for chronic TTH with comorbid depression, offering a safe, evidence-based, and patient-centered alternative to conventional pharmacological therapy.

Keywords

Chronic tension-type headache (TTH), Transcranial magnetic stimulation (TMS), Stress syndrome, Depression, Non-pharmacological methods, Biofeedback, Acupuncture, Electromyography (EMG), Cognitive-behavioral therapy (CBT), Relaxation, Neurorehabilitation, Mobilization, Dry-needling, Neurostimulation.

Headache is defined as a type of pain located in the head region, which can vary in clinical presentation and intensity. The international classification of headache disorders divides headaches into three main groups: the first group includes headaches of unknown etiology; the second group consists of headaches and neuropathies with a known cause; and the third group includes other headaches, such as facial pain and other localized pains [1]. According to current epidemiological data, headaches occur in up to 96% of the population over a lifetime. The prevalence is higher among women, which is associated with sex-related differences in headache distribution. The most common type is tension-type headache (TTH), accounting for approximately 40% of cases, while migraine prevalence is about 10% [2]. Headache is a complex clinical condition that negatively affects biological and psycho-social well-being; therefore, its treatment approach must be multifaceted, integrated, and multimodal. The number of scientific studies, experimental results, and evidence supporting the effectiveness of non-pharmacological interventions as alternatives or supplements to standard drug-based therapy is steadily increasing. Complementary and alternative medicine strategies, such as acupuncture, nutraceuticals, or herbal preparations, are noteworthy due to their relative affordability and the possibility of use outside hospital settings, making them attractive and convenient options for patients. However, these strategies are not currently an integral part of mainstream medical practice and lack sufficient robust evidence for wide clinical application.

Psychological and behavioral strategies, including psychotherapy, biofeedback, and relaxation techniques, help patients develop self-management skills, reduce stress, pressure, and mental strain, and improve mental health in managing chronic headache. However, effective implementation of these strategies may require specially trained professionals and adequate resources. Physical therapy is mainly a valuable adjunct for preventive purposes in headache management, though there is still no broad consensus on standardized protocols. Neuromodulation procedures provide effective approaches and methodologies targeting the specific neurophysiological mechanisms of headache, particularly migraine, and portable, mobile devices used by patients represent promising solutions [3].

There are several key reasons for using non-pharmacological approaches in headache treatment. Excessive use of medications can lead to the transformation of headaches into chronic forms. Drugs commonly used in treatment, including non-steroidal anti-inflammatory drugs (NSAIDs), ergotamines, and triptans, when overused or used regularly, may result in medication-overuse headache (MOH). Patients often do not realize that their headaches are caused by the medications they are taking, which leads to a harmful cycle of frequent drug use and seeking stronger medications. It is important to note that headache development due to overuse is associated not with the potency of the drug, but with the frequency of its use [4]. Excessive use of analgesics can also lead to various adverse effects and the development of medication-overuse headache (MOH). Therefore, special attention should be paid to the risk of excessive medication use during periods of migraine symptoms [5]. Non-steroidal anti-inflammatory drugs (NSAIDs), such as aspirin and ibuprofen, may cause gastric ulcers and increase the risk of cardiovascular and cerebrovascular adverse events. Triptans, which are used in migraine therapy, can cause nausea, dizziness, and dry mouth, and may also carry a risk of cardiovascular complications. Opioid analgesics, such as codeine and oxycodone, can lead to constipation, somnolence, and nausea, and are associated with the risk of misuse and addiction. On the other hand, non-pharmacological interventions, such as physiotherapy, acupuncture, or cognitive-behavioral therapy, generally have minimal side effects and a relatively lower risk profile [6].

Non-pharmacological interventions often involve lower initial costs compared to prescription medications, making them more economically sustainable and preferable. Methods

such as relaxation exercises, stress management techniques, and lifestyle modifications typically do not require ongoing expenses. Some patients may have personal reasons for limiting medication use or preferring natural and complementary medical approaches.

Traditionally, CAM (complementary and alternative medicine) approaches include acupuncture, nutraceuticals and herbal preparations, chiropractic and massage therapy, homeopathy, and similar treatment methods. Non-pharmacological interventions also include specific psychological methods, such as cognitive-behavioral therapy, relaxation exercises, and stress management techniques. Other neuro- or physical stimulation methods, such as neurostimulation, biofeedback, and device-assisted interventions, are also considered non-pharmacological approaches. Often, providing patients with information about the nature of their condition, sufficient support from a healthcare provider, and lifestyle modifications can be among the simplest and most effective forms of assistance, particularly in headache management [7].

Chronic tension-type headache (TTH) is the most common form of primary headache disorder, with depressive symptoms present in 20–50% of patients. Depression is directly associated with anxiety and negative mood states. Identifying these co-occurring psycho-emotional disorders is crucial for helping patients adjust emotional regulation and achieve better headache control [8].

Transcranial magnetic stimulation (TMS) is a novel method for treating chronic pain. The aim of research is to investigate the effect of low-frequency repetitive TMS (rTMS) on chronic TTH by evaluating both subjective and objective pain, and to assess improvements in quality of life and mental health. Studying the effectiveness of low-frequency rTMS on the right dorsolateral prefrontal cortex in patients with treatment-resistant depression demonstrates significant correlations between improvements in depression inventory scores, psychological components, social functioning, mental health, general health, vitality, and physical activity [9].

Acupuncture involves inserting fine needles into specific points of the body, aiming to remove blockages related to the flow of vital energy (Qi) along the 14 meridians and its arrival at the 361 classical points. According to traditional perspective, Qi circulates with the blood and performs its functions. Therefore, if a blockage occurs in the flow of Qi, blood flow slows down or stops, resulting in pain [10]. There is a substantial body of scientific research on the effectiveness of acupuncture, covering a wide range of clinical conditions, including low back pain, depressive disorders, anxiety, headache, insomnia, arthritis, and allergic reactions.

A related method to acupuncture is dry needling, which differs from acupuncture in that needles are inserted not into standardized traditional points, but into painful zones and myofascial trigger points. Several studies have reported the effectiveness of this method in treating tension-type headache and cervicogenic (neck-origin) headache [11]. According to the "gate control theory of pain", needle insertion into the skin and tissues activates peripheral A-delta fibers. The activation of these fibers stimulates interneurons located in the dorsal horn of the spinal cord, facilitating the closure of neural "gates." In this way, the transmission of nociceptive (pain-transmitting) impulses to the thalamus is limited, and the central nervous system's reception of pain signals is reduced. In other words, non-painful sensory signals inhibit painful input, overriding it. Another important factor explaining acupuncture mechanisms is the inhibition of the caudal trigeminal nucleus (nucleus caudalis trigeminalis). This nucleus processes pain afferents from cranial blood vessels and the dura mater, so its decreased activity significantly contributes to the reduction of pain perception, particularly in the pathogenesis of migraine.

Additionally, neurobiological studies show that acupuncture stimulates the release of endogenous analgesic substances, including endorphins, enkephalins, and dynorphins. These

endogenous opioids provide analgesic effects both centrally and peripherally, reducing pain sensitivity and leading to the alleviation of clinical symptoms [12].

Cognitive-behavioral therapy (CBT) is a psychotherapeutic approach based on the biopsychosocial model, consisting of a set of cognitive and behavioral strategies aimed at headache management and improvement of quality of life. The main function of the cognitive component is to identify dysfunctional beliefs and thought patterns (e.g., catastrophizing, avoidance behaviors, obsessive ruminations), understand how they can increase stress and trigger headache, and replace them with adaptive, constructive cognitive approaches such as acceptance and mindfulness.

Behavioral strategies focus on identifying habits and behaviors that trigger, intensify, or maintain headaches, applying stepwise interventions, and modifying them. These factors may include smoking, low physical activity, poor sleep hygiene, and unhealthy eating habits [13]. CBT approaches have been extensively studied for migraine and other primary headaches. Research shows that although there are empirically supported and robust behavioral treatment methods in this field, they are often unavailable or underutilized for many patients in clinical practice [14].

EMG-biofeedback is an effective non-pharmacological method aimed at reducing symptoms of headache, particularly tension-type headache (TTH), by assessing and controlling muscle tension. This approach is based on electromyography (EMG) technology, which records muscle electrical activity in real time and provides patients with visual or auditory feedback on their muscle tension levels. This process is crucial for training muscle relaxation, reducing stress responses, and correcting dysfunctional muscle activity [3].

During training, electrodes are typically placed on the frontalis, masseter, and trapezius muscles, which play a central role in TTH pathogenesis, as they often exhibit excessive activity in response to stress, psycho-emotional strain, jaw clenching (bruxism), poor posture, or prolonged computer use. High muscle tone increases blood circulation in the head and neck, muscle perfusion, and the transmission of pain impulses through nerve fibers.

During EMG-biofeedback sessions, patients learn to monitor their muscle activity, perform relaxation exercises correctly, and reduce muscle tone. Research has confirmed the positive effects of this method, including:

- Significant reduction in muscle tension,
- Decrease in headache frequency and intensity,
- Improvement in stress and anxiety levels,
- Enhancement of overall psychophysiological state and quality of life.

Thus, EMG-biofeedback is considered an effective multimodal approach for patients with TTH, helping to correct muscle dysfunction, manage psychological factors, and promote musculoskeletal relaxation. Muscle tension is displayed on visual or auditory monitors through low- and high-frequency signals-low-frequency tones indicate lower tension, while high-frequency tones indicate higher tension. The primary goal of EMG-biofeedback is to help the user identify stimuli that trigger muscle tension, modify their responses, and apply relaxation strategies over time, resulting in a significant reduction in headache frequency and intensity [15].

Relaxation techniques can be studied and applied in practice to regulate stress and pain responses, reduce sympathetic nervous system activity, and decrease muscle tension. Methods to achieve a relaxed state are highly diverse, ranging from traditional yoga and meditation practices to modern breathing exercises and mindfulness techniques. Scientifically validated methods include progressive muscle relaxation, autogenic training, and meditation [3]. Joint manipulation refers to rapid, controlled movements performed at the end range of a joint's motion, whereas mobilization involves slower, broader, and controlled movements within the joint's normal range

of motion. In general practice, manipulation or mobilization of the spinal and cervical joints is used to alleviate injuries associated with headache. Studies indicate that adults suffering from migraine and tension-type headache (TTH) often exhibit increased sensitivity in the neck and head region. Recent evidence shows that physical therapy significantly reduces headache intensity and frequency in TTH not only in the short term (up to 8 weeks) but also in the long term (up to 26 weeks post-intervention) [16]. The reduction of exercise-induced hyperalgesia is associated with the activation of pain-inhibitory pathways, highlighting that headache management should not focus solely on local tissues but also include strategies to normalize central nervous system excitability.

Due to the heterogeneity of headache mechanisms, the most appropriate physical exercise program should be tailored to the type of pain. For instance, aerobic exercises are effective for migraine prevention, while specific neck and shoulder exercises yield better results for patients with tension-type and cervicogenic headaches. Furthermore, cranio-cervical flexion exercises have been shown to significantly reduce headache frequency, intensity, and duration.

Although some studies note that physical exercises may trigger migraine in certain individuals, regular physical activity can have a preventive effect, likely due to changes in the migraine-triggering threshold in active individuals. Additional mechanisms include increased levels of plasma beta-endorphins, endocannabinoids, and brain-derived neurotrophic factors. Therefore, patients with migraine should be encouraged to perform exercises with controlled intensity, frequency, and duration to achieve the most optimal therapeutic outcomes [3].

Neurostimulation or neuromodulation is a relatively new and rapidly developing therapeutic approach used in the treatment of chronic pain syndromes, including headache. This approach involves modulating the activity of the brain, cranial nerves, and peripheral nerves through electrical or magnetic impulses. The main objective is to influence the neural pathways involved in the transmission and perception of pain and to regulate their functional activity [17]. Since magnetic fields are generated as short-term impulses, there are several types of transcranial magnetic stimulation (TMS): single-pulse TMS, paired-pulse TMS, and repetitive TMS (rTMS). Single-pulse TMS exerts a therapeutic effect by disrupting cortical hyperexcitability waves that arise following increased depressive neuronal activity responsible for cortical spreading depression in migraine aura, pain perception, and sensory changes. This process affects the activity of the trigeminovascular and trigeminocervical systems and modulates neuronal conductivity.

In a pilot study, high-frequency rTMS targeting the left dorsolateral prefrontal cortex was applied based on observations that this region exerts inhibitory effects on pain pathways. The results showed that after 12 sessions, patients with chronic migraine experienced significant clinical improvement in attack frequency and use of abortive medications [18]. Currently, a handheld, portable TMS device with cognitive control is the only device approved by the US FDA for the treatment of migraine with aura [19]. A randomized clinical trial was conducted with 72 migraine patients, who were randomly assigned to rTMS and tDCS groups. Participants received 3 sessions of rTMS or 12 sessions of tDCS targeting the left dorsolateral prefrontal cortex (DLPFC). One month after the final session, follow-up assessments were conducted to evaluate pain intensity, anxiety, depression levels, and impact on daily life. Statistical analyses were performed using IBM SPSS Statistics 26. Results indicated that both rTMS and tDCS have potential therapeutic effects in reducing pain intensity, improving daily functioning, and lowering anxiety levels in patients with chronic migraine. However, significant positive changes in depression scores were observed only in the rTMS group [20]. Non-pharmacological treatment methods mainly include psychotherapy, behavioral therapy, physiotherapy,

mobilization, TMS, and needle therapy (acupuncture), and they are often used in combination with medications. Their efficacy is scientifically validated.

According to research, electromyography (EMG) biofeedback and relaxation exercises, when used individually or in combination, can reduce headache activity by nearly 50%. Relaxation exercises and physical activity improve sleep quality, increase energy levels, and enhance subjective well-being. Cognitive-behavioral therapy (CBT) significantly reduces tension-type headache (TTH) symptoms, and its effectiveness is further enhanced when combined with medication. Mindfulness therapy alleviates pain, while yoga may serve as a beneficial adjunctive intervention for TTH. Massage, manual therapy, and other physical methods decrease pain intensity and frequency, shorten pain duration, and improve quality of life, making them promising non-pharmacological alternatives. Dry needling safely reduces headache intensity and frequency. Additionally, acupuncture provides long-term benefits, and transcutaneous electrical nerve stimulation (TENS) significantly reduces headache severity [21].

Conclusion

Chronic headache syndromes with comorbid depression (TTH + depression) have a complex biopsychosocial nature, and their treatment is most effective when pharmacological and non-pharmacological approaches are combined. Recent scientific literature, randomized clinical trials, and meta-analyses highlight that non-pharmacological therapies are a key therapeutic direction in managing this condition. Evidence indicates that TMS (transcranial magnetic stimulation), tDCS, acupuncture, biofeedback, CBT, mindfulness, relaxation techniques, physiotherapy, and properly tailored physical exercises significantly reduce symptoms in patients with chronic headache comorbid with depression. These therapies decrease pain frequency and intensity by 30–60%, reduce muscle tension, stress reactivity, and trigeminal system excitability, and improve psychoemotional state, sleep, cognitive functions, and overall quality of life.

Neuromodulation methods-particularly repetitive transcranial magnetic stimulation (rTMS)-have been scientifically proven to achieve therapeutic effects on depression scores equal to or greater than pharmacological treatments and to normalize the activity of the prefrontal and somatosensory systems in tension-type headache (TTH). Acupuncture and dry needling effectively reduce pain by inhibiting the trigeminovascular system and enhancing endogenous opioid release. Psychological interventions-including CBT, mindfulness, relaxation, and stress management techniques-reduce catastrophic thinking, alleviate depressive symptoms, increase pain perception thresholds, and foster self-management skills.

Physiotherapeutic approaches-such as manual therapy, neck and shoulder muscle strengthening exercises, and aerobic training-address the musculoskeletal component, reduce central sensitization, and facilitate long-term clinical remission. These non-pharmacological interventions also play a crucial role in mitigating the overuse of medications, medication-overuse headache, and the adverse effects of pharmacotherapy on the gastrointestinal, cardiovascular, and nervous systems.

Thus, non-pharmacological approaches are considered a modern, effective, and safe component of the comprehensive treatment of chronic tension-type headache with comorbid depression. When applied in conjunction with pharmacotherapy within a multimodal therapy framework, they lead to optimal clinical outcomes, enhanced psycho-emotional stability, and a significant improvement in quality of life.

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