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Effects of Stabilization Exercises with Sleep Hygiene on Anxiety and Depression in Low Back Pain Patients: An Experimental Study.

Dr. Muskan Khazi [1], Mohammad Akbar Khan [2], Prof. A.K. Vijay Krishna Kumar [3]

[1]Assistant professor, Department of Physiotherapy, Dr. B. R Ambedkar College of Physiotherapy, Bangalore, India.
[2]Intern, Department of Physiotherapy, Dr. B. R Ambedkar College of Physiotherapy, Bangalore, India.
[3]Principal, Department of Physiotherapy, Dr. B. R Ambedkar College of Physiotherapy, Bangalore, India.

Abstract
Chronic low back pain (CLBP) is commonly defined by symptom duration and frequency, recent scoping and narrative reviews recommend defining CLBP as low back pain present for at least three months and often occurring on at least half the days in the previous six months. CLBP is highly prevalent and frequently associated with functional limitation and reduced quality of life. Large studies and reviews report that anxiety and depressive symptoms are frequent in people with chronic pain, including CLBP, population and clinic samples often find ~20–40% screening positive for anxiety/depression. Poor sleep and CLBP have a bidirectional relationship: long-term poor sleep quality increases the risk of developing chronic and disabling back pain, while persistent pain itself frequently disrupts sleep. Anxiety and depression are also highly comorbid with CLBP and significantly contribute to pain-related disability. Improvements in pain and function following physiotherapy or structured exercise programs are often accompanied by reductions in depressive and anxiety symptoms, suggesting that physical rehabilitation may produce both somatic and psychological benefits. Sleep-hygiene education typically includes guidance on regular sleep-wake schedules, limiting stimulating substances before bedtime, and optimizing the sleep environment. While such education alone can modestly improve sleep metrics, its integration with structured exercise particularly relaxation or moderate physical activity has demonstrated more robust benefits.

Aim of the study: To evaluate the Effect of Stabilization exercise combined with Sleep Hygiene Education on Anxiety and Depression in Chronic Low Back Pain patients.

Methodology: This study is an experimental study will be conducted among 30 adults both male and female aged 18-65 years. Participants will be selected using convenient sampling based on pre-defined inclusion and exclusion criteria. Patient's eligible will be informed about the objectives and significance of the study, and written informed consent will be obtained prior to participation. Data will be collected using a demographic information sheet, Beck's depression inventory (BDI), Beck Anxiety inventory

(BAI), Pittsburgh sleep quality index (PSQI) and Visual Analogue scale (VAS). Data will be analyzed using descriptive statistics such as mean, standard deviation, frequencies, and percentages to assess the Effect of Stabilization exercise combined with Sleep Hygiene Education on Anxiety and Depression in Chronic Low Back Pain patients.

Keywords: Low Back Pain, Anxiety, Depression, Sleep Hygiene Education, Stabilization Exercises.

1. Introduction

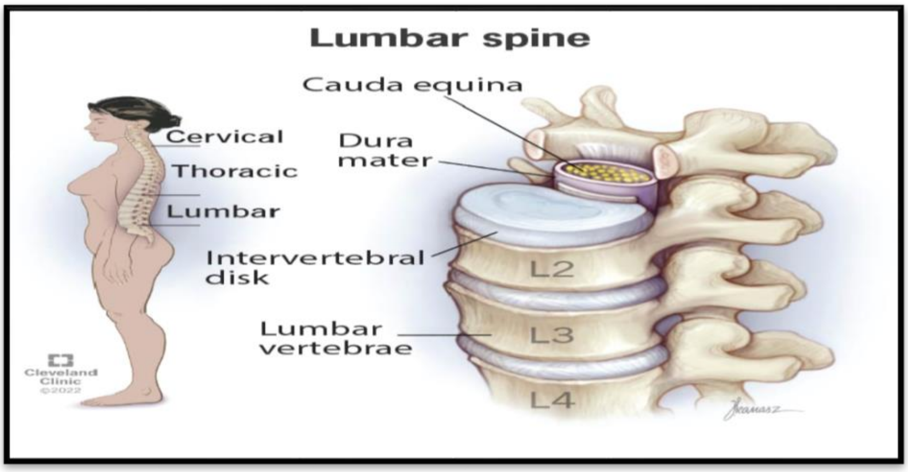
Low back pain causes more years lost to disability than any other condition worldwide. It refers to pain experienced between the lower rib cage and buttock creases but can extend into the legs. It is not a single condition but rather a symptom with many underlying causes. Although a specific diagnosis is available for some, for most, the condition is referred to as “non-specific,” meaning there is no identifiable cause. Low back pain is an episode of pain in the lumbar region (between the lower rib margins and the gluteal folds) that has been present for at least 24 hours. It is considered acute if lasting <12 weeks, chronic if ≥12 weeks, and recurrent if new episodes occur after at least 6 months of pain-free period.

Acute low back pain is defined as lasting less than 12 weeks, with 85–95% of cases being non-specific, meaning no clear anatomical cause can be identified. The remaining 5–10% have specific causes such as disc herniation with radiculopathy, vertebral fracture (osteoporotic or traumatic), spinal stenosis (rare in the acute phase), inflammatory conditions like the onset of ankylosing spondylitis, or serious red-flag conditions such as cauda equina syndrome, infection, or cancer (less than 1%).

Chronic low back pain persists for 12 weeks or longer and is classified into three main categories. The vast majority (90–95%) is non-specific chronic low back pain with no identifiable pathoanatomical cause. Of the specific causes (5–10%), the most common are discogenic pain from internal disc disruption (26–42% of all chronic cases), zygapophyseal (facet) joint pain (10–15%), sacroiliac joint pain (10–25%), persistent radiculopathy or neuropathic pain (e.g., failed back surgery syndrome or stenosis), and inflammatory axial spondyloarthritis (0.3–5%). Clinically, the most useful modern classification is the biopsychosocial model, which divides chronic low back pain into nociceptive-dominant, neuropathic-dominant, and nociplastic/central sensitization-dominant types; the latter is the most severe, associated with the highest disability, widespread pain, and significant overlap with fibromyalgia.

The pathophysiology of chronic low back pain involves multiple overlapping mechanisms: peripheral sensitization from injured discs, facets, muscles, or ligaments; central sensitization, which is the most important driver of persistent pain and leads to amplified pain perception, hyperalgesia, and allodynia; reduced descending pain inhibition; maladaptive neuroplastic changes and cortical reorganization in the somatosensory cortex; endogenous opioid system dysfunction; glial cell activation with release of pro-inflammatory cytokines such as TNF-α, IL-1β, and IL-6; fear-avoidance behavior leading to disuse, muscle inhibition, and deconditioning; sleep disturbance that lowers pain thresholds and creates a vicious cycle; and co-existing anxiety or depression that further impairs serotonin/norepinephrine-mediated descending inhibition.

Figure 1: Anatomy of the Lumbar spine



The main anatomical structures proven to generate low back pain through diagnostic blocks are the outer third of the annulus fibrosus of the intervertebral disc and vertebral endplates, the zygapophyseal (facet) joints innervated by the medial branches of the dorsal rami, the posterior ligamentous portion of the sacroiliac joint, the lumbar multifidus and erector spinae muscles (though rarely the primary source), the thoracolumbar fascia, and the nerve roots or dorsal root ganglia in cases of radicular pain.

Chronic low back pain has a global point prevalence of 7.5–12% and a lifetime prevalence of 15–30%. It remains the leading cause of disability worldwide in adults under 45 years of age according to the Global Burden of Disease 2021 study. Without proper early management, 60–80% of people who experience acute low back pain will progress to chronic pain. It is most prevalent in working-age adults between 30 and 60 years.

Chronic low back pain (CLBP) is commonly defined by symptom duration and frequency, recent scoping and narrative reviews recommend defining CLBP as low back pain present for at least three months and often occurring on at least half the days in the previous six months. CLBP is highly prevalent and frequently associated with functional limitation and reduced quality of life [1].

CLBP ranges from localized lumbar pain to pain with radicular features like leg pain, numbness, weakness. Assessment must look for “red flags” such as infection, fracture, cancer, cauda equina and “yellow flags” such as psychosocial risk factors for poor outcome. Functional limitation and sleep disturbance are common [3].

Pain in CLBP is multi-mechanistic: ongoing nociceptive input from injured structures, neuropathic mechanisms when nerves are compressed/irritated (radiculopathy), and central nervous system changes (central sensitization / altered pain processing) that maintain pain in a subgroup of patients. Neuroinflammation and abnormal innervation of degenerated discs are also described mechanisms [4]. Prevalence of CLBP ranged from 3.9% to 25.4%, depending on age group and study population. Further, a recent review of 35 studies revealed that 21% to 68% of individuals aged 60 years or older had CLBP in the last 12 months, substantiating a high prevalence of CLBP among older adults [5].

Many patients with CLBP have non-specific pain (no single structural cause found). Common structural contributors when present include degenerative intervertebral disc disease (discogenic pain), facet joint arthropathy, spinal stenosis, spondylolisthesis, and radiculopathy from disc herniation. Imaging findings are degeneration, Modic changes do not always correlate with pain [2].

Sleep disturbance affects 55–88% of patients with chronic low back pain (compared to only 10–30% in the general population), with severe insomnia present in 40–60%. The relationship is strongly bidirectional: pain causes fragmented sleep, difficulty initiating sleep, and early morning awakening, while poor sleep lowers the pain threshold by 30–50%, increases pro-inflammatory cytokines (IL-6, TNF-α), worsens central sensitization, and is one of the strongest predictors of pain flare-ups and long-term disability.

Psychological comorbidity is extremely common: clinical depression affects 20–45% of chronic low back pain patients (versus 5–8% in the general population), while 60–80% have clinically relevant depressive symptoms; anxiety disorders affect 25–40%; pain catastrophizing, the strongest psychological predictor of poor outcome, is present in 40–70%; and high fear-avoidance beliefs are seen in 50–70% of patients.

According to recent guidelines including the World Health Organization (WHO) (2023) National Institute for Health and Care Excellence (NICE), American Physical Therapy Association (APTA) Clinical Practice Guidelines, and updated systematic reviews, exercise therapy is recommended as the first line treatment for chronic low back pain (CLBP). Among exercise approaches, motor control and stabilization exercises have demonstrated moderate to high quality evidence for reducing pain and disability. Current evidence suggests that no single type of exercise is superior for all patients; therefore, treatment should be individualized and progressively loaded based on patient tolerance and functional goals. Stabilization exercises aim to restore deep trunk muscle activation, improve neuromuscular control, enhance spinal stability, reduce fear avoidance behaviours, and prevent recurrence.

The rehabilitation program typically spans 8–12 weeks, with supervised sessions two to three times per week and daily low load home exercises. The initial phase focuses on activation of deep stabilizing muscles such as the transversus abdominis and multifidus. Exercises such as the Abdominal Drawing in Manoeuvre (ADIM), multifidus activation in prone positions, and diaphragmatic breathing are performed in pain free ranges with low load and sustained holds. This phase emphasizes motor relearning and correction of faulty recruitment patterns. Progression to the second phase occurs once patients demonstrate proper muscle activation without compensatory movements and stable pain levels.

The second phase incorporates static stabilization exercises that challenge trunk control while adding limb movements. Exercises such as bridging, bird dog, modified side planks, and dead bug exercises are commonly prescribed with moderate repetitions and controlled holds. Evidence from recent Cochrane reviews supports motor control and trunk endurance training in reducing disability in CLBP patients. As patients improve, exercises are progressed by increasing hold times, adding resistance bands, or introducing unstable surfaces.

The final phase integrates dynamic and functional stabilization with progressive loading. Full planks, advanced side planks, squats with core bracing, lunges with trunk control, and anti-rotation resistance exercises are introduced to simulate functional activities. Current recommendations indicate that exercise intensity should gradually progress from low to moderate levels, and mild pain during exercise (not exceeding 5/10 and not persisting beyond 24 hours) is considered acceptable. Weekly exercise duration should reach approximately 75–150 minutes, and aerobic activities such as walking or cycling are encouraged. Evidence suggests that a structured, progressive stabilization program over 8–12 weeks results in clinically meaningful reductions in pain intensity and disability, along with improvements in trunk endurance and functional capacity.

Sleep disturbance is highly prevalent in individuals with chronic low back pain, affecting approximately 50–80% of patients. Poor sleep contributes to increased pain sensitivity, central sensitization, systemic inflammation, mood disturbances, and impaired recovery. Contemporary research emphasizes that sleep disruption is not merely a consequence of pain but also a contributing factor to pain persistence. Therefore, addressing sleep is considered an essential component of CLBP management. Current guidelines recommend behavioural sleep interventions and Cognitive Behavioural Therapy for Insomnia (CBTI) as first line treatments for chronic sleep disturbances.

Management begins with a comprehensive sleep assessment using validated tools such as the Pittsburgh Sleep Quality Index (PSQI), Insomnia Severity Index (ISI), and sleep diaries. The foundation of sleep management includes structured sleep hygiene education. Patients are advised to maintain consistent sleep and wake times, including weekends, to regulate circadian rhythms. Time spent in bed should approximate actual sleep duration, and prolonged daytime naps should be avoided. Stimulus control therapy is strongly recommended, meaning the bed should be used only for sleep and intimacy. If a patient remains awake for more than 20 minutes, they should leave the bed and return only when sleepy. The avoidance of electronic screens before bedtime is also encouraged to reduce blue light exposure.

Environmental optimization is particularly important for CLBP patients. Evidence suggests that medium firm mattresses improve both sleep quality and back pain symptoms. Side lying with a pillow between the knees or supine lying with a pillow under the knees helps maintain spinal neutrality and reduce mechanical stress. The bedroom environment should be cool, dark, and quiet to facilitate restorative sleep. Establishing a wind down routine 30–60 minutes before bed, including gentle lumbar mobility exercises, diaphragmatic breathing, progressive muscle relaxation, or a warm shower, can reduce muscle tension and sympathetic nervous system activation.

Patients are advised to avoid caffeine after late afternoon, alcohol before bedtime, heavy evening meals, and vigorous exercise close to bedtime. Heat therapy applied to the lumbar region before sleep may reduce muscle stiffness and pain perception. Daytime physical activity is strongly encouraged, as regular exercise improves sleep efficiency and reduces pain severity. For patients with persistent insomnia lasting more than three months or those with comorbid anxiety or depression, CBT I is recommended. CBT I include cognitive restructuring, sleep restriction therapy, relaxation techniques, and behavioural modifications, and it has strong evidence supporting its effectiveness in chronic pain populations.

Recent evidence supports a multimodal approach combining exercise therapy, sleep interventions, and pain neuroscience education for optimal outcomes in CLBP patients. Addressing both physical and behavioural contributors leads to reductions in pain intensity, improvements in sleep quality, decreased psychological distress, and enhanced overall quality of life.

Large studies and reviews report that anxiety and depressive symptoms are frequent in people with chronic pain, including CLBP, population and clinic samples often find ~20–40% screening positive for anxiety/depression. Multiple cohorts and genetic/ Multiple research studies show pain and depression influence each other over time, people with back pain are more likely to later develop major depression, and people with depressive symptoms are more likely to report later back pain (though some twin analyses suggest shared familial factors also contribute) [6,7].

Sleep-hygiene education typically includes guidance on regular sleep–wake schedules, limiting stimulating substances before bedtime, and optimizing the sleep environment. While such education alone can modestly improve sleep metrics, its integration with structured exercise—particularly relaxation or moderate physical activity—has demonstrated more robust benefits. In a randomized trial of adults with chronic sleep complaints, a six-week intervention combining sleep education and weekly moderate physical exercise led to significant improvements in subjective sleep quality, reduced sleep latency and nocturnal awakenings, and enhanced mood, vitality, and depressive symptoms.

The Beck Depression Inventory (BDI) scale, developed and approved by Beck et al.[14], in 1961, served as the methodology for the current investigation. This evaluation instrument was intended to measure the level of depression. The interpretation of,

1-101: These ups and downs are considered normal
11-16: Mild mood disturbance
17-20: Borderline clinical depression
21-30: Moderate depression
31-40: Severe depression
Over 40: Extreme depression

Beck anxiety Inventory (BAI) - The BAI is a short list describing 21 anxiety symptoms such as "wobbliness in legs", "scared" and "fear of losing control"
The total score is calculated by finding the sum of the 21 items.
Beck Anxiety Score
Score of 0-21: Low anxiety
Score of 22-35: Moderate anxiety
Score of 36 and above: Potentially concerning levels of anxiety.

Pittsburgh Sleep Quality Index (PSQI)
The PSQI was designed to evaluate overall sleep quality Each of the questionnaire's 19 self-reported items belongs to one of seven subcategories: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. Five additional questions rated by the respondent's roommate or bed partner are included for clinical purposes and are not scored.

Chronic low back pain (CLBP) is a prevalent musculoskeletal condition defined by persistent lumbar pain lasting more than three months and is a leading cause of disability worldwide. It significantly affects functional ability, work productivity, and quality of life across all age groups, with increasing prevalence due to ageing populations and sedentary lifestyles. CLBP is increasingly recognized as a biopsychosocial condition influenced not only by mechanical factors but also by psychological and lifestyle components [1,3].

Anxiety and depression are common comorbidities in individuals with chronic low back pain, with approximately 20–40% of patients exhibiting psychological distress. Pain and psychological symptoms share a bidirectional relationship, where persistent pain contributes to emotional distress, and anxiety and depression, in turn, exacerbate pain perception and disability. These factors are associated with poorer treatment outcomes and prolonged recovery [4,5].

The Visual Analogue Scale (VAS) is one of the most frequently used patient-reported outcome measures for pain intensity in chronic low back pain (CLBP). Systematic reviews of CLBP trials report that the VAS was included in a large proportion of studies (e.g., ~60% of trials in one review) and is commonly used either alone or alongside other pain measures. The VAS shows acceptable reliability and responsiveness in CLBP, and minimally clinically important change (MCIC) estimates for chronic LBP have been published (≈20 mm on a 0–100 mm VAS). Therefore, the VAS is an appropriate and widely accepted outcome measure for assessing pain intensity in this population.

The Sleep disturbances are frequently reported in patients with CLBP and demonstrate a bidirectional relationship with pain. Poor sleep quality increases pain sensitivity, while chronic pain disrupts sleep patterns. Anxiety and depression further compound sleep disturbances, creating a cycle that negatively impacts physical and psychological health [6,7].

In Physiotherapy remains a cornerstone in the management of CLBP, aiming to reduce pain, improve spinal stability, and restore function. Sleep hygiene education focuses on behavioral strategies to improve sleep quality. Integrating sleep hygiene education with physiotherapy may provide additional benefits by addressing both physical and psychological aspects of CLBP. Therefore, this study evaluates the effect of physiotherapy combined with sleep hygiene education on anxiety and depression in patients with chronic low back pain [2,8,9].

Aim of the study

To evaluate the Effect of Stabilization exercise combined with Sleep Hygiene Education on Anxiety and Depression in Chronic Low Back Pain patients.

Methodology

Study design: Experimental Study (Pre and Post)
Study setting: Dr. B.R Ambedkar college of Physiotherapy
Sample size: 30
Sample Method: Convenient Sampling Method
Criteria for Sample selection: The participants are selected for the study based on following criteria
Inclusion Criteria

- Adults aged 18–65 years both male and female
- Diagnosed with chronic low back pain (>3 months duration)
- Exhibiting mild to moderate anxiety or depression (beck depression inventory score >10 & beck anxiety inventory score (0-21)

Exclusion Criteria
- Recent Spine surgery
- Current use of sleep medication
- Diagnosed sleep disorders (e.g., sleep apnea)
- Severe psychiatric illness.

Outcome measures:

Beck's depression inventory (BDI)
Beck Anxiety inventory (BAI)
Pittsburgh sleep quality index (PSQI)
Visual Analog Scale [VAS]

Procedure

All patients with low back pain lasting more than 3 months who visited Dr. B. R. Ambedkar College of Physiotherapy, Bangalore, were screened for the required inclusion and exclusion criteria. Patients suffering from low back pain for more than 3 months were assessed for anxiety, depression, pain intensity, and sleep quality using the Beck Depression Inventory (BDI), Beck Anxiety Inventory (BAI), Visual Analog Scale (VAS), and Pittsburgh Sleep Quality Index (PSQI). The need, purpose, and importance of the study were thoroughly explained to them. Those who expressed willingness to participate were recruited into the study. An information sheet detailing the goal and significance of the study was provided to each patient, and written informed consent was obtained from all participants. Patients who scored BDI >10 and BAI in the range of 0–21 (mild to moderate anxiety) or 22–35 (moderate to severe anxiety) were included in the study. Baseline scores were recorded for all selected outcome measures. The recruited patients then underwent a 6-week physiotherapy intervention combined with sleep hygiene education. After completion of the 6-week program, patients were reassessed using the Beck Depression Inventory (BDI), Beck Anxiety Inventory (BAI), Visual Analog Scale (VAS), and Pittsburgh Sleep Quality Index (PSQI). The data collected from all outcome measures were subjected to appropriate statistical analysis.

Hypothesis

Null hypothesis (H0): There will be no significant difference in the change in anxiety and depression between Chronic Low Back Pain Patients who receive stabilization exercises combined with sleep hygiene education.

Alternate hypothesis (H1)

There will be significant difference in the change in anxiety and depression between Chronic Low Back Pain Patients who receive stabilization exercises combined with sleep hygiene education.

Data Analysis

Statistical analysis was performed using SPSS version 29.0 (IBM SPSS Statistics for Windows, Version 29.0; IBM Corp., Armonk, NY). Descriptive statistics were expressed as frequencies and percentages for categorical variables, while continuous variables were summarized using mean and standard deviation. Pre and Post comparison was done using paired t test. A *p*-value < 0.05 was considered statistically significant.

Age	Frequency	Percent
20-29 years	9	30.00
30-39 years	7	23.33
40-49 years	6	20.00
50 years and above	8	26.67
Total	30	100.00

Table 1: Distribution based on age

The age-wise distribution of the study participants shows that out of 30 subjects, the largest proportion belonged to the **20–29 years** age group, accounting for **9 participants (30.0%)**. This was followed by the **50 years and above** group with **8 participants (26.67%)**. The **30–39 years** age group comprised **7 participants (23.33%)**, while the **40–49 years** group included **6 participants (20.0%)**. The age of the participants ranged from **21 to 60 years**, with a **mean age of 39.3 ± 12.5 years**.

Figure 2: Representation based on age

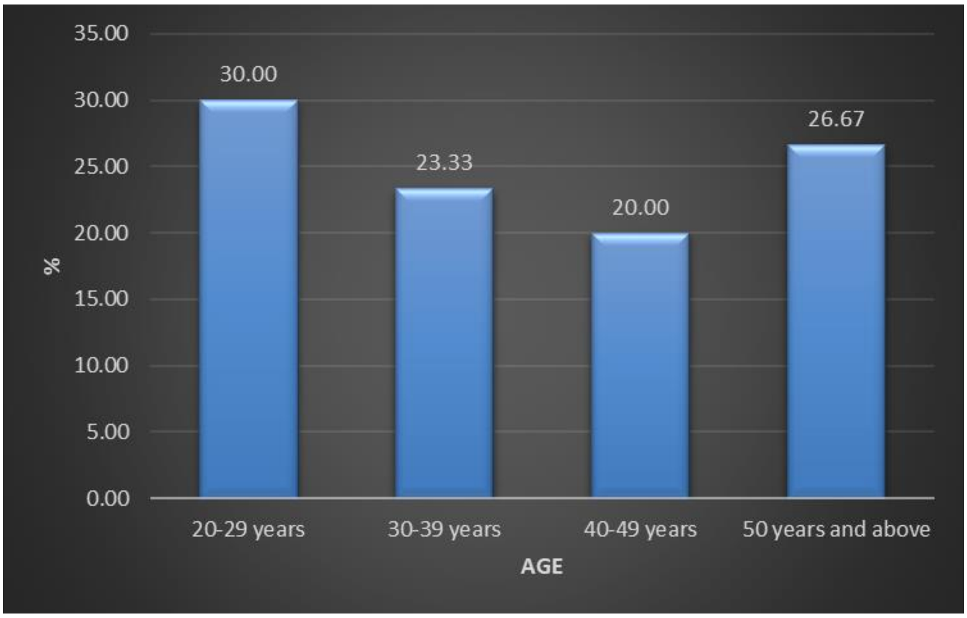
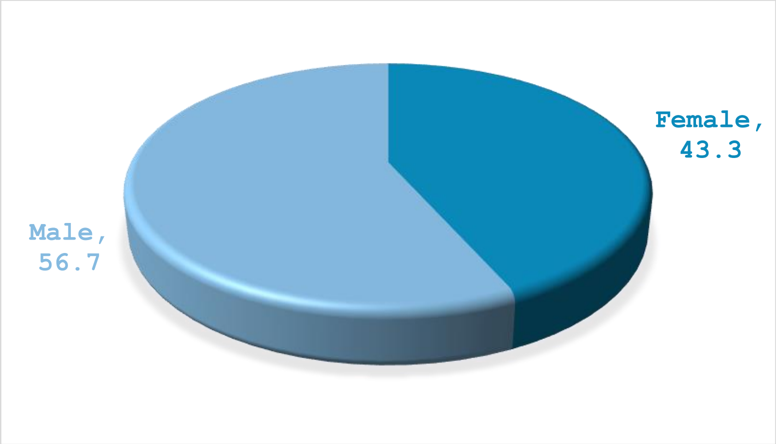


Table 2: Distribution based on gender

Gender	Frequency	Percent
Female	13	43.3
Male	17	56.7
Total	30	100.0

Out of the 30 participants included in the study, **17 were males (56.7%)** and **13 were females (43.3%)**

Figure 3: Representation based on gender



	N	Minimum	Maximum	Mean	Std. Deviation
Height	30	1.48	1.95	1.663	0.122
Weight	30	50.00	96.00	75.533	11.301
BMI	30	19.70	37.50	27.437	4.285

Table 3: Descriptive statistics of Anthropometric characteristics

The anthropometric assessment of the 30 participants revealed a **mean height of 1.66**

± 0.12 m, with values ranging from **1.48 to 1.95 m**. The **mean body weight was 75.53 ± 11.30 kg**, with a minimum of **50 kg** and a maximum of **96 kg**. The **mean body mass index (BMI) was 27.44 ± 4.29 kg/m²**, ranging from **19.7 to 37.5 kg/m²**

Figure 4: Representations based on height

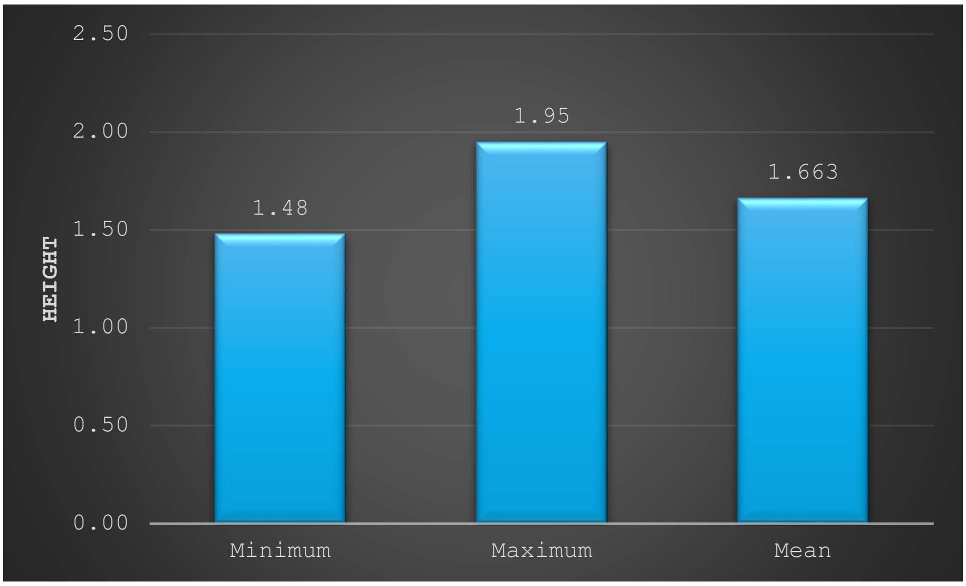


Figure 5: Representations based on weight

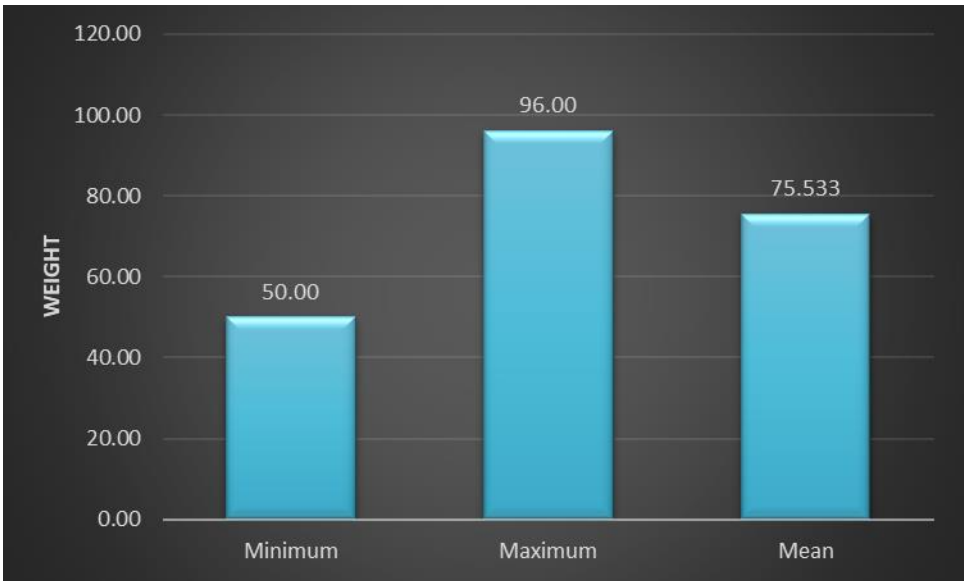
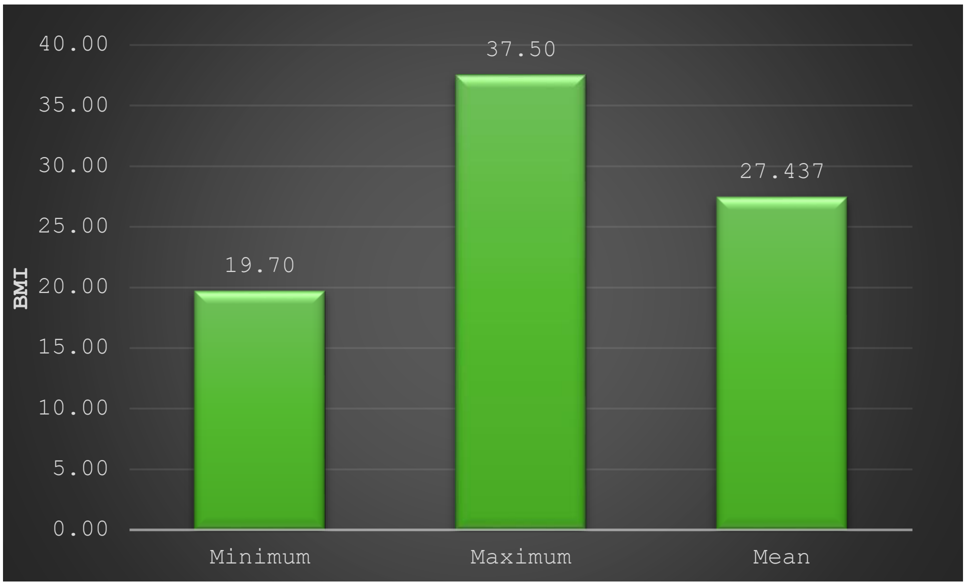


Figure 6: Representations based on BMI



		Mean	Std. Deviation	Average difference	t value	p value
VAS	Pre	7.4333	1.19434	3.467	16.705	p<0.001
	Post	3.9667	1.44993			

Table 4: Pre-Post comparison in VAS

The mean VAS score showed a significant reduction from **7.43 ± 1.19** in the pre-intervention period to **3.97 ± 1.45** post-intervention. The average difference was **3.47**, and this reduction was found to be statistically significant (**t = 16.705, p < 0.001**), indicating a marked improvement in pain levels following the intervention.

Figure 7: Representations based on VAS

		Mean	Std. Deviation	Average difference	t value	p value
BAI	**Pre**	15.4000	4.70216	6.067	10.100	p<0.001
	Post	9.3333	4.32581			

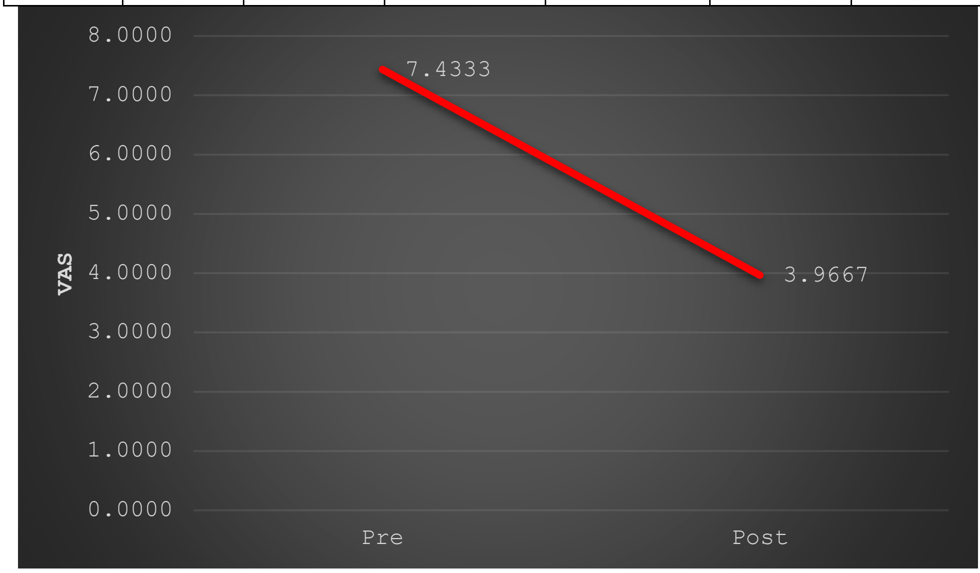
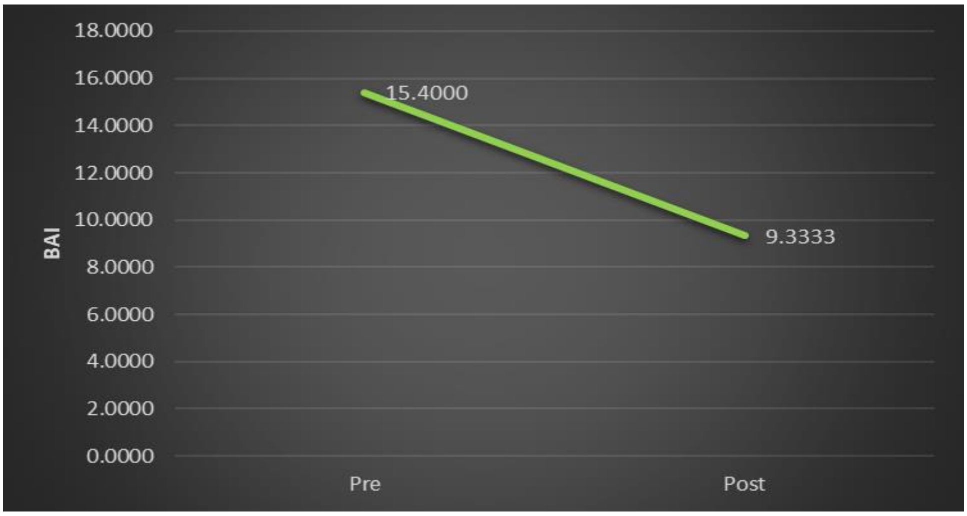


Table 5: Pre-Post comparison in BAI

The mean BAI score decreased significantly from **15.40 ± 4.70** before intervention to **9.33 ± 4.33** after intervention. The average difference observed was **6.07**, with a statistically significant change (**t = 10.100, p < 0.001**), suggesting a substantial reduction in anxiety levels post-intervention.

Figure 8: Representations based on BAI

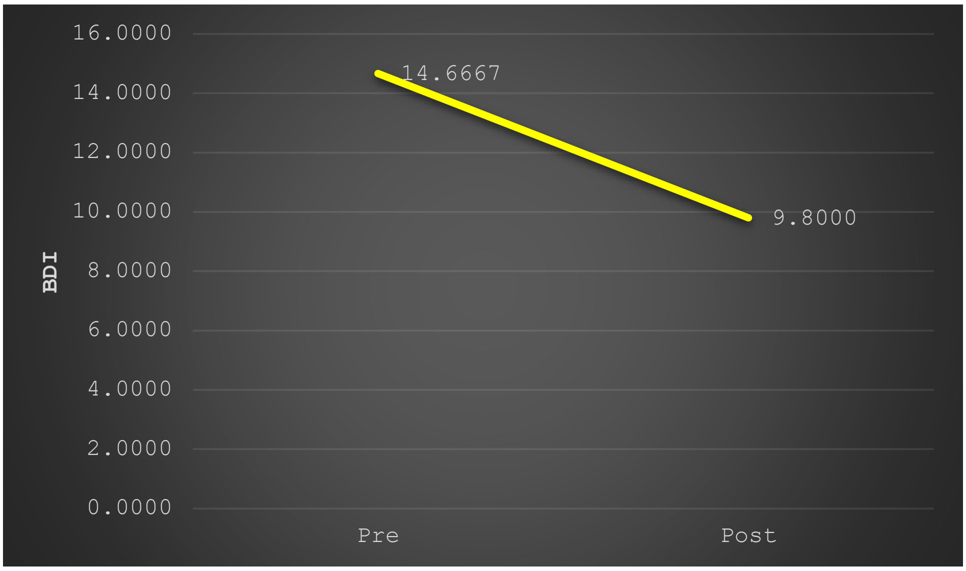


		Mean	Std. Deviation	Average difference	t value	p value
BDI	**Pre**	14.6667	4.83759	4.867	4.097	p<0.001
	Post	9.8000	8.38060			

Table 6: Pre-Post comparison in BDI

The mean BDI score reduced from **14.67 ± 4.84** at baseline to **9.80 ± 8.38** following the intervention. The mean difference was **4.87**, and this change was statistically significant (**t = 4.097, p < 0.001**), demonstrating a significant improvement in depressive symptoms after the intervention.

Figure 9: Representations based on BDI



2. Discussion

Chronic low back pain (CLBP) is defined as pain persisting for at least three months and occurring on most days over a six-month period. It is a highly prevalent condition and is often associated with functional limitations and reduced quality of life. Sleep hygiene education focuses on maintaining regular sleep schedules, avoiding stimulants before bedtime, and improving the sleep environment. While sleep education alone provides limited benefits, its combination with structured exercise has been shown to produce greater improvements in sleep quality, mood, and depressive symptoms [1,3]. The prevalence of CLBP varies widely across populations, and anxiety and depression are common among individuals with chronic pain, with approximately 20–40% affected. Evidence suggests a bidirectional relationship between pain and depression, with each increasing the risk of the other over time. Poor sleep and chronic low back pain also influence one another, as sleep disturbances increase the risk of persistent back pain, while ongoing pain further disrupts sleep. Anxiety and depression significantly contribute to pain. Improvements in pain and function following physiotherapy or exercise programs are frequently accompanied by reductions in anxiety and depressive symptoms, highlighting the combined physical and psychological benefits of rehabilitation [3]. Statistical analysis was conducted using SPSS version 29.0. Categorical variables were summarized using frequencies and percentages, while continuous variables were expressed as mean and standard deviation. Pre- and post-intervention outcomes were compared using the paired t-test, with a p-value of less than 0.05 considered statistically significant [4]. This study comprised 30 individuals aged between 18 and 60 years, with a mean age of 39.3 ± 12.5 years. The highest proportion of participants belonged to the 20–29 years age group (30.0%), followed by those aged 50 years and above (26.67%). Participants aged 30–39 years and 40–49 years represented 23.33% and 20.0% of the sample, respectively, indicating adequate representation across adult age groups [5]. In terms of gender distribution, males constituted a slightly greater proportion of the study population (56.7%) compared to females (43.3%), allowing for comparison of intervention effects across both genders [6]. Anthropometric evaluation revealed an average height of 1.66 ± 0.12 m, mean body weight of 75.53 ± 11.30 kg, and mean BMI of 27.44 ± 4.29 kg/m². The BMI findings suggest that many participants were classified as overweight, a factor that may contribute to musculoskeletal strain and psychological burden, further justifying the need for targeted therapeutic intervention [6,7]. Analysis of pain severity using the Visual Analog Scale (VAS) showed a statistically significant reduction following the intervention. Mean VAS scores declined from 7.43 ± 1.19 at baseline to 3.97 ± 1.45 after treatment, with a mean difference of 3.47 ($t = 16.705$, $p < 0.001$), demonstrating a substantial improvement in pain outcomes [8,10]. Similarly, anxiety levels assessed by the Beck Anxiety Inventory (BAI) exhibited a significant decrease after the intervention. The mean BAI score reduced from 15.40 ± 4.70 before treatment to 9.33 ± 4.33 post-treatment, with a mean difference of 6.07 ($t = 10.100$, $p < 0.001$), indicating the effectiveness of the combined intervention in reducing anxiety symptoms [9]. Depressive symptoms, evaluated using the Beck Depression Inventory (BDI), also showed notable improvement. The mean BDI score declined from 14.67 ± 4.84 at baseline to 9.80 ± 8.38 after the intervention. This reduction, with a mean difference of 4.87, was statistically significant ($t = 4.097$, $p < 0.001$), reflecting a meaningful decrease in depressive symptom severity [8,9]. The results of this research showed that the use of stabilization exercises is effective in the reduction of pain-related disability, sleep disturbance, and psychological status in NSCLBP patient [8,10]. The improvement in the outcome measure assessed could be due to the reestablishment of the normal control of the local muscles lumbar multifidus and transversus abdominis, which reduced the activity of more superficial muscles (rectus abdominis, external oblique, and internal oblique) which, when recruited, stabilized the spine and increased activity in the lumbar muscles [4,5]. This resulted in a decrease in pain, which improved sleep quality and, in turn, improved their psychological status. Furthermore, the co-contraction of the local muscles, such as transversus abdominis and lumbar multifidus, had been reported to be effective in the stabilization of the motion segments of the lumbar spine, particularly within the neural zone, thus providing a stable base on which the global muscles (superficial muscles) can safely act [9]. The findings of this study shows that stabilization exercises are very effective in the reduction of pain-related disability in short term intervention, which is contrary to the result of the study by Koumantakis et al. [13], who reported a reduction in the level of disability and pain in short term by their participants after undergoing general exercise than stabilization enhanced exercise. The results of this study confirm to the study of Akodu et al. [9], who reported that stabilization exercise was effective in the management of pain and functional disability in patients with NSCLBP. The findings of this study support the report of the study of Shakeri et al. [11], which focused on the effect of lumbar stabilization exercises on pain and disability in women with menstrual low back pain, and the results showed that lumbar stabilization exercises improve pain and disability. The result of this study also supports the report of the study by Nava-Bringas et al. [12], who, in their study on the adherence to a stability exercise program in patients with CLBP, reported that there was reduction in pain, with functional improvement, and that the improvement presented more quickly than the control following adherence to a lumbar stabilization exercise program [9,10]. The reduction in pain-related disability appears to play a central role in improving both sleep quality and psychological status. Enhanced stabilization of the lumbar spine provides a stable base for movement and reduces stress on spinal structures. Several previous studies support these findings, reporting that stabilization exercises improve pain and functional outcomes in individuals with chronic or recurrent low back pain, with some evidence suggesting faster improvement compared with general exercise programs [2,6]. This study also found a significant improvement in psychological status, including anxiety and depression, following stabilization exercise training. These changes may result from reduced pain perception and improved physical function. Earlier research has shown that depression and anxiety are highly prevalent in individuals with chronic low back pain and are closely associated with reduced quality of life. Consistent with previous reports, this study supports the view that physical rehabilitation can positively influence both physical and psychological health [6,7]. Sleep disturbance also improved significantly after the intervention, likely due to reductions in pain and disability. Pain and sleep share a bidirectional relationship, where pain disrupts sleep and poor sleep increases pain sensitivity and emotional distress. Sleep problems are also strongly linked with anxiety and depression, further highlighting the interconnected nature of these variables. Although sleep disturbance improved, its association with pain and disability was weaker than its relationship with psychological factors, possibly because many participants still experienced mild insomnia after treatment [4,5,8]. Overall, this study provides evidence that stabilization exercises benefit multiple dimensions of NSCLBP, including pain-related disability, sleep disturbance, and psychological well-being. These variables are closely interrelated and should be considered together during patient assessment and treatment planning. Incorporating outcome measures for pain, sleep quality, anxiety, and depression into rehabilitation programs may improve overall management and support more comprehensive recovery in patients with NSCLBP [8,9,10]. In summary, the outcomes of the present study demonstrate that physiotherapy combined with sleep hygiene education produced significant reductions in pain intensity, anxiety, and depressive symptoms in individuals with chronic low back pain. These findings underscore the value of integrating physical rehabilitation with sleep-focused educational strategies to address both the physical and psychological dimensions of chronic low back pain, thereby supporting its clinical relevance and therapeutic effectiveness [4,5,6,9].

3. Limitations and recommendation

The Despite the significant findings, the present study has certain limitations. Objective monitoring of adherence to the sleep hygiene protocol was not performed, and compliance was primarily based on patient self-report, which may have introduced reporting bias. Detailed history of concurrent medication use was not systematically documented, and the potential influence of analgesics, antidepressants, or other medications on pain, sleep, anxiety, and depression outcomes could not be fully controlled. Additionally, no sleep diary was maintained, limiting the ability to track daily sleep patterns, sleep duration, and night-to-night variability in sleep quality. These factors may have affected the interpretation of the sleep-related and psychological outcomes of the intervention.

4. Conclusion

The present study concludes that physiotherapy combined with sleep hygiene education is effective in reducing pain intensity, anxiety, and depressive symptoms in patients with chronic low back pain. Following a six-week intervention program, participants demonstrated a statistically significant reduction in pain levels, as evidenced by a marked decrease in VAS scores ($p < 0.001$). Additionally, significant improvements were observed in psychological outcomes, with both anxiety (BAI) and depression (BDI) scores showing meaningful reductions post-intervention ($p < 0.001$).

These findings highlight the close interrelationship between chronic pain, psychological health, and sleep behaviour. The integration of structured physiotherapy exercises with sleep hygiene education appears to address not only the physical aspects of chronic low back pain but also the associated psychosocial components. Therefore, a multidimensional rehabilitation approach that includes sleep education alongside physiotherapy may enhance overall treatment outcomes in chronic low back pain patients. The study supports incorporating sleep hygiene education as an essential adjunct to conventional physiotherapy for effective holistic management of chronic low back pain.

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