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Effect of Progressive Muscle Relaxation in Students with Tension-Type Headache: A Pre-Post Interventional Study

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Abstract

Tension-Type Headache (TTH) is a common condition strongly associated with stress. Its prevalence is particularly high among students, where it is often aggravated by poor sleep, academic pressure, and inadequate relaxation. TTH negatively affects general health and academic performance, underscoring the need for effective, non-pharmacological stress-reduction strategies such as Progressive Muscle Relaxation (PMR). To evaluate the effectiveness of PMR in reducing the severity and disability associated with TTH among students. This quantitative pre–post interventional study included 36 students diagnosed with TTH according to the International Classification of Headache Disorders (ICHD) criteria. Written informed consent was obtained from all participants. Headache severity and disability were measured using the Headache Disability Index (HDI) before and after a six-week PMR intervention. Data normality was assessed using the Shapiro–Wilk test, and pre and post intervention scores were compared using a paired t-test. Associations with demographic variables were analyzed using the chi-square test. PMR significantly reduced headache-related disability. Mean HDI scores decreased from 50.67±15.85 to 21.89±12.48 ($p < 0.001$), with a large effect size ($\eta^2 = 0.923$). No adverse effects were reported. Progressive Muscle Relaxation is a promising, safe, and practical non-pharmacological intervention for managing TTH among students. Regular practice may help reduce headache severity, improve coping with stress, and enhance overall quality of life and academic performance.

Major Findings: Progressive Muscle Relaxation (PMR) significantly reduced headache-related disability in students with tension-type headache, showing it to be a safe and practical intervention. Given the high burden of TTH on student performance and well-being, these findings support PMR as a simple, cost-effective strategy for improving student health in academic settings.

Keywords: Headache Disability Index, Tension-Type Headache, Progressive Muscle Relaxation, Relaxation Therapy, Stress Management, Student Health

1. Introduction

Headaches significantly impair quality of life and can be highly disabling. Among the major headache disorders: Cluster headache, Migraine, and Tension-Type Headache (TTH) - Tension-type headache is the most prevalent globally[1]. TTH is typically characterized by bilateral, recurrent, mild to moderate headaches described as constricting or pressing in nature, not aggravated by routine physical activity. The International Classification of Headache Disorders, 3rd edition (ICHD-3), provides diagnostic criteria based on clinical history and exclusion of other conditions. Although the exact molecular mechanisms remain unclear, peripheral factors appear to initiate pain in TTH, while central sensitisation contributes to the transition from episodic to chronic forms[2].

TTH is most common among women, with prevalence rates ranging from 35-78 % across different populations.

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According to the International Headache Society (2004), about 44% of patients experience functional impairment and reduced quality of life due to TTH[3]. It is the most prevalent headache disorder among individuals aged 20–64 years, with patients typically being female (80%) and around 40 years of age on average[3]. The Global Burden of Disease (2019) reported a worldwide prevalence of 21.1%, with regional variations: South Asia (33.1%), Southeast and East Asia and Oceania (11.1%)[4]. Based on ICHD-3 criteria, TTH is classified into three subtypes: infrequent episodic (IETTH), frequent episodic (FETTH), and chronic TTH (CTTH)[4].

Pericranial muscle tenderness is a consistent finding in TTH, present in up to 60% of patients, though not always correlated with pain severity[3]. Manual palpation of pericranial muscles such as the frontal, temporal, masseter, sternocleidomastoid, splenius, and trapezius can help in documenting tenderness, often scored on a 0–3 scale[5].

Exercise and relaxation techniques have been shown to reduce stress and muscle tension, thereby alleviating TTH symptoms. Relaxation therapy is more effective than no treatment or placebo in reducing headache frequency and severity[3].

Progressive Muscle Relaxation (PMR), first developed by Jacobson, is a simple, non-invasive technique involving sequential tensing and relaxing of muscle groups to induce a state of deep relaxation[6,7]. It has been shown to reduce anxiety, improve sleep, lower blood pressure, and relieve muscle spasm[6,8].

PMR operates through both "top-down" and "bottom-up" mechanisms. In the top-down process, higher centers such as the cerebral cortex and cerebellum regulate muscle relaxation, while in the bottom-up process, proprioceptive feedback from tensed and relaxed muscles stimulates the brainstem and spinal cord, leading to overall relaxation[7]. Ease of learning, low cost, absence of side effects, and suitability for self-practice make PMR a valuable intervention for stress, anxiety, depression, and pain management[7,9].

Previous research has explored PMR in patients with chronic illnesses such as cancer, schizophrenia, and post-surgical conditions, demonstrating improvement in psychological well-being and reduction in distress[9]. Although PMR has been evaluated in various clinical populations, there is limited evidence specifically assessing its effectiveness among student populations with Tension-Type Headache. This study was therefore designed to address that gap by evaluating a standardized six-week PMR program in undergraduate students with TTH.

2. Materials and Methods

2.1 Study Design and Participants

The sample size of 36 was selected based on feasibility and on prior interventional PMR studies in similar populations that reported measurable within-group effects with comparable sample sizes, making this sample adequate to assess pre–post changes in HDI in the current context. This quantitative pre–post interventional study was conducted among undergraduate students diagnosed with Tension-Type Headache (TTH) using the International Classification of Headache Disorders (ICHD-3) criteria. Before commencing the study, ethical clearance was obtained from the college. Written informed consent was obtained from all participants prior to enrolment. A total of 36 participants (both male and female) were enrolled and completed the six-week intervention.

2.2 Eligibility Criteria

Eligible participants were aged 18-25 years, of either gender, and had a clinical diagnosis of TTH based on ICHD-3 criteria. Participants were required to be willing to participate in the six-week Progressive Muscle Relaxation (PMR) program and attend follow-up assessments. Exclusion criteria included other primary or secondary headache disorders, a history of neck injury or cervical spine pathology, and current use of medications likely to affect headache or relaxation responses (e.g., sedatives, antidepressants, or muscle relaxants).

2.3 Intervention Protocol

Participants were trained in Jacobson's PMR (standardized bottom-to-top protocol). The sequence included: feet - calves - thighs - abdomen - chest - hands/forearms - upper arms - shoulders/neck - face. Each muscle group was tensed for 5-7 seconds and relaxed for 10-15 seconds. Sessions lasted 15 minutes. Training was delivered by a qualified physiotherapist in a single supervised session; participants then practiced twice daily guided by a standardized audio recording provided by the investigators. Adherence was monitored via daily practice logs and weekly supervised compliance checks.

Table 1. Descriptive statistics for age

(n = 36)	Range	Mean	S.D.
Age (Years)	17 to 24	20.64	2.03

The participants mean age was 20.64±2.03 years, and they ranged in age from 17 to 24. (Table 1).

2.4 Outcome Measures

The primary outcome measure was the Headache Disability Index (HDI), which assesses the functional limitations and emotional distress caused by headaches in daily life[10]. Assessments using the HDI were performed

Table 2. Demographic characteristics

(n = 36)		Frequency	%
Gender	Male	9	25
	Female	27	75
Which academic year are you in right now?	First year	9	25
	Second year	6	16.7
	Third year	3	8.3
	Final year	9	25
	Intern	9	25
How frequently do you experience headaches?	Frequently	5	13.9
	Occasionally	19	52.8
	Rarely	12	33.3
How long does your headache usually last?	More than 15 minutes	32	88.9
	More than 1 day	4	11.1
Two or more of the following characteristics occur in headaches:	Bilateral (both sides) location	12	33.3
	Bilateral (both sides) location, Mild or moderate intensity	7	19.4
	Bilateral (both sides) location, Pressing/tightening (non-pulsating) quality	1	2.8
	Mild or moderate intensity	8	22.2
	Mild or moderate intensity, Not aggravated by routine physical activity such as walking or climbing stairs	2	5.6
	More than 15 min	1	2.8
	Pressing/tightening (non-pulsating) quality	3	8.3
	Pressing/tightening (non-pulsating) quality, Mild or moderate intensity	1	2.8
	Bilateral (both sides) location, None of the above	1	2.8
Do you experience nausea or vomiting during your headache episodes?	No	36	100
Do you experience a loss of appetite (anorexia) during your headache episodes?	No	36	100
Do you experience sensitivity to light or sound during these episodes?	Yes	12	33.3
	No	24	66.7
Is your headache associated with any diagnosed disorder?	No	36	100
How frequent are your headache attacks in a month?	Less than 1 day a month	18	50
	More than 1 day but less than 15 days a month	18	50
If yes, which disorder is associated with your headaches?	No	36	100
If yes, how many episodes do you experience this sensitivity?	One	18	50.0

at baseline (pre-test) and after completion of the six-week intervention (post-test).

3. Results

Of the 36 participants, 75% were women and 25% were men. The academic year distribution showed equal representation from first year, final year, and interns (25% each), while 16.7% were in the second year and 8.3% in the third year. More than half (52.8%) reported experiencing headaches occasionally, 33.3% rarely, and 13.9% frequently. The majority of headaches lasted more than 15 minutes (88.9%), while 11.1% reported a duration of more than one day. The most common headache characteristics were bilateral location (33.3%) and mild-to-moderate intensity (22.2%). None of the participants reported nausea, vomiting, or loss of appetite during headache episodes, while 33.3% reported sensitivity to light or sound. All participants indicated that their headaches were not associated with any diagnosed disorder. Half (50%) experienced headaches less than one day per month, while the remainder reported one to fifteen days per month (Table 2).

The mean HDI score decreased from 50.67±15.85 at baseline to 21.89±12.48 post-intervention. A paired t-test showed a significant reduction in HDI ($t(35) = 20.50$, mean difference = 28.78, 95% CI 25.92–31.63, $p < 0.001$). The corresponding effect size was very large (partial $\eta^2 = 0.923$) (Table 3). As illustrated in Figure 1, mean HDI scores decreased significantly from pre-test to post-test following the six-week PMR program.

The normality of the data was assessed using the Shapiro–Wilk test. Both pre-test ($W = 0.976$, $p = 0.599$) and post-test ($W = 0.964$, $p = 0.292$) HDI scores were not significantly different from a normal distribution ($p > 0.05$), indicating that the assumption of normality was satisfied.

Figure 1 illustrates a reduction in total tension headache scores from pre-test to post-test, suggesting a positive effect of the intervention.

Table 3. Comparison of the total score (Tension headache)

Tension headache	Mean	S.D.	Mean difference	95% C.I for difference	Effect size	"t"	df	p value
Pre-test score	50.67	15.85	28.78	25.92 to 31.63	0.923	20.50	35	< 0.001*
Post-test score	21.89	12.48						

("t" = Paired "t" test; df = Degrees of freedom; * Significant)

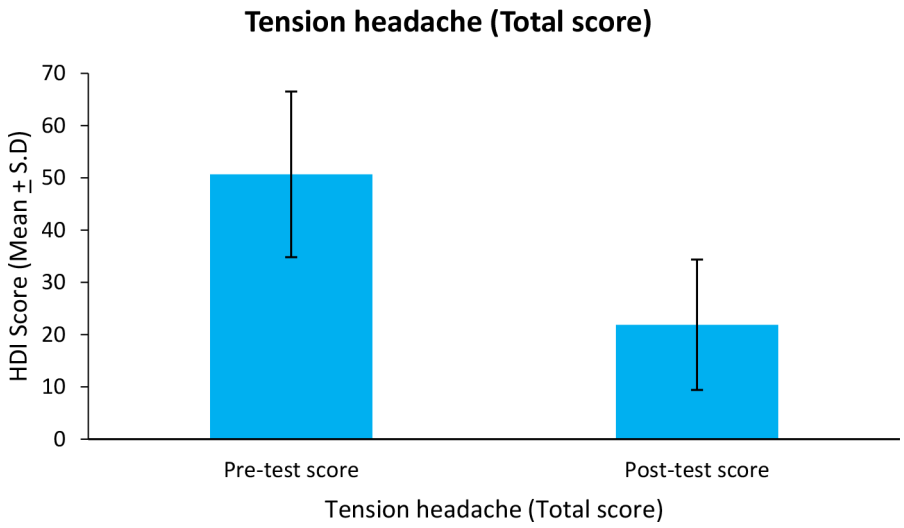


Figure 1. Pre- and post-intervention Headache Disability Index (HDI) scores among students following a six-week Progressive Muscle Relaxation (PMR) program. Values are mean ± SD. $p < 0.001$ (paired t-test).

4. Discussion

Tension-Type Headache (TTH) is highly prevalent and commonly managed with non-pharmacological approaches, including physiotherapy and relaxation techniques[3]. In this study of 36 undergraduate students, PMR training over six weeks produced a large and statistically significant reduction in headache-related disability: mean HDI decreased from 50.67±15.85 to 21.89±12.48 (mean difference 28.78; 95% CI 25.92–31.63; $p < 0.001$; $\eta^2 = 0.923$) (Table 3).

These findings are concordant with previous work demonstrating benefit of PMR for headache and related symptoms. Kumar and Raje reported reduced pain and stress following PMR compared with TENS in a TTH population[3]. Broader evidence shows PMR, often combined with deep breathing or guided imagery, promotes psychological and physiological relaxation and improves sleep, fatigue, anxiety and blood-pressure control across diverse clinical groups (hemodialysis patients, hypertensive patients, COVID-19 patients)[6,7,8,11]. Mechanistically, PMR appears to act through both top-down and bottom-up pathways. Cortical processes and volitional attention (top-down) enhance awareness and regulation of muscle tension, while sequential tensing–relaxing provides proprioceptive feedback (bottom-up) that reduces peripheral muscle hyperactivity and modulates brainstem and spinal nociceptive processing[7].

Karademir *et al*., reported that progressive muscle relaxation significantly reduced pain intensity and pericranial muscle tension in individuals experiencing recurrent headaches[12]. Abdelbasset *et al*., observed that PMR practice led to improvements in autonomic regulation and reductions in stress-related physiological responses[13]. Previous studies have also reported that regular PMR practice results in decreased headache frequency and perceived stress levels in young adults[14]. Singh and Kaur noted improvements in muscle relaxation, sleep quality, and overall wellbeing following consistent PMR sessions[15]. In addition, Henz and Ferreira demonstrated reductions in head and neck electromyographic activity after PMR, providing further evidence for its role in decreasing pericranial muscle overactivity[16].

Given that pericranial muscle tenderness and increased pericranial electromyographic activity are common in TTH, PMR's focus on muscle relaxation provides an explanation for reduced headache disability in our sample[3,5]. The sample characteristics here, predominantly female mirror literature showing higher TTH prevalence in women[4].

Strengths of this study include use of a validated outcome measure (HDI), standardized diagnostic criteria (ICHD-3) for participant selection, and application of appropriate statistical tests with reporting of effect size and confidence intervals. The very large effect size suggests a clinically meaningful benefit of PMR in reducing headache-related disability in this sample.

Clinically, PMR can be readily integrated into student wellness and stress-management programs as a low-cost, safe, and scalable strategy to reduce headache-related disability and improve coping with academic stress.

5. Limitations and Recommendations

The study has certain limitations. It was conducted at a single institution, which may limit the generalizability of the findings. Outcomes relied on self-report tools rather than incorporating objective measures such as pericranial EMG. The follow-up period was six weeks, which does not allow conclusions about the long-term sustainability of the observed benefits. Exploring multimodal approaches that integrate PMR with other physiotherapy or behavioral interventions may clarify optimal strategies for managing tension-type headache.

6. Conclusion

This study demonstrated that Progressive Muscle Relaxation (PMR) significantly reduced the severity of tension-type headaches and improved student well-being, underscoring its value as a simple, non-pharmacological approach to headache management. Given its ease of implementation, PMR could be readily incorporated into stress-management and preventive health programs for students.

7. References

1. Ahmed F. Headache disorders: Differentiating and managing the common subtypes. Br J Pain. 2012; 6(3):124-132. https://doi.org/10.1177/2049463712459691 PMid:26516483 PMCid:PMC4590146.

2. Ashina S, Mitsikostas DD, Lee MJ, Yamani N, Wang SJ, Messina R, *et al*. Tension-type headache. Nat Rev Dis Primers. 2021; 7(1):24. https://doi.org/10.1038/s41572-021-00257-2 PMid:33767185.
3. Kumar S, Raje A. Effect of progressive muscular relaxation exercises versus transcutaneous electrical nerve stimulation on tension headache: A comparative study. Hong Kong Physiother J. 2014; 32(2):86-91. https://doi.org/10.1016/j.hkpj.2014.06.002
4. Repiso-Guardeño A, Moreno-Morales N, Armenta-Pendón MA, Rodríguez-Martínez MDC, Pino-Lozano R, Armenta-Peinado JA. Physical therapy in tension-type headache: A systematic review of randomized controlled trials. Int J Environ Res Public Health. 2023; 20(5):4466. https://doi.org/10.3390/ijerph20054466 PMid:36901475 PMCid:PMC10001815.
5. International Headache Society. The International Classification of Headache Disorders, 3rd edition (ICHD-3); 2023. Available from: https://ichd-3.org/. Accessed 8 Apr 2024.
6. Boughdady A, Elashri N, Ibrahim S. Effect of Jacobson's progressive muscle relaxation on fatigue and sleep quality among geriatric patients undergoing hemodialysis. Zagazig Nurs J. 2024; 20(1):149-167. https://doi.org/10.21608/znj.2024.343343
7. Toussaint L, *et al*. Effectiveness of progressive muscle relaxation, deep breathing, and guided imagery in promoting psychological and physiological states of relaxation. Evid Based Complement Alternat Med. 2021; 2021:5924040. https://doi.org/10.1155/2021/5924040 PMid:34306146 PMCid:PMC8272667.
8. Ermayani M, Prabawati D, Susilo WH. The effect of progressive muscle relaxation on anxiety and blood pressure among hypertension patients in East Kalimantan, Indonesia. Enferm Clin. 2020; 30:121-125. https://doi.org/10.1016/j.enfcli.2020.07.025
9. Muhammad Khir S, Wan Mohd Yunus WMA, Mahmud N, Wang R, Panatik SA, Mohd Sukor MS, *et al*. Efficacy of progressive muscle relaxation in adults for stress, anxiety, and depression: a systematic review. Psychol Res Behav Manag. 2024; 17:345-365. https://doi.org/10.2147/PRBM.S437277 PMid:38322293 PMCid:PMC10844009.
10. Jacobson GP, Ramadan NM, Aggarwal SK, Newman CW. The Henry Ford Hospital Headache Disability Inventory (HDI). Neurology. 1994; 44(5):837-842. https://doi.org/10.1212/WNL.44.5.837 PMid:8190284.
11. Liu K, *et al*. Effects of progressive muscle relaxation on anxiety and sleep quality in patients with COVID-19. Complement Ther Clin Pract. 2020; 39:101132. https://doi.org/10.1016/j.ctcp.2020.101132 PMid:32379667 PMCid:PMC7102525.
12. Karademir S, Yildirim Y, Kiliç SP. The effect of progressive muscle relaxation on pain and muscle tension in individuals with recurrent headache. Complement Ther Clin Pract. 2019;35:265-70.
13. Abdelbasset WK, Nambi G, Alsubaie SF, Elnegamy TE. Effects of progressive muscle relaxation on autonomic functions and stress-related symptoms in adults. Medicine (Baltimore). 2020; 99(40):e22579.
14. Kaur J, Kaur G. Effect of progressive muscle relaxation on headache frequency and stress among young adults. Indian J Physiol Pharmacol. 2019; 63(3):223-9.
15. Singh R, Kaur P. Impact of progressive muscle relaxation on sleep quality, muscle relaxation, and wellbeing in adults with stress-related complaints. J Clin Diagn Res. 2017; 11(5):CC01-CC04.
16. Henz D, Ferreira C. Effects of progressive muscle relaxation on head and neck EMG activity and perceived relaxation. Appl Psychophysiol Biofeedback. 2018; 43(1):45-52.

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