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Effects of Combined High-Intensity Laser Therapy, Guided Imagery, and Music on Quality of Life and General Health in Patients with Chronic Musculoskeletal Pain: A Randomized Controlled Trial

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ABSTRACT

Objective: This study aimed to investigate the effects of combining High-Intensity Laser Therapy (HILT), a non-symbolic physical treatment, with various symbolic/behavioral interventions, including Guided Imagery (GI), rooted in the biosemiotics model of healing.

Methods and Materials: This randomized clinical trial included 83 patients with CMSP (aged 18-70 years) who were divided into five treatment groups: Laser Therapy alone (LT), LT + Guided Imagery (GI), LT + GI + Health Education (HE), LT + Music (M), and LT + M + HE. All groups received 6 HILT sessions. QoL (SF-12) and general health (GHQ-12) were measured at baseline, post-intervention, and one-month follow-up. Statistical analysis included repeated measures ANOVA.

Findings: Intragroup analyses showed that the PCS improved significantly ($p<0.001$) only in the combined intervention groups (LT+GI, LT+GI+HE, and LT+MT). GHQ-12 scores (lower scores indicating better general health) showed significant decreases in the MD component across nearly all groups. The LT+GI group demonstrated statistically superior gains in PMH compared to several other arms ($p<0.05$). Conversely, the LT+MT group showed the most consistent and significant reduction in the overall GHQ-12 total score during the follow-up phase ($p<0.001$).

Conclusion: Structured intervention programs substantially enhance the quality of life and overall health in individuals with CMSP. The findings demonstrate that integrating symbolic and non-symbolic interventions can be effective for maximizing physical and psychological gains, particularly in physical health and positive mental health.

Keywords: Quality of Life, General Health, Chronic musculoskeletal pain, Biosemiotics, Psychological.

Introduction

Chronic musculoskeletal pain (CMSP) represents a significant global health challenge, imposing a heavy burden of disability due to its complex physical and psychosocial impairments (Dueñas et al., 2016). Health officials, researchers, and therapists recognize pain as a multifaceted phenomenon that complicates its assessment and management (Bourbonnais et al., 2004). Defined by the World Health Organization (WHO) and the International Association for the Study of Pain (IASP) as an unpleasant sensory and emotional experience associated with actual or potential tissue damage, Schug (2020), chronic pain persists longer than the expected healing period, typically three to six months (Bagheri & Arabi, 2018). CMSP, a common subtype, involves persistent pain affecting bones, joints, muscles, or soft tissues and is a leading cause of disability, affecting approximately 20% of individuals worldwide (Kenis et al., 2024; Laguna et al., 2023).

The severity of chronic pain significantly diminishes an individual's quality of life (QoL) (Su et al., 2014). QoL is a broad concept encompassing physical health, psychological state, and social relationships (Felce & Perry, 1995; Ferrans, 2010). CMSP limits physical function and mobility, often leading to psychological distress, including anxiety and depression (Hadi et al., 2019; Tüzün, 2007). Consequently, effective management is crucial for restoring function and enhancing psychological health (Chibnall & Tait, 2001).

To effectively address this impact, a comprehensive understanding of pain's causes is required, moving beyond a purely medical approach. Theoretical models, particularly the biopsychosocial model, provide a robust framework for integrating physiological, psychological (e.g., pain catastrophizing), and social factors in the development and maintenance of chronic pain (Gatchel et al., 2007; Meints & Edwards, 2018). This model highlights that non-medical factors, especially psychological ones like fear-avoidant behaviors, significantly influence pain perception and play crucial roles in coping and disability (Dueñas et al., 2016; Turk & Okifuji, 2002).

Despite this holistic understanding, treatment often begins with pharmacological approaches, including NSAIDs, muscle relaxants, and opioids (Moulin et al., 2002; Schug, 2020). However, these medications carry significant risks of misuse and adverse outcomes, such as gastrointestinal issues, dependency, and cardiovascular events (Robinson et al., 2015; Sani & Zin, 2025). Given the limitations of pharmacological approaches, non-invasive physical treatments are essential alternatives (Shi & Wu, 2023). High-Intensity Laser Therapy (HILT) is one such treatment that aims to reduce inflammation and promote tissue repair (Arroyo-Fernández et al., 2023). HILT uses higher-power beams (over 500 milliwatts) than low-power laser therapy, enabling deeper tissue penetration and more efficient energy delivery (Conforti & Fachinetti, 2013; Ezzati et al., 2020; Thabet et al., 2017). HILT is highly effective at reducing musculoskeletal pain by enhancing mitochondrial activity, boosting ATP production, and inducing vasodilation to improve blood flow (Hennessy & Hamblin, 2016; Shi & Wu, 2023; Song et al., 2018).

While HILT addresses the physical dimension, psychological methods remain equally critical for managing chronic pain (Organization, 2020). Guided imagery (GI), a mind-body technique, is a prominent complementary method that focuses on pleasant mental images to induce relaxation and achieve specific outcomes, such as pain relief (Astin et al., 2005). Through mental visualization, the patient engages their mind to produce profound physiological effects, demonstrating the body's response to symbolic input (Kaplun et al., 2023).

The potential for synergy between these physical and psychological approaches is rooted in Wilma Bucci's Multiple Code Theory, which posits that experiences are processed across sub-symbolic, non-verbal symbolic, and verbal symbolic levels (Bucci, 1997, 2013). This framework helps resolve the body-mind dichotomy by viewing their relationship as symbolic and sub-symbolic systems (Solano, 2010). Furthermore, the biosemiotic explanation of healing suggests that symbolic signs, like imagery, can recalibrate physiological processes and activate neural pathways similar to those engaged by the physical treatment (Goli, 2024). Drawing on the biosemiotic approach to mind–body phenomena proposed by Goli (2022), Goli et al. (2016), the healing response may be conceptualized as a complex semiotic process that integrates both material and symbolic signs (Goli et al., 2016). It is therefore plausible that synchronizing these symbolic and physical signs, by enhancing the placebo response, could optimize the healing process and alleviate pain (Goli, 2024). Based on Goli's biosemiosetic multimodal therapy formulation, the researchers compiled an imagery script focused on the expected biological changes from laser therapy and the laser-induced bodily sensations.

Although both laser therapy and guided imagery have been studied separately, a significant research gap exists regarding the combined and synchronized use of non-symbolic (HILT) and symbolic (evidence-based GI simulating HILT effects) interventions (Posadzki et al., 2012; Song et al., 2018). This study aims to address this gap by exploring if the simultaneous application of these modalities results in a synergistic effect, thereby enhancing the healing process and improving patient outcomes by integrating both the physical and psychological dimensions of chronic musculoskeletal pain (Bucci, 1997, 2013). Scientific reviews and meta-analyses support this premise, showing that combining physical and psychological modalities for chronic musculoskeletal pain (CMP) yields superior outcomes compared with single-modality treatments, suggesting an enhanced or synergistic effect (Elbers et al., 2022; Scascighini et al., 2008).

Methods and Materials

Study Design

This study is a randomized clinical trial with a pretest–posttest design and a one-month follow-up period. It aims to evaluate the effects of high-intensity laser therapy on pain intensity and health-related quality of life (HRQoL) in patients with chronic musculoskeletal pain. Participants will be assigned equally to intervention and control groups in a 1:1 ratio. Library research will be conducted to establish the theoretical foundations, while field methods will be used to collect experimental data.

Inclusion Criteria were Musculoskeletal pain of inflammatory or degenerative origin lasting more than 3 months, Age between 18 and 70 years, Literacy and ability to complete questionnaires, Willingness to participate in clinical sessions, and Cognitive and perceptual ability to follow instructions. Exclusion Criteria were Cognitive or perceptual limitations preventing participation, Pain caused by cancer or neuropathic conditions, Presence of new acute or severe diseases, Concurrent use of new therapies (medications, physiotherapy, or alternative methods) that may interfere with the effects of laser treatment, Severe side effects or medical complications during treatment, Withdrawal from participation, Non-adherence to the treatment protocol, Incomplete assessment data (pretest, posttest, or follow-up) and Major psychiatric or neurological disorders.

Sample Size and Sampling Method

The required sample size was determined using an a priori power analysis in G*Power 3.1, assuming a 5% significance level, 80% power, and an anticipated effect size of f = 0.19. The effect size was selected based on findings from previous studies with similar designs and outcomes (Cinar et al., 2018). The analysis indicated that 17 participants per group (85 total) would provide adequate statistical power.

To ensure adequate statistical power despite potential attrition, a total of 100 eligible individuals were recruited via convenience sampling from Dr. Moaydi's Pain Clinic. During the study, 17 participants dropped out, leaving 83 participants. These dropouts occurred either because participants did not complete the required number of laser sessions or, in the combined intervention groups, failed to follow up on their assigned exercises consistently.

Random Allocation

To ensure equal group sizes, participants will be randomly allocated to the intervention and control groups using a block-randomization method. For the determined sample size of 85 patients, eleven blocks of varying sizes (5, 10, 15) are planned: eight blocks of size 5, three of size 10, and one of size 12. Within each block, all possible sequences of the five treatment groups (A, B, C, D, E) will be considered. A sequence will be randomly selected, and participants will be assigned accordingly. This process will continue until all participants are allocated.

Intervention Procedure

The study protocol involved participants receiving High-Intensity Laser Therapy (HILT) according to standardized, evidence-based clinical protocols and completing six sessions over 2 weeks under the supervision of qualified specialists. To ensure balanced group sizes and maintain the integrity of the study, participants were assigned to one of the five intervention arms using a block-randomized design. While the active nature of the HILT and psychological interventions made blinding of participants and therapists infeasible, the study maintained blindness by ensuring that all outcome assessors responsible for collecting quality-of-life and general health data were unaware of participants' group assignments.

Group 1: Laser therapy without guided imagery (LT)

Group 2: Laser therapy with guided imagery during laser sessions (LT+GI)

Group 3: Laser therapy with guided imagery during sessions and daily guided imagery at home (LT+GI+HE)

Group 4: Laser therapy with music during sessions (LT+M)

Group 5: Laser therapy with music during sessions and daily music at home(LT+M+HE)

Compliance with home exercises was monitored through a WhatsApp group. One was made for group 3 and one for group 5. Daily reminders were sent in the group, and they had to reply to confirm they had completed the exercise.

Interventions

Following informed consent, therapeutic interventions will commence. All groups will receive laser therapy according to a standard protocol, consisting of 6 sessions (3 per week). Physical medicine specialists will set laser parameters (e.g., wavelength, power, duration) based on existing evidence and chronic pain management standards. Laser therapy will be conducted under expert supervision.

Guided Imagery: Includes relaxation and visualization techniques, such as imagining calming environments, using positive imagery, and engaging in deep breathing exercises to reduce stress and promote mental relaxation. After each session, a brief assessment of feelings and bodily sensations will be recorded.

For groups 2 and 3, recorded guided imagery will be played during laser therapy sessions via headphones for 20 minutes.

Group 3 participants will also practice daily guided imagery at home, supported by audio files and written instructions.

Group 5 participants will follow similar protocols using music rather than guided imagery.

Outcome Measures:

The outcome was health-related quality of life (HRQoL) and general health.

Measurements will be taken at three time points: baseline (pre-intervention), post-intervention, and follow-up.

Health-Related Quality of Life Questionnaire: This questionnaire includes 12 items covering Physical functioning, Role limitations due to psychological problems, Energy/vitality, Mental status, Social functioning, Physical pain, and General health perception. The minimum and maximum scores for each dimension range from 0 to 100. Montazeri and colleagues evaluated the validity and reliability of this scale in Iran. The reliability for the 12 psychological and physical components was reported as 0.72 and 0.73, respectively.

General Health Questionnaire (GHQ): The GHQ, developed by Goldberg, was designed to assess general health in students and has been validated in Iran by Yaghoubi and colleagues. This questionnaire consists of 12 items and two subscales: Positive mental health indicators and Indicators of psychological disorders. Responses are scored using a 4-point Likert scale: Not at all (0), Normal (0), More than normal (1), Much more than normal (1). Thus, the maximum possible score for the 12-item GHQ is 12. Factor 1: Positive mental health indicators (items 2, 3, 4, 6, 10, 12). Factor 2: Psychological disorder indicators (items 1, 5, 7, 8, 9, 11).

Analysis

Continuous and categorical data were reported as mean ± SE and as frequency (%), respectively. The Shapiro-Wilk test, along with Q-Q plot, skewness, and kurtosis statistics, was used to assess data normality. The Pearson’s chi-square test (or the exact Fisher’s test) was used to compare baseline demographic characteristics between groups. Due to a small sample size and violations of normality assumptions, the intra- and inter-group comparisons were analyzed using the generalized estimating equation (GEE) model to compare baseline, immediately post-intervention, and one-month follow-up pain and quality-of-life scores. Post hoc analysis with the Bonferroni adjustment was performed for pairwise comparisons. SPSS (version 20; SPSS Inc., Chicago, IL, USA) was used for the analysis.

Findings and Results

A total of 83 patients aged 18 to 70 years participated in this study. We found no significant differences between the groups in their baseline demographic characteristics (p-value > 0.05; Table 1). These results demonstrate that the groups were well-balanced.

Quality of life and its components

The mean changes in quality-of-life scores from the SF-12 and its physical and mental components across the groups are shown in Table 2 and Figure 1. The interaction between time and group on the SF-12 quality-of-life score and its physical health component (SF-12-PCS) was significant. These findings indicate that the patterns of improvement in quality of life and physical health status varied among the groups (p-value < 0.05) (Fig. 1).

Intragroup comparisons- There was a significant improvement in quality of life and its mental component in all groups, except in patients who received LT+M+HE (p-values = 0.150 and 0.106) at both assessment points relative to baseline (p-value < 0.001) (Table 2). Regarding the physical component, significant improvements were observed in patients who received LT+GI (p-value <0.001), LT+GI+HE (p-value <0.001), and LT+M (p-value <0.001). In contrast, those who received only LT and those who received LT+M+HE showed no significant changes in their scores (p-value > 0.05) (Table 2).

Inter-groups comparison- The mean scores of quality of life by SF-12, and its components (physical and mental) were not significantly different between groups (p-value > 0.05) (Table 2).

General Health and its components

The mean changes of general health score by GHQ-12 and its components in the groups are shown in Table 3 and Figure 2. The interaction effects of time and group on the positive mental health (PMH) and mental disorder (MD) components were significant. These findings indicate that the patterns of improvement in PMH and MD status varied among the groups (p-value < 0.05) (Fig. 1).

Intragroup comparisons- There was a significant improvement in the mental disorder component in each group at both assessment points from baseline (p-value <0.001) (Table 3). In terms of general health, as measured by GHQ-12, significant improvement was observed in all patients (p-value < 0.05), except those who received LT+GI (p-value = 0.223). Patients who received only LT and those who received LT+M+HE showed no significant changes in their PMH component scores (p-value >0.05)(Table 3).

Inter-groups comparison- The mean scores for general health according to GHQ-12 and its components (PMH and MD) did not show significant differences between groups (p-value > 0.05) (Table 3). However, during the follow-up phase, a significant difference in the mean scores of general health and its components between groups was observed (p-value < 0.05). Post-hoc pairwise comparisons with Bonferroni correction revealed that improvement in general health was greater and more consistent in patients who received LT+M compared to those who received LT+GI (8.94 ± 0.5 vs. 11.67 ± 0.65; p-value < 0.001) and LT+M+HE (8.94 ± 0.5 vs. 11.44 ± 0.63; p-value < 0.001) (Table 3). Regarding the PMH component, patients who received LT+GI performed better than those who received LT, LT+M, or LT+M+HE (p-value < 0.05). Patients who received LT+M+HE demonstrated less improvement in their MD component score compared to those who received LT+GI (5.06 ± 0.7 vs. 2.39 ± 0.38; p-value < 0.001) and LT+GI+HE (5.06 ± 0.7 vs. 2.24 ± 0.39; p-value < 0.001) (Table 3).

Table1

Baseline demographic characteristics of the participants.

Variable		Group LT	LT+GI	LT+GI+HE	LT+M	LT+M+HE	P-value
Sex	**Female**	10 (62.5%)	17 (94.4%)	11 (64.7%)	11 (68.8%)	11 (68.8%)	0.150
	Male	6 (37.5%)	1 (5.6%)	6 (35.3%)	5 (31.3%)	5 (31.3%)	
Education	**Diploma**	10 (62.5%)	16 (88.9%)	10 (58.8%)	10 (62.5%)	10 (62.5%)	0.632
	Associate's degree	2 (12.5%)	0 (0.0%)	2 (11.8%)	2 (12.5%)	1 (6.3%)	
	Bachelor degree	4 (25.0%)	1 (5.6%)	4 (23.5%)	2 (12.5%)	3 (18.8%)	
	Master's degree	0 (0.0%)	1 (5.6%)	1 (5.9%)	2 (12.5%)	2 (12.5%)	

LT: Laser Therapy, GI: Guided Imagery, HE: Home Exercise, M: Music.

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Table2

Changes in quality of life as measured by the SF-12 and its physical and mental components within and between the groups.

Outcome	Group	Intervention Time			Intra-Group Comparisons P-value	Group	Time	Group* Time
		Before	Immediately After	Follow-up				
SF-12-PCS	**LT**	53.95 ± 1.95	60.53 ± 2.37	57.24 ± 2.46	0.074	0.753	**<0.001***	**0.027***
	LT + GI	48.83 ± 1.7	61.99 ± 2.13	61.4 ± 1.8	**<0.001***			
	LT + GI + HE	47.06 ± 1.83	57.59 ± 2.57	60.68 ± 2.11	**<0.001***			
	LT + M	50.66 ± 2.54	59.54 ± 2.01	56.25 ± 2.66	**0.011***			
	LT + M + HE	53.29 ± 2.58	58.22 ± 2.44	55.92 ± 3.38	0.363			
Inter-Group Comparisons P-value		0.067	0.677	0.309				
SF-12-MCS	**LT**	59.86 ± 5.01	71.63 ± 4.91	71.88 ± 4.4	**<0.001***	0.755	**<0.001***	0.112
	LT + GI	58.12 ± 5.06	71.79 ± 3.41	71.37 ± 3.55	**<0.001***			
	LT + GI + HE	57.24 ± 3.28	71.95 ± 4.48	77.6 ± 2.48	**<0.001***			
	LT + M	65.14 ± 4.5	78.13 ± 3.18	70.67 ± 4.84	**<0.001***			
	LT + M + HE	61.3 ± 3.85	69.47 ± 4.72	65.38 ± 3.66	0.150			
Inter-Group Comparisons P-value		0.687	0.501	0.083				
SF-12_Total	**LT**	57.36 ± 3.17	66.94 ± 3.55	65.69 ± 3.22	**<0.001***	0.910	**<0.001***	**0.043***
	LT + GI	54.2 ± 3.21	67.65 ± 2.24	67.16 ± 2.55	**0.002***			
	LT + GI + HE	52.94 ± 2.27	65.88 ± 3.43	70.46 ± 2.09	**0.004***			
	LT + M	59.03 ± 2.87	70.28 ± 2.17	64.58 ± 3.65	**<0.001***			
	LT + M + HE	57.92 ± 2.74	64.72 ± 3.49	61.39 ± 3.17	0.106			
Inter-Group Comparisons P-value		0.417	0.652	0.166				

*PCS: Physical Component Score, MCS: Mental Component Score, LT: Laser Therapy, GI: Guided Imagery, HE: Home Exercise, M: Music. *p-value less than 0.05 is statistically significant. Data are shown as mean ± SE.*

Table3

Changes in general health, as measured by GHQ-12 and its components, within and between the groups.

Outcome	Group	Intervention Time			Intra-Group Comparisons P-value	Group	Time	Group*Time
		Before	Immediately After	Follow-up				
GHQ-12-PMH	**LT**	5.88 ± 0.62	7.31 ± 0.83	6.81 ± 0.46	0.096	0.083	**<0.001***	**0.002***
	LT + GI	5.89 ± 0.48	9.06 ± 0.7	9.28 ± 0.69	**<0.001***			
	LT + GI + HE	4.88 ± 0.42	8.12 ± 0.72	8.41 ± 0.76	**<0.001***			
	LT + M	6.25 ± 0.59	7.69 ± 0.47	5.69 ± 0.53	**<0.001***			
	LT + M + HE	6.19 ± 0.61	7.5 ± 0.61	6.38 ± 0.36	0.105			
Inter-Group Comparisons P-value		0.244	0.417	**<0.001***				
GHQ-12-MD	**LT**	5.31 ± 0.84	3.25 ± 0.55	2.94 ± 0.55	**<0.001***	0.435	**<0.001***	**0.025***
	LT + GI	6.67 ± 0.95	2.06 ± 0.43	2.39 ± 0.38	**<0.001***			
	LT + GI + HE	7.76 ± 0.68	3.06 ± 0.75	2.24 ± 0.39	**<0.001***			
	LT + M	6.5 ± 1	2.94 ± 0.51	3.25 ± 0.48	**<0.001***			
	LT + M + HE	6.75 ± 0.81	3.31 ± 0.72	5.06 ± 0.7	**<0.001***			
Inter-Group Comparisons P-value		0.269	0.356	**0.006***				
GHQ Total	**LT**	11.19 ± 0.64	10.56 ± 0.76	9.75 ± 0.46	**0.036***	0.234	**<0.001***	0.121
	LT + GI	12.56 ± 0.8	11.11 ± 0.84	11.67 ± 0.65	0.223			
	LT + GI + HE	12.65 ± 0.53	11.18 ± 0.66	10.65 ± 0.59	**0.007***			
	LT + M	12.75 ± 0.74	10.63 ± 0.57	8.94 ± 0.5	**<0.001***			
	LT + M + HE	12.94 ± 0.69	10.81 ± 0.49	11.44 ± 0.63	**<0.001***			
Inter-Group Comparisons P-value		0.328	0.958	**0.002***				

*PMH: Positive Mental Health, MD: Mental Disorder, LT: Laser Therapy, GI: Guided Imagery, HE: Home Exercise, M: Music. *p-value less than 0.05 is statistically significant. Data are shown as mean ± SE.*

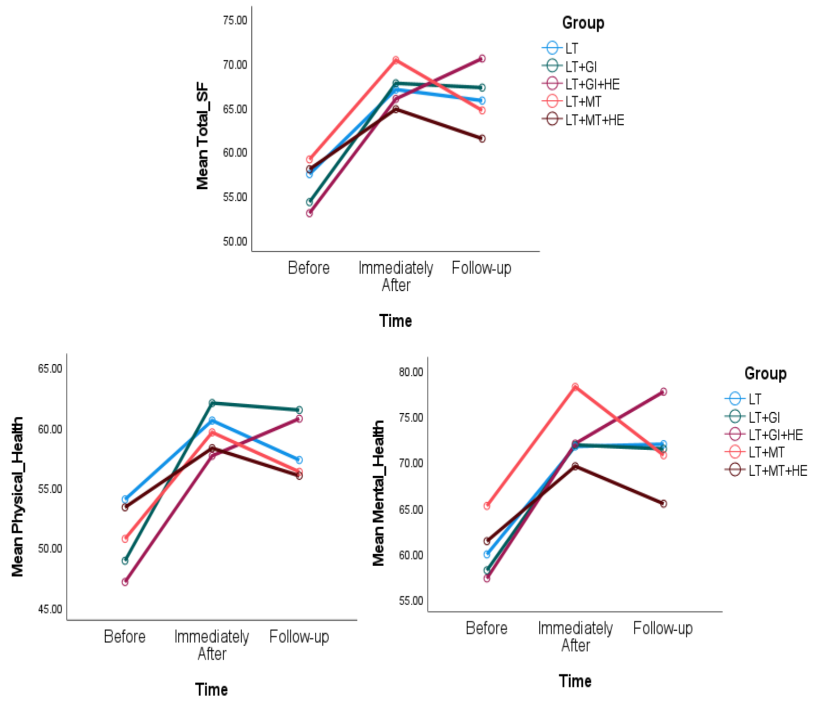

Figure1

Mean of quality of life by SF-12, and its components score changes among treatment groups over time.

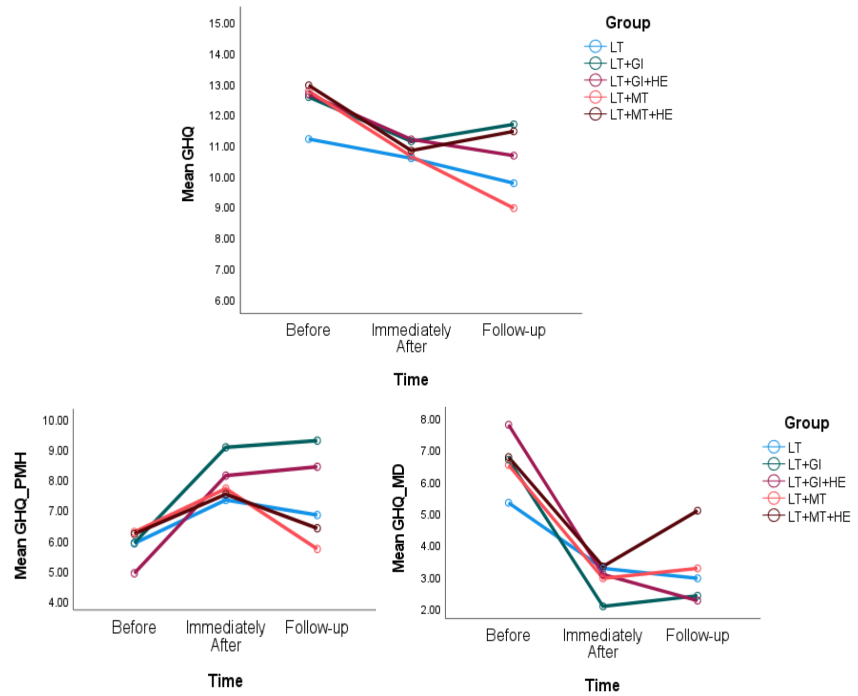

Figure2

Mean of general health by GHQ-12, and its components score changes among treatment groups over time.

Discussion and Conclusion

The findings of this randomized controlled trial provide evidence that structured, multimodal intervention programs substantially enhance quality of life (QoL) and general health in individuals with chronic musculoskeletal pain (CMSP). This outcome is critical because CMSP is a multifaceted phenomenon imposing a heavy burden of physical and psychosocial impairments (Dueñas et al., 2016). The consistent improvement in mental health across all structured groups reinforces the validity of the biopsychosocial model (Gatchel et al., 2007; Meints & Edwards, 2018). Effective management must move beyond a purely medical approach (Kovačević et al., 2022) to address the complex nature of pain (Bourbonnais et al., 2004).

A key finding was that improvements in physical health status (SF-12-PCS) were greater in patients who received High-Intensity Laser Therapy (HILT) combined with a psychological or behavioral element, compared with those who received HILT alone. This suggests that adding a symbolic or behavioral intervention is necessary to maximize the functional benefits of the physical treatment. HILT is efficient at reducing musculoskeletal pain by enhancing cellular activity and improving blood flow (Bathini et al., 2022; Hennessy & Hamblin, 2016; Song et al., 2018). However, the functional gains are maximized when integrated with psychological support, which is consistent with findings that multimodal physiotherapy programs markedly enhance health-related QoL by combining approaches that target multiple facets of the condition (Cuesta-Vargas et al., 2013). Furthermore, studies have shown that integrating consistent physical activity and rehabilitation measures improves both physical functioning and mental well-being in patients with chronic pain (Tello et al., 2025).

While all groups experienced improvements in general mental health, the combined HILT and Guided Imagery (GI) group demonstrated superior gains in positive mental health (PMH). This highlights GI's unique role as a mind-body technique that focuses on pleasant mental images to induce relaxation and achieve specific outcomes (Astin et al., 2005; Kaplun et al., 2023). The theoretical basis for this synergy is rooted in Wilma Bucci's Multiple Code Theory, which posits that experiences are processed across sub-symbolic, non-verbal symbolic, and verbal symbolic levels (Bucci, 1997, 2013). This framework helps resolve the body-mind dichotomy by viewing their relationship as symbolic and sub-symbolic systems (Solano, 2010). The biosemiotic explanation of healing further suggests that symbolic signs, like imagery, can recalibrate physiological processes and activate neural pathways similar to those engaged by the physical treatment (Goli, 2024). The synchronization of these symbolic and physical signs, through enhanced placebo response, could optimize the healing process and alleviate pain (Goli, 2024).

The benefits of psychological interventions are widely supported in the literature. They lead to better quality of life, increased life satisfaction, and improved coping mechanisms compared to physical treatments alone (Greenberg et al., 2020; Sharma et al., 2020). Psychological interventions have been found to reduce the overall burden of pain across everyday functioning, work, social relationships, sleep, and emotional health (Sharma et al., 2020). Systematic reviews support the incorporation of such interventions into multidisciplinary pain-management pathways to build resilience and alter pain perception (Leccese et al., 2025). The finding that the HILT and Music group showed more consistent benefits in overall general health during follow-up compared to the HILT and GI group suggests that different psychological modalities may offer distinct, sustained benefits across the general health spectrum, warranting further comparative study.

Despite significant within-group improvements, the absence of marked inter-group differences in overall mean scores may be attributed to overlapping therapeutic mechanisms across modalities and the relatively short follow-up duration. Chronic musculoskeletal pain involves complex biopsychosocial dynamics that often require longer interventions for differentiation across treatment modalities (El-Tallawy et al., 2021; Wscieklica et al., 2024). The results indicate that targeted physical approaches yield functional and psychological benefits when systematically implemented. However, patient heterogeneity in baseline functional capacity, the use of a convenience sample, and variations in adherence likely influenced outcome variability (El-Tallawy et al., 2021; Wscieklica et al., 2024). Low adherence to guided imagery home sessions, despite positive immediate feedback, may have further limited the cumulative psychological effects.

Moreover, cultural factors might influence responsiveness to guided imagery and laser interventions, warranting caution when generalizing these results beyond the study's sociocultural context. Future studies should use longer, more structured protocols, employ randomized sampling, and incorporate engagement-enhancing strategies to improve compliance and refine understanding of sustained effects within comprehensive pain-management frameworks.

This study provides supporting evidence that structured physical intervention programs substantially enhance quality of life and general health in individuals with chronic musculoskeletal pain. Within-group improvements indicate clinical relevance, even in the absence of pronounced inter-group distinctions. The results align with prior research underscoring the therapeutic impact of laser and other physical rehabilitation approaches. Long-term investigations involving larger samples and extended follow-up durations are recommended to deepen understanding of sustained effects and to explore integration of these interventions within comprehensive pain management frameworks.

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Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

This study has received ethical approval under the ethics code IR.MUI.MED.REC.1404.116, issued by the Ethics Committee of Isfahan University of Medical Sciences, School of Medicine. In addition, the clinical trial has been registered with the Iranian Registry of Clinical Trials (IRCT) under the registration number IRCT20190404043159N7.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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Authors' Contributions

All authors equally contribute to this study.

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