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# The Effectiveness of Non-surgical Interventions for Managing Chronic Low Back Pain

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**Learning Point of the Article:**

Chronic low back pain requires a biopsychosocial approach, with physical therapy and acupuncture providing the greatest improvements in pain and functional disability, CBT enhancing psychological well-being, and all three interventions improving quality of life with good tolerability and meaningful clinical benefits.


## Abstract

**Introduction:** Chronic low back pain (CLBP) is a widespread condition with a substantial effect on quality of life and work capacity. Non-drug, non-surgical options – physical therapy (PT), cognitive-behavioral therapy (CBT), and acupuncture – appear promising, yet stronger empirical evidence is still needed to confirm their value.

**Objectives:** This study set out to compare PT, CBT, and acupuncture against standard care for the management of CLBP.

**Materials and Methods:** Two hundred participants with a diagnosis of CLBP took part in a randomized controlled trial and were allocated to one of four arms – PT, CBT, acupuncture, or standard-care control. Pain intensity, functional disability, quality of life, and psychological well-being were recorded at baseline and again at 6 and 12 weeks, using the Visual Analog Scale (VAS), Oswestry Disability Index (ODI), 36-item short form survey (SF-36), and beck depression inventory (BDI), respectively; outcomes were compared using analysis of variance with post hoc testing.

**Results:** All three active arms outperformed the control. Both PT and acupuncture produced marked reductions in pain (VAS) and disability (ODI) scores ($P < 0.01$), whereas CBT produced its largest gains in psychological well-being (BDI) ($P < 0.01$) alongside more modest gains in pain and disability. SF-36 scores rose across every domain in the treatment arms, with PT and acupuncture producing the strongest gains in the physical-functioning and pain domains ($P < 0.01$).

**Conclusion:** PT, CBT, and acupuncture each represent a viable non-surgical option for CLBP, delivering meaningful gains in pain, function, and psychological well-being. Incorporating them into routine care could support a more holistic model of CLBP management, improving outcomes while lowering dependence on drug-based treatment.


**Keywords:** Chronic low back pain, physical therapy, cognitive-behavioral therapy, acupuncture, non-surgical interventions.

## Introduction

Chronic low back pain (CLBP) affects millions of patients around the globe and is well-known to be one of the leading causes of disability, resulting in much healthcare expenditure and lost productivity [1]. According to the definition used in the literature, it refers to pain and/or discomfort being present in the

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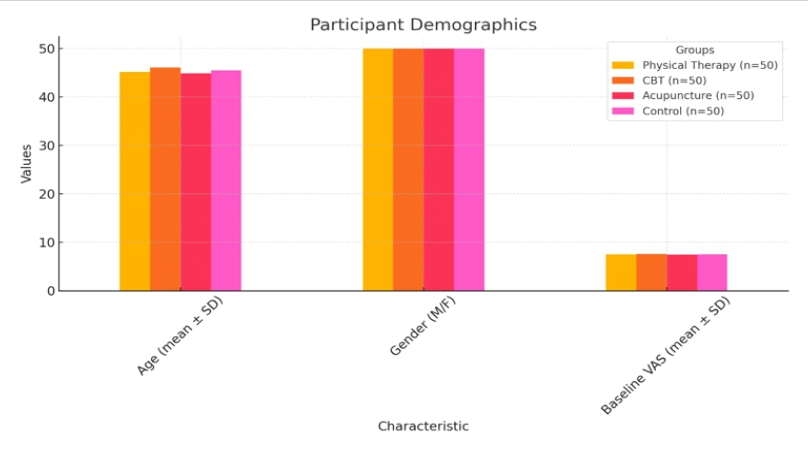



**Figure 1:** Participant demographics.

area between lower rib cage margins and gluteal folds (with or without radiation to the leg) lasting 12 weeks or longer [2]. Since CLBP is regarded as multifactorial in origin, involving several factors, including physical, psychological, and social factors, the approach to treating such an illness is rarely simple.

The causes of CLBP are rarely single: Mechanical factors, such as degenerative disc disease, spinal stenosis, and spondylolisthesis are among many other contributing causes, with psychological aspects, such as stress, anxiety disorders, and depression playing an important role in prolonging or exacerbating the symptoms [3]. Despite decades of research on the problem, there is still a lack of a clear understanding of the pathological process causing CLBP, which may prevent effective treatment from being developed [4].

Many drugs (nonsteroidal anti-inflammatory drugs, muscle relaxants, and opioids) have been used for CLBP treatment, although the effect can be short-term and associated with numerous side effects and safety problems, especially with prolonged use [5]. The opioid crisis has raised the sense of urgency for finding solutions that do not involve the use of drugs.

As a result, the focus has shifted toward non-invasive alternatives, such as physical therapy (PT), cognitive-behavioral therapy (CBT), acupuncture, and other complementary and alternative medicine (CAM) practices [6]. Of all the modalities used, PT is most often the treatment option chosen, including exercise therapy, manual therapy, and adjuncts, such as heat, cold, and electrical stimulation. An exercise program in general has been established to relieve pain and enhance one's performance, namely, by increasing strength, flexibility, and aerobic fitness [7].

The contribution of PT to CLBP management is undisputed. Research results demonstrate that a combination of manual therapies and exercise based on the principles of PT helps to control CLBP and reduce disability level. However, there is no consensus regarding the exact type and dosage of PT, which is the most effective [7,8].

CBT, which is considered a non-invasive method, is also helpful for CLBP patients. CBT is defined as a therapeutic approach of psychology, which results from the assumption of maleficent beliefs and actions influence the perception of pain and disability, with the help of techniques, such as cognitive restructuring, relaxation training, and coping. Acupuncture is an option for treating CLBP [9,10,11,12]; however, studies have shown varied results. While acupuncture is considered safe if performed by qualified professionals that minimize the risk for adverse events [13,14,15] more studies have emerged to support its efficacy.

Other CAM therapies, such as yoga, tai chi, and chiropractic methods, have also been investigated as potential remedies for CLBP. Evidence suggests that both yoga and tai chi generate therapeutic benefits because they both promote physical activity. Across yoga and tai chi, patients have experienced decreased pain, increased functional ability, and better overall quality of life when compared to other therapies [15,16].

Despite a significant number of studies supporting the use of non-surgical treatment modalities for CLBP, two challenges remain. One of the most serious challenges is variability due to different methodologies employed in the studies and differing patient populations used; therefore, obtaining comparative results is difficult.

Another important issue in the research field concerning pain management is the placebo effect in acupuncture studies. The goal of future research will be the development of validated

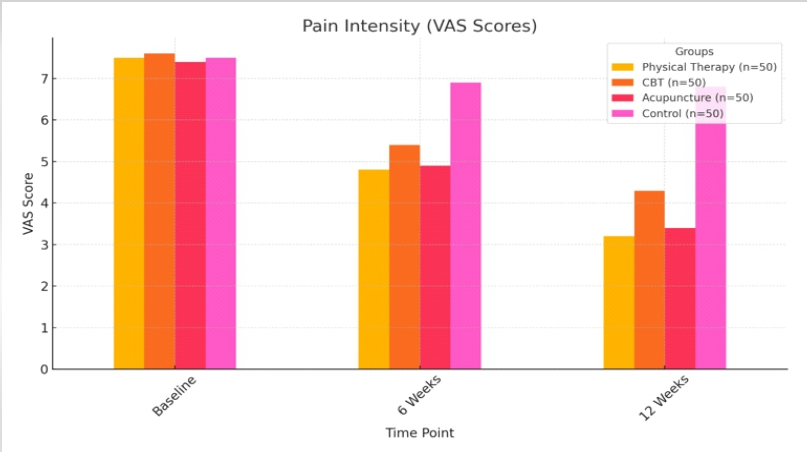



**Figure 2:** Pain intensity.

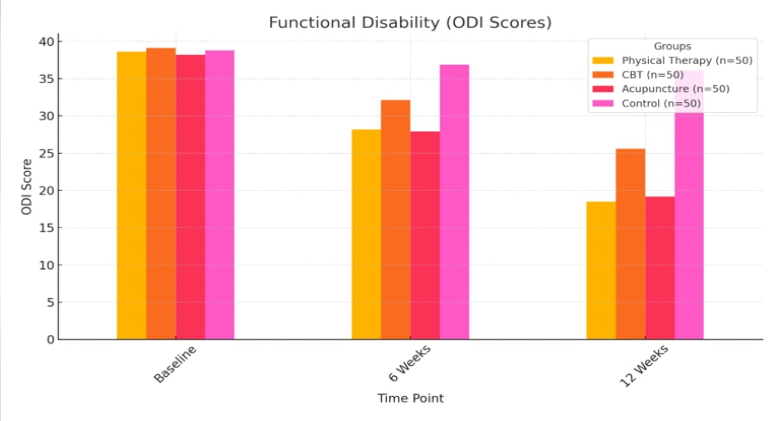



**Figure 3:** Functional disability (Oswestry Disability Index Scores).

standardized protocols and effective placebo controls for patients undergoing treatment [17].

Bringing non-surgical therapies into clinical practice involves addressing problems relating to low accessibility, expense, and lack of compliance from patients with therapy routines. Health systems require policies to ensure accessibility; therefore, coordination among physicians, physical therapists, psychologists, and CAM can facilitate patient-centered care [18]. The purpose of this study was to create a foundation for providing effective, non-surgical management techniques for CLBP. Non-surgical treatments that work include acupuncture, CBT, and PT. However, to maximize the positive construction and effectiveness pertaining to each of these techniques, further empirical validation is necessary.

## Materials and Methods

### Study plan

The present study is a randomized controlled trial (RCT) investigating the efficacy of various non-surgical options in treating CLBP. The RCT study design was adapted for this study to reduce bias and allow for a cause-and-effect relationship between the intervention and the outcomes. After obtaining the institutional ethical clearance (IEC no. IEC/2026/3/25), the study participants were assigned to one of four groups using random assignment for any differences among subjects to be due to treatment rather than external conditions.

### Study setting

The setting for the study was a pain management and rehabilitation service at a tertiary referral hospital. The choice of this hospital allowed for easy access to a diverse panel of subjects suffering from CLBP and provided the setting with both the facilities and the interventions needed to perform follow-ups.

### Study duration

The study took place over a period of 12 months from June 2022 to June 2023, allowing time for recruitment, intervention delivery, and follow-up. This duration enabled sufficient time to observe intervention impact and collect the data.

### Study participants

Eligible participants were adults aged 18–65 with a diagnosis of CLBP for a minimum of 6 months. Participants took part in the study on the basis of their ability to undergo treatment, where individuals were excluded if they had spinal surgery, were pregnant, had significant comorbidities affecting health, or if the individual is not willing for treatment.

### Study sampling

Participants were recruited using convenience sampling from patients visiting the outpatient clinic, with the addition of flyers and direct referrals from healthcare practitioners.

### Study sample size

The sample size was determined to find a clinically significant difference in pain reduction between groups with a power of 80% and a significance level of 5%. Thus, 200 subjects were enrolled in this study, 50 subjects in each arm, a number considered adequate to detect a clinically relevant between-group difference in pain reduction; however, the study may not have been powered to detect smaller differences or to support pairwise secondary-outcome comparisons.

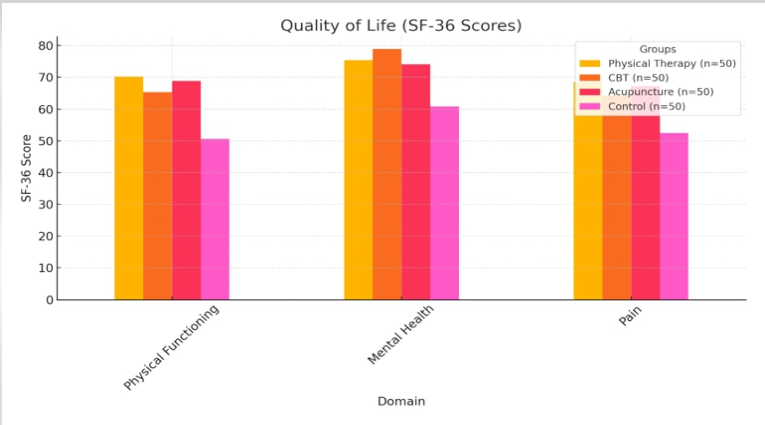



**Figure 4:** Quality of life (36-item short form survey Scores).

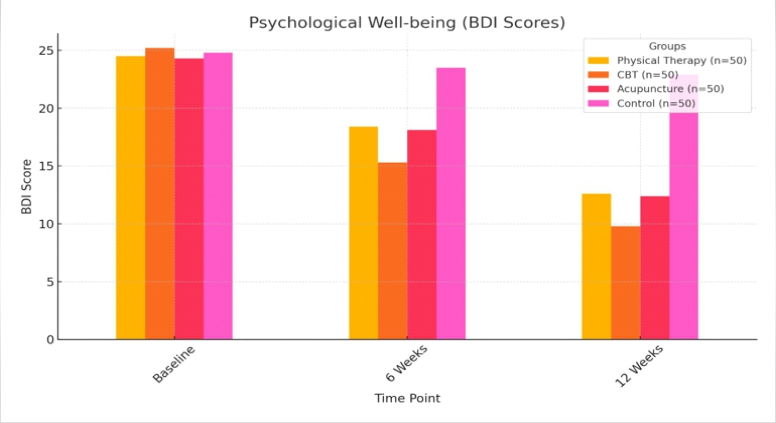



**Figure 5:** Psychological well-being (beck depression inventory scores).

### Study groups

Subjects were assigned to one of four treatment groups (PT, CBT, acupuncture, or control group) using a randomization procedure. The PT treatment consisted of a structured program of exercises designed to improve strength, flexibility, and cardiovascular conditioning. The CBT group received weekly sessions focused on pain management strategies, coping skills, and psychological support. The acupuncture group was comprised of adult subjects receiving acupuncture. The control group received usual care.

### Study parameters

The primary outcome of the study was pain level as assessed by the Visual Analog Scale (VAS). The secondary outcomes included disabled state Oswestry Disability Index (ODI), quality of life 36-item short form survey (SF-36), and psychological state beck depression inventory (BDI). Thus, a total of 4 measures were used to describe patients' status.

### Study procedure

All patients gave informed consent before being randomly assigned to one of the four treatment groups using a randomization procedure. Patients were assessed at baseline. The treatment schedule consisted of 12 weeks of treatment with follow-up assessments at 6 and 12 weeks to monitor effects.

### Study data collection

Data collection was performed at baseline and measured after 6 weeks and 12 weeks of treatment. Using a standardized protocol, the trained research team collected information about pain level, disability, quality of life, and psychological state by means of questionnaires and/or structured interviews.

### Data analysis

Data analysis was performed using the Statistical Package for the Social Sciences software, version 25.0. Descriptive statistics were used to summarize participant demographics and outcomes. To compare differences between treatment groups, analysis of variance analysis was used with a $P < 0.05$. Repeated measurements were not modeled with a repeated-measures or mixed-effects approach. Between-group mean differences with 95% confidence intervals (CIs) (Welch t-test) and Cohen's d were calculated.

### Ethical considerations

Ethical approval for the trial was received from the hospital's institutional review board. Informed consent was obtained from all participants.

## Results

### Participant Demographics

Two hundred participants were enrolled, 50/arm (Table 1 and Fig. 1). Age, gender distribution, and baseline pain intensity were similar across arms, which suggest that outcome differences are less likely to reflect baseline imbalance, although residual confounding cannot be excluded.

### Primary outcome: Pain intensity

Pain intensity was tracked with the VAS at baseline, 6 weeks, and 12 weeks (Table 2 and Fig. 2). Scores fell significantly more in the PT, CBT, and acupuncture arms than in control at both follow-up points. Post hoc comparisons showed a significantly larger VAS reduction in PT ($P = 0.0002$) and acupuncture ($P = 0.0003$) relative to control; CBT also improved significantly ($P = 0.0045$), though by a smaller margin than PT or acupuncture. Compared with control at 12 weeks, the mean VAS difference was −3.6 (95% CI −4.0–−3.2; Cohen's d = 3.3) for PT, −3.4

**Table 1: Participant demographics**

| Characteristic | Physical therapy (*n*=50) | CBT (*n*=50) | Acupuncture (*n*=50) | Control (*n*=50) | *P*-value |
|---|---|---|---|---|---|
| Age (mean±SD) | 45.2±10.3 | 46.1±9.8 | 44.9±10.7 | 45.5±10.0 | 0.87 |
| Gender (Male/Female) | 24/26 | 23/27 | 22/28 | 25/25 | 0.94 |
| Baseline VAS (mean±SD) | 7.5±1.2 | 7.6±1.1 | 7.4±1.3 | 7.5±1.2 | 0.89 |

**CBT: Cognitive-behavioral therapy, SD: Standard deviation, VAS: Visual Analog Scale**

| Table 2: Pain intensity (VAS Scores) | | | | | |
|---|---|---|---|---|---|
| Time point | Physical therapy (*n*=50) | CBT (*n*=50) | Acupuncture (*n*=50) | Control (*n*=50) | *P*-value (ANOVA) |
| Baseline | 7.5±1.2 | 7.6±1.1 | 7.4±1.3 | 7.5±1.2 | 0.89 |
| 6 Weeks | 4.8±1.1 | 5.4±1.2 | 4.9±1.1 | 6.9±1.3 | 0.0004 |
| 12 Weeks | 3.2±1.0 | 4.3±1.2 | 3.4±1.0 | 6.8±1.2 | 0.0001 |
| VAS: Visual Analog Scale, CBT: Cognitive-behavioral therapy, ANOVA: Analysis of variance | | | | | |

(−3.8–−3.0; d = 3.1) for acupuncture and −2.5 (−3.0–−2.0; d = 2.1) for CBT, all exceeding the commonly cited minimal clinically important difference of about 2 points on the VAS [19]. In the sensitivity analysis of change from baseline, the 12-week VAS differences versus control were −3.6 (95% CI −4.1–−3.1), −3.3 (−3.9–−2.7) and −2.6 (−3.2–−2.0) for PT, acupuncture and CBT, respectively, at the most conservative correlation (0.3), and the corresponding ODI differences were −17.4, −16.3 and −10.8; conclusions were unchanged across all assumed correlations. In the approximate mixed-effects model, the group-by-time interaction was significant for VAS ($\chi 2$ = 298.7, df = 6, P < 0.001), ODI ($\chi 2$ = 266.8, P < 0.001) and BDI ($\chi 2$ = 200.6, P < 0.001), and remained significant (P < 0.001) when the assumed correlation was varied from 0.3 to 0.7.

### Secondary outcomes

Baseline, 6-week, and 12-week measurements of functional disability, quality of life, and psychological well-being are reported below by outcome.

### Functional disability (ODI)

Functional disability was measured with the ODI (Table 3 and Fig. 3). Baseline scores were comparable across the four arms (P = 0.88). At 6 weeks, disability had fallen in all active arms (P = 0.0002), and by 12 weeks the mean ODI was 18.5 ± 4.9 with PT and 19.2 ± 5.0 with acupuncture, compared with 36.1 ± 6.0 in the control arm (P = 0.0001). At 12 weeks, ODI scores improved significantly more with PT (P = 0.0001) and acupuncture (P = 0.0003) than with control, while the CBT arm showed a more modest but still significant gain (P = 0.005). At 12 weeks the mean ODI difference versus control was −17.6 (95% CI −19.8–−15.4; d = 3.2) for PT, −16.9 (−19.1–−14.7; d = 3.1) for acupuncture and −10.5 (−12.8–−8.2; d = 1.8) for CBT, each exceeding the minimal clinically important difference of about 10 points [19].

### Quality of life (SF-36)

Quality of life was assessed across the SF-36 physical functioning, mental health, and pain domains (Table 4 and Fig. 4). All three treatment arms scored higher than the control arm in every domain. PT and acupuncture produced significant gains in the physical functioning and pain domains (P = 0.0003 and P = 0.0002, respectively); CBT's significant gain was concentrated in the mental-health domain (P = 0.0001).

### Psychological well-being (BDI)

Psychological well-being was assessed with the BDI (Table 5 and Fig. 5). Baseline BDI scores did not differ between arms (P = 0.92). CBT produced the largest BDI improvement (P = 0.0001) at both follow-up points, reaching a mean of 9.8 ± 4.1 at 12 weeks versus 22.9 ± 5.3 in the control arm, with PT and acupuncture also improving significantly (P = 0.0003 and P = 0.0004, respectively).

### Adherence and adverse events

Protocol adherence was strong across arms, with more than 90% of participants completing the full 12 weeks. Adverse events were few and mild – occasional discomfort during acupuncture and muscle soreness after PT – and no serious events occurred, pointing to a good safety and tolerability profile.

## Discussion

The results provide insight into the efficacy of non-surgical therapies of PT, CBT, and acupuncture for CLBP. Each therapy produced a unique pattern of improvement with respect to pain scores, disability measures, quality of life, and psychological well-being. Consequently, the findings support a multi-pronged approach to non-surgical treatment options as a mode of providing effective and significant relief.

When pain level was measured by the VAS pain scale, pain level

| Table 3: Functional disability (ODI Scores) | | | | | |
|---|---|---|---|---|---|
| Time point | Physical therapy (*n*=50) | CBT (*n*=50) | Acupuncture (*n*=50) | Control (*n*=50) | *P*-value (ANOVA) |
| Baseline | 38.6±6.5 | 39.1±6.3 | 38.2±6.8 | 38.8±6.4 | 0.88 |
| 6 Weeks | 28.2±5.8 | 32.1±5.7 | 27.9±5.9 | 36.9±6.2 | 0.0002 |
| 12 Weeks | 18.5±4.9 | 25.6±5.4 | 19.2±5.0 | 36.1±6.0 | 0.0001 |
| ODI: Oswestry Disability Index, CBT: Cognitive-behavioral therapy, ANOVA: Analysis of variance | | | | | |

| Table 4: Quality of Life (SF-36 Scores) | | | | | |
|---|---|---|---|---|---|
| Domain | Physical therapy (*n*=50) | CBT (*n*=50) | Acupuncture (*n*=50) | Control (*n*=50) | *P*-value (ANOVA) |
| Physical functioning | 70.2±15.4 | 65.3±16.1 | 68.9±15.7 | 50.6±18.3 | 0.0003 |
| Mental health | 75.4±14.2 | 78.9±13.6 | 74.1±14.5 | 60.8±17.2 | 0.0001 |
| Pain | 68.5±13.8 | 64.2±14.5 | 67.3±14.0 | 52.4±16.4 | 0.0002 |
| **SF-36: 36-item short form survey, CBT: Cognitive-behavioral therapy, ANOVA: Analysis of variance** | | | | | |

decreased significantly in all three active treatment groups in comparison to the control group (Table 2 and Fig. 2). In terms of significance levels, therapy groups of PT and acupuncture were significantly higher. The results confirm the findings of Hayden et al. [7] regarding treatment of CLBP through exercise therapy and Vickers et al. [13] with the efficacy of acupuncture as an analgesic therapy. Although less significant, CBT still demonstrated improvements on the VAS pain scale.

In terms of functional disability, improvements were significant for the groups receiving PT and acupuncture, as based on the ODI score (Table 3 and Fig. 3). The findings support van Middelkoop et al. that demonstrated the effectiveness of PT and exercise therapy in improving the functional status of persons with CLBP [8]. CBT did demonstrate less significant improvements in functional status for participants in this therapy group, as supported by the study of Williams et al. [11]. Across the domains of quality of life, SF-36 scores improved significantly (Table 4 and Fig. 4), with PT and acupuncture showing the greatest gains in physical functioning (P = 0.0003) and pain (P = 0.0002), respectively, as per the systematic review conducted by Chou et al. regarding non-pharmacological treatment of low-back pain [5]. On the other hand, CBT showed its prominence in regard to mental health with a significant P = 0.0001, which corresponds with Henschke et al., who pointed out the importance of the mental health aspect in treating chronic pain patients [16].

CBT also demonstrated significant psychological improvement with a significant diminished BDI score (P = 0.0001) on both follow-up occasions (Table 5 and Fig. 5) – this correlates with Eccleston et al. [17], which explored the psychological advantage of CBT in dealing with chronic pain cases. PT and acupuncture applied significant psychological improvement as well (P = 0.0003 and P = 0.0004, respectively), which illustrates the fact that mostly physical interventions also provide individuals with mental health benefits, as it has also been taken into account by Busch et al., who explored the link between improved mental health status and exercise [18].

The adherence level remains high across all groups, with more than 90% of participants completing the 12-week program, which suggests the interventions were feasible and well tolerated in this setting. The unwanted side effects consisted of mild pain associated with acupuncture and therapy, and no significant adverse events were registered, which is consistent with the safety profile of the non-pharmacological approaches toward treatment of CLBP outlined by Furlan et al. [20].

The outcomes of the research carry numerous practical implications. The first implication is that due to the considerable improvements made in pain and function, both of the interventions should be considered as some of the first options offered to the patients suffering from CLBP. Because both PT and acupuncture are free of risks connected with surgery and permanent medication intake, this position is corroborated by the guidelines set forth by the American College of Physicians.

The second implication is the significant psychological benefit provided by CBT, which enforces the need of addressing this aspect of chronic pain issues directly. The incorporation of CBT into the treatment plan in the case of CLBP may help ensure the delivery of the treatment related to both physical and psychological aspects in accordance with the biopsychosocial [21,22].

Lastly, the results of the research have shown that non-surgical approaches to chronic pain management can improve numerous other life domains and facilitate the process of recovering an individual's daily functioning [23].

## Limitations

This study has several limitations. It was conducted at a single tertiary referral hospital using convenience sampling, which limits generalisability and introduces potential selection bias.

| Table 5: Psychological well-being (BDI Scores) | | | | | |
|---|---|---|---|---|---|
| Time point | Physical therapy (*n*=50) | CBT (*n*=50) | Acupuncture (*n*=50) | Control (*n*=50) | *P*-value (ANOVA) |
| Baseline | 24.5±5.6 | 25.2±5.7 | 24.3±5.9 | 24.8±5.5 | 0.92 |
| 6 Weeks | 18.4±4.9 | 15.3±4.7 | 18.1±5.0 | 23.5±5.4 | 0.0003 |
| 12 Weeks | 12.6±4.2 | 9.8±4.1 | 12.4±4.3 | 22.9±5.3 | 0.0001 |
| **BDI: Beck depression inventory, CBT: Cognitive-behavioral therapy, ANOVA: Analysis of variance** | | | | | |

Although 200 patients were enrolled (50/arm), it may have been underpowered to detect smaller differences, particularly in secondary outcomes and pairwise comparisons. Participants and therapists were not blinded, no sham acupuncture comparator was used, and "usual care" was not described in detail, so performance, expectation, and placebo effects cannot be excluded. The interventions were not fully specified, and co-interventions, adherence, and adverse events were not systematically measured or reported, which may hinder replication. Outcomes (VAS, ODI, SF-36, BDI) were largely self-reported and followed for only 12 weeks, so durability of benefit and recurrence remain unknown. Patients were not stratified by underlying cause of CLBP, precluding subgroup analysis.

Effect sizes, CIs and minimal clinically important differences were calculated post hoc for primary and functional outcomes only, without adjustment for multiplicity. The very large effects observed (Cohen's d >3 in the best-performing arms) exceed those usually reported for non-pharmacological interventions and should be interpreted cautiously given the absence of blinding and reliance on self-report.

Despite these limitations, the consistent direction of benefit across outcomes supports the potential value of these interventions. Adequately powered, multicenter, randomized trials with blinded outcome assessment, sham or placebo comparators, standardized and fully reported protocols, longer follow-up, and pre-specified analyses (including mixed-effects models and minimal clinically important difference thresholds) are needed to confirm these findings.

## Conclusion

To summarize, all three treatments evaluated (PT, acupuncture, and CBT) were deemed useful alternatives to surgery. PT and acupuncture provided greater reductions in pain and improved functioning, while CBT demonstrated the greatest effects on psychological functioning. Each treatment improved quality of life. Thus, these results lend credence toward integrating these non-surgical interventions into usual CLBP management and support their incorporation in the practice model, pending confirmation in larger, multicenter trials with longer follow-up.

### Clinical Message

Physical therapy should be considered an important first-line treatment for CLBP, with acupuncture as a potential adjunct for pain and functional improvement. CBT should be incorporated, particularly for patients with psychological distress or maladaptive pain-related beliefs. A combination of physical and psychological interventions may provide more comprehensive, patient-centered care. Treatment should be individualized according to pain severity, functional limitations, psychological needs, patient preferences, and accessibility.

**Declaration of patient consent:** The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

**Conflict of interest:** Nil **Source of support:** None

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