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The Effects of Specific Exercise Modalities on Tension-Type Headache Symptoms: A Narrative Review

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Abstract:
Background: Tension-type headache (TTH) is the most prevalent primary headache disorder, characterized by a complex pathophysiology involving pericranial muscle tenderness,

craniocervical muscle weakness, and central sensitization. While pharmacological treatments are common, their long-term efficacy is limited by potential adverse effects and the risk of medication-overuse headache.
Aim: This narrative review aims to evaluate the influence of specific exercise modalities—including strength training, aerobic exercise, and low-intensity interventions such as yoga, pilates, and relaxation exercises—on TTH frequency, intensity, and duration. **Material and methods:** A comprehensive literature search was conducted using PubMed/MEDLINE, Google Scholar, and Cochrane Library for peer-reviewed studies published between 2015 and 2025. The analysis focused on active physical interventions in adult patients with TTH.
Results: Strength training targeting the deep neck flexors and extensors effectively reverses muscle atrophy and corrects the cervical extension/flexion ratio, particularly when combined with postural correction. Aerobic exercise modulates central pain processing, showing comparable efficacy to body awareness therapies. Novel interventions focusing on the posterior kinetic chain (hamstring relaxation) and progressive muscle relaxation show promise in addressing widespread hyperalgesia.
Conclusions: Physical training is a potent, disease-modifying intervention for TTH. Optimal outcomes require long-term (3–6 months) multimodal protocols that combine local biomechanical correction with systemic pain modulation.

Key Words: Tension-type headache; Exercise therapy; Strength training; Aerobic Exercise; Yoga; Pilates; Central sensitization; Posterior kinetic chain; Progressive Muscle Relaxation.

Content

7. References

1. Introduction

In terms of global prevalence, tension-type headache (TTH) remains the most frequently encountered neurological condition [1]. According to the Global Burden of Disease 2019 study, TTH affects approximately 26% of the general population [2,3] with lifetime prevalence rates reported as high as 78% in certain demographics. [4]. Like migraine, TTH exhibits a gender display, though it is less pronounced, with women consistently reporting higher prevalence rates (27.1%) compared to men (23.4%) [5].

Clinically, this primary headache disorder is defined by bilateral pain with a constricting or pressing quality, typically ranging from mild to moderate severity. Attacks of pain can persist from minutes to days, usually appear without nausea, and are not exacerbated by routine physical activity; however, patients may occasionally exhibit photophobia or phonophobia. Additionally, increased pericranial tenderness during manual palpation can be present in some forms of the disease. In compliance with clinical criteria provided by the International Classification of Headache Disorders, third edition, TTH subdivides into three subtypes according to its frequency: infrequent form <12 days per year, a frequent episodic lasting between 12 and 179 days per year, and a chronic form present for 180 days per year or more [6]. Understanding this difference is crucial since the disorder's pathophysiology evolves significantly as it becomes chronic.

It is critical to acknowledge that primary headache disorders rarely exist in isolation. Danish population studies have revealed that up to 94% of migraineurs also report coexistent TTH [4]. Furthermore, comorbid neck pain affects nearly 90% of patients with mixed headache presentations [7], and 80% of patients with TTH exhibit low back pain [8]. This multimorbidity is not benign; the presence of co-occurring TTH and spine pain serves as a strong predictor for worsened prognosis and increased disability [9,10]. Consequently, physical training interventions for this group must provide a balance between being sufficiently active to address the myofascial restrictions of TTH and neck pain [11,12], yet carefully graded to avoid exacerbating the neurovascular sensitivity of migraine [13,14]. Other well-recognized aggravating factors are sleep disturbance and stress [15]. Research shows that poor sleep quality lowers pain thresholds and prevents the nocturnal relaxation of pericranial muscles, directly contributing to morning TTH. Stress, however, stands as a trigger reported by nearly 70% of patients [16].

Infrequent TTH management relies strongly on pharmacological interventions, including over-the-counter analgesics like NSAIDs. However, both frequent and chronic TTH may require preventative medicalization with more specialized drugs like antidepressants (e.g., amitriptyline, mirtazapine, venlafaxine) along with non-pharmacological prophylactics. [15,17] Nonetheless, long-term medication use of NSAIDs carries risks of gastrointestinal, renal, and hepatic adverse effects, as well as paradoxical development of medication-overuse headache [18]. Non-pharmacological alternatives, although underestimated by society, seem to be the key to treating chronic pain conditions. Examples of a wide range of popular interventions for this condition involve physical therapy, manual joint mobilization techniques, electromyography biofeedback, psychological education, acupuncture, and last but not least, physical activity [15].

The introduction of physical activity as part of multidisciplinary therapy allows for more in-depth work with the triggers associated with peripheral pain than relying on the use of medications only. Neurophysiologically, aerobic and high-intensity resistance training induce Exercise-Induced Hypoalgesia. This phenomenon contributes to pain modulation through the activation of the endogenous opioid and endocannabinoid systems, the release of Brain-Derived Neurotrophic Factor (BDNF), as well as the restoration of descending inhibitory pathways. Another crucial component of physical activity is its anti-inflammatory effect through the reduction of pro-inflammatory cytokines (IL-1β, TNF-α, and IL-6) and an elevation of the anti-inflammatory (IL-10) [19]. Then again, from a mechanical standpoint, specific strength and flexibility exercises aim to restore the normal length-tension relationships of the cervical musculature, correcting the "Upper Crossed Syndrome" posture (weak deep neck flexors/lower trapezius vs. tight pectorals/upper trapezius/suboccipitals) [20].

The benefits of physical activity in the treatment of chronic pain disorders are widely recognized, yet there remains a significant gap in understanding how specific training modalities impact the clinical course of TTH. Hence, this review aims to evaluate the effects of activities such as strength training, aerobic exercise, and low-intensity physical interventions on headache frequency, intensity, and duration in TTH patients.

2. Research Materials and Methods

A comprehensive literature search was conducted using PubMed/MEDLINE, Google Scholar, and Cochrane Library for peer-reviewed studies published between 2015 and 2025, to ensure the inclusion of the most recent therapeutic advances and pathophysiological insights. The search strategy utilized a combination of Medical Subject Headings (MeSH) and free-text keywords including: *"Tension-type headache"*, *"TTH"*, *"Chronic tension-type headache"*, *"Exercise therapy"*, *"Strength training"*, *"Aerobic exercise"*, *"Yoga"*, *"Pilates"*, *"Progressive muscle relaxation"*, *"Physical activity"*, *"Myofascial trigger points"*, and *"Central sensitization"*. Boolean operators (AND, OR) were employed to refine search results (e.g., *"Tension-type headache AND Strength training"*). Studies were included if they investigated active physical exercise modalities as a standalone or primary intervention in adult participants with diagnosed TTH, according to the International Classification of Headache Disorders (ICHD) criteria.

3. Pathophysiology

Pathophysiology of TTH is complex and yet not fully understood despite the popular nature of the disease. Potential mechanisms of the condition include genetic factors, peripheral mechanisms linked to myofascial trigger points, and central sensitization [15]. As genetic factors concerning pathophysiology go beyond the scope of this article, this chapter will discuss only peripheral and central mechanisms.

3.1. Peripheral Mechanisms

One of the possible, but not entirely distinctive, symptoms of TTH is tenderness of the paracranial muscles on palpation, both during and without headache attacks. Literature describes increased muscle hardness due to sustained constriction in TTH. Enhanced tenderness and hardness of tissues are often attributed to the presence of myofascial trigger points - hypersensitive spots in skeletal muscles that are associated with palpable nodules in taut bands [15,21,22]. In TTH, these are usually located in the suboccipital, upper trapezius, sternocleidomastoid, and temporalis muscles [10]. Certain studies suggest that continuous maintenance of a forward head posture (FHP) leads to the selective recruitment of muscle fibers, causing the formation of active myofascial trigger points [23]. Consequently, this may result in a local energy crisis leading to ischemia and release of inflammatory factors (such as bradykinin, calcitonin gene-related peptide (CGRP), substance P, serotonin, and norepinephrine), potentially leading to sensitization of peripheral nociceptors, especially in chronic TTH [23,24].

3.2. Central Mechanisms

In episodic TTH, peripheral mechanisms dominate. However, in frequent and chronic TTH, prolonged abnormal peripheral pain stimuli from myofascial structures cause central sensitization, resulting in the presence of hyperalgesia and allodynia. Available studies identify several mechanisms that could lead to this phenomenon. First hyperexcitability of Second-Order Neurons - especially sensitization of the Trigeminal Cervical Nucleus. This nucleus receives afferent input from the upper cervical nerve roots (C1-C3) and the trigeminal nerve. Another structure affected by hypersensitivity are dorsal horns of the spinal cord from levels C1 to C4. In chronic cases, these second-order neurons become hyperexcitable, amplifying sensory inputs. Second, there is impaired descending inhibition in the supraspinal pain modulation systems - specifically the Periaqueductal Gray (PAG) and the Rostral Ventromedial Medulla. In consequence, the inability to maintain normal inhibitory control over incoming pain signals results in widespread hyperalgesia [15]. In general, patients with chronic TTH demonstrate lower pressure pain thresholds (PPTs) not only in the cranio-cervical region but also in extracephalic areas (e.g., the tibialis anterior), indicating a generalized sensitization of the central nervous system [25].

4. Literature review

4.1. Strength training: Rebuilding the Craniocervical Foundation

Craniocervical dysfunction in the neck musculature is not only a symptom but also an active driver of TTH chronification. Specific patterns of muscle impairment include weakness and atrophy of deep neck flexors (DNFs) (longus colli and longus capitis), and extensors in combination with overactivity and shortening of the superficial muscles (sternocleidomastoid and upper trapezius). Described imbalances often result in FHP, where the load on the cervical spine increases [26]. Therefore, the DNFs are usually the primary target of strength-based exercise interventions

In the last decade, few studies have examined the consequences of reversing DNFs atrophy and its impact on headaches in patients with frequent or chronic TTH. Martín-Vera et al. (2023) [27] conducted a randomized controlled trial (RCT) involving patients in a 12-week supervised exercise program. Participants engaged in specific craniocervical isometric exercises (isometric cervical flexion, extension, and lateral flexion) with shoulder girdle strengthening (horizontal and vertical rows, shoulder abduction, and horizontal abduction) using elastic bands. Later results were measured using an ultrasound imaging, confirming an increase in the thickness of the longus colli and cervical multifidus muscles, with a clinically correlating reduction in headache intensity and duration compared to the control group. However, there were no differences between groups in terms of headache frequency. Other results revealed increased PPTs of the temporalis, masseter, upper trapezius muscle, and median nerve. This pivotal link between muscle growth and symptom relief supports the hypothesis that reversing atrophy in deep stabilizers raises the threshold for pain generation.

Further completing these findings, 4-weeks RCT by Choi (2021) [28] demonstrated that performing deep cervical muscle flexion exercises helps not only in correcting the FHP and pain reduction but also improves sleep quality. Moreover, deep cervical muscle exercises showed superior effects compared to the group performing passive stretching. The mechanism proposed here is that stabilization of the cervical spine during the day reduces cumulative neck strain, preventing nighttime muscle tension that often disrupts sleep—a key finding given the strong bidirectional relationship between sleep disturbances and TTH.

However, other evidence suggests that "strength" may not be the sole answer. In a rigorous 10-week RCT conducted by Madsen et al. (2018) [29], elastic band strength training targeting the trapezius and neck extensors was compared with an ergonomic posture correction control group in terms of TTH symptoms. An 11% decrease in frequency and a 10% decrease in duration were observed within the “strength” group in comparison to a 24% reduction in frequency and a 27% reduction in duration for the “ergonomic” group. Although both groups numerologically improved, surprisingly, the ergonomic posture group obtained a higher reduction in frequency and duration of headaches than the strength training group. The researchers conclude that a combination of postural and strength exercises may be an even more efficient solution. On the other hand, the relatively short duration of the study may have influenced the results. There is likely a limit to the extent of neural adaptations that can occur during short-term interventions, while significant physiological changes in chronic pain disorders require more time.

Rinne et al. (2023) [30] supported this hypothesis in their 6-month progressive training intervention. The specific neck-shoulder exercise program started with low-load motor control exercises (similar to the DNF protocols) and progressively graduated to high-load resistance training for the neck and shoulders. The outcomes were vastly different from the shorter Madsen study: weekly headache frequency in the exercise group was nearly halved, dropping by 47%. The juxtaposition of Madsen (10 weeks, limited difference) and Rinne (6 months, significant difference) suggests a dose-response relationship. Chronic TTH involves established neuroplastic changes in the brainstem; reversing these likely requires sustained afferent input and metabolic adaptations, which can only be provided by long-term, progressive resistance training.

The most recent study in this field integrated strength with explicit postural education. Padrós-Augé et al. (2025) [31] investigated this multimodal approach in a prospective single-arm pilot study involving patients with chronic primary headaches (migraine and TTH). During their 14-week protocol, patients not only strengthened their muscles but also strengthened them in a biomechanically advantageous position by applying posture correction. The study showed a large effect on reducing headache duration (r = 0.562) and functional improvement (r = 0.716). The implication is that the "functional" application of force (teaching the patient to hold their head correctly while exerting force) may be better than isolated strengthening exercises. This fills a gap identified in previous studies by considering both muscle performance (strength) and the quality of its use (posture). Information on the strength exercise protocols used and key clinical outcomes of the cited studies are presented in **Table 1**.

Table 1. Strength Training Studies (2015-2025).

Study Characteristics	**Intervention Protocol**	**Key Clinical Outcomes**
Martín-Vera et al. (2023) [27] RCT n = 40 12 weeks	Protocol: 2–3 sessions/week. 3 sets of 8–10 repetitions at Borg Scale 7/10 (Vigorous). Exercises: 1. Mobility: cervical spine and arms. 2. Strength (elastic bands): shoulder flexion, abduction, horizontal row, "bird-dog". 3. DNF: craniocervical flexion (chin tucks) and isometric cervical flexion/extension.	Significant decrease in headache intensity and duration compared to controls. Ultrasound confirmed increased muscle thickness of the longus colli and cervical multifidus.

Choi (2021) [28] RCT n = 32 4 weeks	Protocol: 5 sessions/week. Exercises: deep cervical flexion: patient in supine position performing craniocervical flexion (chin tuck) to flatten the cervical lordosis against the bed, holding contractions. Comparison: vs. static stretching exercises.	Significant improvement in Headache Disability Inventory (HDI) and Pittsburgh Sleep Quality Index (PSQI-K) scores compared to the stretching-only group.
Madsen et al. (2018) [29] RCT n = 60 10 weeks	Protocol: 3 sessions/week (total 1 hour/week) using elastic resistance bands. Exercises: targeted strengthening of shoulder abductors (lateral raise), trapezius (shrugs), and neck extensors. Comparison: vs. ergonomic and posture correction counseling.	Improved muscle function. However, no significant difference in headache frequency reduction between the strength group and the ergonomic control group.
Rinne et al. (2023) [30] RCT n = 116 6 months	Protocol: progressive home-based program. High frequency (4–6x/week). Exercises: Phase 1: low-load cervical and axio-scapular motor control exercises. Phase 2: progression to high-load isometric and dynamic resistance exercises for the neck and upper body using elastic bands. Phase 3: maintenance with stretching.	Headache frequency decreased by 47% in the exercise group. Significantly greater improvement in Neck Disability Index (NDI) vs. transcutaneous electrical nerve stimulation control.

Padrós-Augé et al. (2025) [31] Pilot Study n = 24 14 weeks	Protocol: 8 weeks supervised group training (3x/week) followed by 6 weeks non-supervised. Exercises: progressive strength training for neck and shoulder muscles combined with explicit postural correction instructions to maintain neutral cervical alignment during exertion.	Large effect size for reduction in headache duration (r = 0.562) and improvement in overall functional status. Significant reduction in headache frequency.

4.2. Aerobic Exercise: Systemic Modulation and the Migraine-TTH Overlap

While strength training targets the local biomechanics, aerobic exercise addresses the systemic dysregulation of pain processing. Aerobic training, defined as structured physical activity engaging large muscle groups rhythmically and continuously, has achieved a high status as an intervention. However, its efficacy relies heavily on an understanding of TTH pathophysiology. The key factor determining the chronic nature of TTH, which is at the same time most strongly influenced by aerobic exercise, is central sensitization. It is precisely this disorder that is also the main target for the abovementioned exercise-induced hypoalgesia [19].

In a landmark 12-week RCT by Ataş and Mutlu (2025) [32], a structured exercise program was compared against pure aerobic training on a cycle ergometer. The study differentiated between low and high intensity. Results demonstrated that high-intensity aerobic exercise generated a significantly stronger exercise-induced hypoalgesia response than low-intensity or isometric exercises. Importantly, researchers observed increased PPTs not only in the exercising limbs but also in the non-exercised cranio-cervical region. This provides evidence that intense aerobic training triggers systemic pain inhibitory mechanisms capable of modulating nociception in the trigeminal area, even without direct neck muscle engagement.

Sertel et al. (2017) [33] compared aerobic exercise with body awareness therapy (BAT) in TTH patients. The 6-week aerobic protocol (3x/week, 60 mins) focused on breaking the cycle of pain and immobilization. Both the aerobic and BAT groups showed significant reductions in VAS pain scores, the Pain Disability Index (PDI), and HIT-6 scores compared to controls. Based on the study, it appears that although different starting points are used (physical via aerobics vs. psychological via BAT), both effectively reduce the symptoms of TTH. However, aerobic exercise offers the added benefit of improving physical fitness, essential for patients who often lose physical stamina due to fear of movement (kinesiophobia).

Many patients present with an "overlap syndrome," where TTH co-exists with migraine. This presents a unique challenge, as the pathophysiology involves both the muscular tension of TTH and the neurovascular sensitivity of migraine. Krøll et al. (2018) [34] investigated this specific subgroup in a 12-week RCT involving aerobic exercise (bike/cross-trainer). The results revealed that while patients reported significant reductions in "migraine burden," pain intensity, and neck pain, there were no significant changes in objective PPTs. This contradicts the findings in pure TTH patients (like in Ataş's study), where PPTs improved. Krøll's findings suggest that in mixed headache populations, the benefit of aerobic exercise may not be purely physiological desensitization but rather behavioral. Exercise modifies avoidance behavior; patients learn that movement is safe, which reduces the psychological distress that often triggers attacks. Therefore, for mixed headache patients, aerobic exercise acts as a potent modulator of well-being and function, even if it does not immediately alter the sensitivity of the nociceptors themselves. Information on the aerobic exercise protocols used and key clinical findings of the cited studies are presented in **Table 2**.

Table 2. Aerobic Exercise Studies (2015-2025).

Study Characteristics	**Intervention Protocol**	**Key Clinical Outcomes**
Ataş & Mutlu (2025) [32] RCT n = 54 12 weeks	Protocol: 2 days/week, 45 min/session. Group A (structured): 5 min warm-up + aerobic exercise + strengthening (deep cervical/shoulder) + Stretching (neck). Group B (aerobic): 5 min warm-up + 40 min pure aerobic exercise (moderate intensity).	Both groups showed statistically significant improvements in pain intensity and quality of life. The structured exercise group was superior for improving proprioception and PPTs.
Sertel et al. (2017) [33] RCT n = 60 6 weeks	Protocol: 3 days/week, 60 min/session. Exercises: treadmill walking and cycle ergometer. Intensity: 60–80% of heart rate reserve, progressed from 40-50%. Comparison: vs. BAT.	Significant reduction in Pain Severity (VAS), Pain Disability Index (PDI), and Headache Impact (HIT-6). Aerobic exercise was as effective as specific BAT.

Krøll et al. (2018) [34] RCT n = 52 12 weeks	Protocol: 3 days/week, 45 min/session. Exercises: choice of bike, cross-trainer, or brisk walking. Intensity: high intensity (targeting systemic cardiovascular adaptation). Population: patients with migraine + co-existing TTH and neck pain.	Significant reduction in migraine burden, pain intensity, and neck pain. No significant change in objective PPTs, suggesting benefits may stem from behavioral change (reduced avoidance) rather than physiological desensitization.

4.3. Low-Intensity Physical Interventions

4.3.1. Yoga

Anheyer et al. (2020) [35] performed a systematic review and meta-analysis evaluating 5 RCTs. The analysis differentiated between the effects of yoga on migraine versus TTH. The results showed that the overall benefits of yoga were mainly attributable to people suffering fromTTH. Specifically, for TTH, yoga interventions (typically comprising asanas, pranayama, and relaxation) demonstrated statistically significant reductions in headache frequency (SMD = -1.97), headache duration (SMD = -1.45), and pain intensity (SMD = -3.43). The authors concluded that although the evidence is limited due to the small number of studies and the potential risk of systematic error, yoga is a promising and safe therapeutic option, particularly for reducing the clinical burden of TTH.

4.3.2. Progressive Muscle Relaxation

Addressing the autonomic component of TTH, Gopichandran et al. (2024) [36] conducted a 12-week RCT involving systematic tensing and releasing of muscle groups combined with diaphragmatic breathing. This practice not only reduced pain and disability but also significantly improved sleep quality. Since sleep disturbance is a primary trigger for TTH chronification, progressive muscle relaxation (PMR) serves as a vital tool to lower resting muscle tone before sleep, preventing morning headaches.

4.3.3. Hamstring Relaxation

A new perspective on TTH suggests that tension is not limited to the neck, but spreads to the entire posterior myofascial chain (superficial back line). Kwon et al. (2021) [37] investigated this in a 4-week RCT focused on relaxing and stretching the hamstrings. The program led to significant improvements in headache intensity and duration, as well as neck range of motion. Anatomically, the hamstring fascia is connected to the sacroiliac ligament, the extensor fascia, and ultimately to the cranial fascia. Kwon's findings suggest that releasing tension in the lower kinetic chain may reduce mechanical tension in the sclera and paracranial tissues, offering a new approach to treating headaches.

4.3.4. Pilates

Leite et al. (2023) [38] presented a case series study aiming to determine the effectiveness of a clinical pilates exercise program involving university students with TTH. The study provided mixed results. While 100% of participants reported improvements in daily functioning and coping mechanisms, and the majority experienced reduced negative emotional states, only 2 out of 9 participants reported a decrease in pain intensity. These findings must be interpreted with caution due to the small sample size (n=9), the lack of a control group, and the short duration of time (2 weeks).

In contrast, Hürer et al. (2020) [39] provided a reliable RCT evidence targeting the "sagittal cervical disorientation" (FHP) - a common comorbidity of TTH. The study involved 46 participants randomized to either a clinical pilates group or a home exercise group. The Pilates group showed significantly superior improvements in the craniovertebral angle (an objective measure of head posture) and in the endurance of the DNFs compared to the home exercise group. Although both groups experienced a similar reduction in pain intensity, pilates proved to be particularly effective in correcting the underlying biomechanical defect (posture). This suggests that for TTH patients with visible posture impairments, Pilates offers a distinct advantage by “realigning” the cervical spine, potentially reducing long-term recurrence rates, even if immediate pain relief is comparable to simpler exercises. Information on the low-intensity physical interventions protocols and key clinical findings of the cited studies is presented in **Table 3**.

Table 3. Low-Intensity Physical Interventions Studies (2015-2025).

Study Characteristics	**Intervention Protocol**	**Key Clinical Findings**

Anheyer et al. (2020) [35] Meta-Analysis Included 5 RCTs 6–16 weeks	Interventions analyzed: Hatha Yoga and other traditional forms. Components: 1. Asanas: physical postures/stretching. 2. Pranayama: breathing exercises. 3. Meditation/Relaxation: mindfulness components. Comparison: vs. usual care.	Statistically significant overall effect favoring yoga specifically for TTH (but not migraine) in: Headache frequency (SMD = -1.97) Headache duration (SMD = -1.45) Pain intensity (SMD = -3.43).
Gopichandran (2024) [36] RCT n = 169 12 weeks	Frequency: daily practice, 20 min/session. Protocol: 1. PMR: systematic tensing and releasing of major muscle groups. 2. Deep breathing: diaphragmatic breathing exercises.	Significant decrease in pain severity and disability. Marked improvement in sleep quality, addressing a key trigger for chronic TTH.
Kwon et al. (2021) [37] RCT n = 30 4 weeks	Frequency: 3 days/week, 25 min/session. Protocol: hamstring relaxation program: stretching exercises targeting the superficial back line (distal approach) to influence the craniocervical fascia via myofascial continuity.	Improved headache intensity and duration. Significant increase in cervical range of motion despite the distal nature of the intervention.
Leite et al. (2023) [38] Case Series n = 9 2 weeks	Frequency: 2 sessions/week (4 total), 30 min/session. Protocol: clinical pilates: mat-work based on 8 pilates principles (centering, concentration, precision) adapted for individual needs.	100% of participants reported improved functionality and coping. However, pain intensity reduced in only 2/9 subjects, suggesting that pilates targets disability/function more than immediate pain relief in the short term.

Hürer et al. (2021) [39] RCT n = 46 8 weeks	Frequency: 3 days/week, 60 min/session. Protocol: clinical pilates: stabilization-based mat exercises focusing on core control, scapular alignment, and correcting sagittal cervical disorientation (FHP).	Pilates was superior for correcting head posture, craniovertebral angle, and improving DNF's endurance. Pain relief was comparable to home exercises.

5. Discussion

The body of evidence from 2015 to 2025 marks a significant evolution in the understanding of TTH. We have moved from viewing it as a simple "muscle contraction headache" to recognizing it as a complex disorder of nociceptive processing and biomechanical failure. An analysis of headache parameters reveals distinct responses to specific training methods.

Headache intensity appears to be the most responsive parameter to physical intervention across many methods, often showing improvement earlier than frequency. Decreased intensity can be encountered in various studies cited by this review discussing the impact of physical activity on headache parameters. The broad impact of training modalities such as strength training [27,28,29,30,31], aerobic exercise [32,33,34], or various mind-body interventions [35,36,37,38,39] argues in favor of implementing a multimodal approach combining different activities.

Headache duration is notably influenced by interventions that address the endurance and postural capacity of the craniocervical musculature. Padrós-Augé et al. (2025) [31] showed that combining strength training with specific postural correction had a large effect size for reducing the duration of episodes. This suggests that increasing the "time-under-tension" capacity of the neck extensors prevents the metabolic exhaustion that prolongs a headache attack once it begins.

Headache frequency remains the most challenging parameter to modify, often serving as the primary measure of preventive efficacy. The recent component network meta-analysis by Tao et al. (2025) [40] provides a critical distinction here, separating the effects of different types of exercise. Their analysis found that resistance exercise had the strongest positive effect on reducing headache frequency (iMD −6.00). On the other hand, they noted that stretching exercises performed in isolation may paradoxically be associated with increased frequency in some contexts, possibly due to mechanical irritation of already sensitized paracranial tissues. The "dose-response" relationship for frequency is emphasized by comparing Madsen et al. (2018) [29], who found no frequency reduction after 10 weeks, with Rinne et al. (2023) [30], who achieved 47% reduction after 6 months. This confirms that reversing the central sensitization driving chronic TTH frequency requires sustained neuroplastic input over a period exceeding standard rehabilitation windows.

Despite these positive findings, the quality of evidence in the field faces ongoing difficulties. Varangot-Reille et al. (2022) [41] in a comprehensive systematic review and meta-analysis rated the certainty of evidence as low to moderate, citing high variability in exercise protocols and the inherent impossibility of blinding patients to active physical interventions. There still is a large mismatch between the massive global prevalence of TTH and the relatively small sample sizes in clinical trials, such as the case series by Leite et al. (2023) [38] or the pilot study by Padrós-Augé (2025) [31]. Furthermore, many studies fail to strictly differentiate between episodic and chronic TTH or to account for the medication overuse that often confounds results in chronic populations. However, the rigorous approach in recent trials like Ataş & Mutlu (2025) [32] and Gopichandran (2024) [36], which used robust randomization and important outcome measures, indicates the maturity of this field. In addition to basic pain parameters, physical activity has a profound impact on the multimorbid domains of life affected by TTH. Gopichandran et al. (2024) [36] highlighted that interventions like PMR significantly improve sleep quality. Similarly to deep cervical flexion exercises investigated by Choi (2021) [28]. Ataş and Mutlu (2025) [32] demonstrated that structured exercise improves proprioception and overall quality of life, factors that are often impaired as a result of kinesiophobia and avoidance behaviors. By focusing on disability and self-efficacy, active interventions provide patients with a sense of control over their condition that pharmacological therapies cannot provide.

Beyond isolated exercise, the contemporary literature points toward a multimodal approach as single-modality treatment often fails to address the complex nature of TTH. Numerous reports point out that combining exercise with other interventions provides better effects for decreasing symptoms in the short term and maintaining benefits over time. A notable example is Schiller et al. (2021) [42], who evaluated the effectiveness of acupuncture combined with medical training therapy versus usual treatment. The intervention group receiving both strategies showed significantly superior results in pain intensity compared to monotherapies. Similarly, Georgoudis et al. (2018) [43] observed that while acupuncture and stretching were beneficial, the addition of physiotherapy hands-on techniques (myofascial release) led to further improvements in PPTs. Uzun et al. (2024) [44] demonstrated that the synergy of mobilization and pilates addresses both the articular restriction and the muscular deficit, breaking the cycle of chronic pain more effectively than either alone. The positive effects of such multimodal approaches are consistent with the understanding that they target multiple pathways of the pathology simultaneously: manual therapy or acupuncture provides the immediate analgesia (descending pain modulation). At the same time, active exercise (medical training therapy, pilates) drives the neuroplastic changes required for long-term recovery.

In summary, current knowledge indicates that physical training is not only a supportive tool but also a treatment method that modifies the course of TTH. The synthesis of evidence supports a hierarchy of intervention: resistance training is best for prevention (frequency reduction), multimodal care (manual therapy + exercise) is optimal for symptom management (intensity/duration), and aerobic/relaxation therapies are essential for addressing central sensitization and comorbidities. Future research must bridge the gap between “statistical significance” and “clinical utility.” There is an urgent need for research on long-term adherence strategies, as the benefits of exercise disappear when it is discontinued.

6. Conclusions

Physical training is an effective treatment for TTH, which can significantly reduce the intensity and frequency of headache episodes. Although the heterogeneity of study protocols and difficulties in blinding participants limit the strength of some evidence, data consistently indicate that active rehabilitation is quite reliable and superior to passive care alone. For optimal analgesic effect, clinical treatment must be multifactorial and address both structural and neurophysiological factors causing pain.

Strength matters, especially for the deep flexors and extensors of the neck. However, reversing muscle atrophy is a slow process, meaning that treatment duration determines frequency. A significant reduction in the number of days with headache usually requires long-term resistance training lasting 3 to 6 months, rather than short-term remedies. At the same time, the need for exercise is obvious, as aerobic exercise effectively modulates central sensitization and provides systemic pain relief comparable to specific BATs, which is a key factor for patients with central sensitivity.

The scope of therapy must also extend beyond the neck area. A holistic approach, including relaxation of the distal muscles of the posterior thigh and general posture control using pilates, effectively reduces proximal symptoms by influencing the kinetic continuity of the body. In addition, autonomic regulation through PMR is essential for breaking the stress-pain cycle, significantly improving sleep quality, and reducing disability. Ultimately, given the documented efficacy of individual modalities, there remains a significant gap in multicomponent exercise protocols that could potentially maximize clinical outcomes and enhance the quality of life for patients suffering from TTH.

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Formal analysis: KDW, BC, KD, ZC
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