

A Study to Compare the Effect of Telerehabilitation and inpatient Rehabilitation Using McKenzie Exercise Protocol Among IT Professionals

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Abstract

Introduction: Non-specific Low back pain (NLBP) is a common musculoskeletal condition among working adults and can lead to disability in the workforce, especially IT professionals. Although the McKenzie exercise program is well known for its usefulness in treating lower back pain, nothing is known about how well telerehabilitation works in comparison to regular inpatient rehabilitation.

Objective: this study aimed to evaluate the comparison of telerehabilitation and inpatient rehabilitation among IT professionals with non-specific low back pain by using McKenzie exercise protocol, focusing on disability limitation and sleep disturbance. To explore correlations between sleep quality improvements with NLBP.

Materials and methods: It was an experimental study conducted with 40 participants aged 25–35 years, equally divided into two groups: Group A (telerehabilitation, n = 20) and Group B (inpatient rehabilitation, n = 20). For four weeks, each group participated in 40–45 minutes McKenzie exercise sessions every day. The Groningen Sleep Quality Scale (GSQS) was used to quantify sleep disruption, while the Quebec Back Pain Disability Scale (QBPDS) was used to measure pain and functional impairment. Paired independent t tests were used to analyse scores before and after the intervention.

Results: Both treatments significantly improved sleep quality and disability among groups ($p < 0.001$). In comparison to within the group inpatient therapy (51.6% improvement; mean reduction 33.60 points), telerehabilitation reduced disability scores more (61.6% improvement; mean reduction 39.05 points), with between-group differences approaching statistical significance ($p = 0.026$). There were no apparent variations ($p > 0.05$) in the improvement of sleep quality between the two groups.

Conclusion: Telerehabilitation that uses the McKenzie method works favourably, is safe, and saves time, and it helps reduce disability more than inpatient rehab, while also improving sleep quality just as greatly. These results show that telerehabilitation can work well as another option instead of standard or inpatient physical therapy, especially for busy working adults who have trouble with time, location, or being able to go to the clinic consistently. Including organized telerehabilitation programs in regular healthcare practice can improve access and help people stick with treatment plans when managing non-specific lower back pain.

Keywords: Telerehabilitation; McKenzie method; non-specific low back pain; Quebec Back Pain Disability Scale; Groningen Sleep Quality Scale; IT professionals.

Introduction

Offices are currently depending heavily on information technology, leading to increased usage of computers. Regular employment, including office computer work, have been linked to musculoskeletal diseases. Pain, muscular tension, functional restriction, stiffness, and restricted range of motion are frequently found in the spine, shoulder, upper and lower limbs, with pain being the most common complaint. Non-specific low back pain (NLBP) represents one of the most prevalent musculoskeletal disorders among the working population and is a leading contributor to disability rates, particularly within economically developed countries. NLBP is a multifaceted etiology that may be caused by individual variables, psychosocial factors, biomechanical risk factors, or composed of these. A computer worker's biomechanical risk factors for developing musculoskeletal discomfort include extended periods of sitting, nonergonomic postures, and repeated motions. Factors such as posture type, age, gender, body mass index, and an individual's medical background can serve as inherent risk contributors to the development of low back pain. Both contributing and exacerbating variables for NLBP symptoms may be psychosocial problems at work. Computer professionals who spend a lot of time sitting down often complain of lumbar spine-specific problems, which are more prevalent than those of the cervical and thoracic spines. Our everyday, private, professional, and military lives are now impacted by computers. In recent years, there has been a lot of worry about musculoskeletal problems or illnesses among workers in information technology departments who use computers and related gadgets. Worldwide, it is believed that 15 to 25% of all computer users have musculoskeletal disease. Various epidemiological research found that around 76% of computer workers in India had musculoskeletal pain and discomfort [1,2].

NLBP is highly prevalent, ranging in severity from mild discomfort to a debilitating condition. It has become a significant global public health challenge and is most frequently managed within primary care settings. It is typically described as discomfort, muscular tension, or rigidity situated between the inferior border of the ribs and the upper gluteal region ^[3]. Approximately 80% of people are thought to have back discomfort at certain moments in their lives. It is estimated that between 15% and 30% of people experience low back pain, which typically manifests in young adult. NLBP is common among IT workers with the one-year prevalence ranging from 23% to 38%. Previous studies have identified several risk factors that may predispose workers to the onset of non-specific low back pain^[4,5]. Some of them include biomechanical changes to the spine brought on by employees who work long hours, was obese, smoked, held and lifted heavy objects, and engaged in other tasks that consumed their entire day. Prolonged static posture and the ergonomic features of workstations and chairs, sleep deprivation, socioeconomic factors were the causes. Young adults' biomechanical and numerous psychological issues, including excessive stress, low job satisfaction, a lack of companionship, and an imbalance in work reward, resulted to a higher incidence of LBP ^[5,6]. Advances in rehabilitation technology have introduced practical and innovative approaches for delivering exercise-based therapies that are both cost-efficient and accessible to adults living in the community. Telerehabilitation (TR), for example, is the delivery of rehabilitative and health-related treatments from a distance via telecommunications. TR refers to the application of electronic information and technology, as well as various communication methods (such as phone calls, video conferencing, text messaging, emails, and wearable devices), to facilitate the provision of rehabilitation services for either an individual or multiple patients. A thorough review discovered that TR was just as effective as traditional, in-person rehabilitation in a variety of situations and demographics. TR plays a vital role in promoting exercise, as it allows interventions to be delivered within an individual's everyday environment and supports effective self-management of chronic conditions. By encouraging greater participation in physical activity, telerehabilitation emerges as a practical and accessible option for community-dwelling adults experiencing non-specific low back pain. The exercise Approach based on telerehabilitation eases the load on medical facilities and lowers treatment expenses ^[7,8]. Telerehabilitation provides remote access to comprehensive rehabilitation services, ensuring equitable, high-quality care across locations. It is especially valuable in countries with rural service shortages, and hybrid models combining in-person and remote care can better support complex patients.

In addition to service accessibility, the TR agenda is being advanced by a number of other factors, such as: The advantages of TR include potential savings in travel costs and time for both patients and healthcare systems, the ability to maintain continuity of care through remote service delivery, greater flexibility in adjusting the timing, intensity, and sequencing of interventions, reduced environmental impact by limiting travel, and additional benefits such as enabling rehabilitation within the individual's own social and occupational environment^[9].

Active young individuals are more likely to be affected. Although clinical examination is essential for patient evaluation, it does not fully capture the impact of disease on functional status. While numerous instruments have been developed to evaluate the extent of disability among individuals experiencing low back pain, only a limited number have undergone rigorous validation. Among the most recognized tools are the Roland–Morris Disability Questionnaire, the Dallas Pain Questionnaire, the Quebec Back Pain Disability Scale (QBPDS), the Waddell Disability Index, the Million Visual Analog Scale, the Low Back Outcome Score, and the Oswestry Disability Index (ODI), the latter being one of the most widely applied measures in international research ^[10].

In 1980, The World Health Organization characterized disability can be conceptualized as a condition that reflects limitations in performing activities or fulfilling social roles due to health impairments., "any restriction or lack of ability to perform an activity in a manner or within the range considered normal for human beings" is what the QBPDS implements. The QBPDS was refined from 46 to 20 items through psychometric testing and item analysis. Organized into six factors—rest, posture, ambulation, movement, bending/stooping, and handling heavy loads—it balances comprehensiveness with efficiency, ensuring reliability, sensitivity, and clinical applicability ^[11].

The QBPDS is a self-report instrument composed of 20 items that evaluate functional limitations in individuals with low back pain. Each item requires the patient to indicate the degree of difficulty encountered while performing a specific activity, using a five-point rating scale from 0 ('no difficulty') to 5 ('unable to perform'). The overall score is obtained by summing all item responses, producing a range between 0 and 100, with higher scores reflecting greater levels of disability ^[10,12].

NLBP is closely linked to depression, anxiety, drowsiness, and sleep disruption, all of which intensify pain and reduce quality of life. Poor sleep lowers pain tolerance, worsens mood, and impairs daily functioning, underscoring the strong connection between sleep quality, emotional state, and over all well-being in LBP patients ^[13,14]. Several

standardized instruments have been developed to evaluate sleep health, including the Sleep Diagnosis List, the Pittsburgh Sleep Quality Index, the Sleep Quality Scale, the Medical Outcomes Study (MOS) Sleep Scale, the Groningen Sleep Quality Scale (GSQS), the Epworth Sleepiness Scale, and the SF-36 Health Survey ^[15]. The GSQS assesses subjective sleep quality, including complaints about overall quality, inadequate sleep, difficulty going asleep, and feeling unrested upon waking up. This questionnaire can be helpful for measuring sleep quality in IT professionals ^[15,16]. The GSQS consists of 15 dichotomous items (true/false), which are summed to generate a single composite score. The scoring range extends from 0 to 14, with higher scores reflecting poorer sleep quality; a score of 14 indicates the most severe disturbance ^[17].

In 1981, Robin McKenzie created the Mechanical Diagnosis and Therapy, often referred to as the McKenzie technique, as a method of classification and therapy for LBP. The McKenzie technique offers the strongest empirical evidence (validity, reliability, and generalizability) among clinical feature-based categorization methods established in the previous 20 years ^[18]. Many physiotherapists regard the McKenzie technique as an effective approach for managing patients with NLBP. The McKenzie static back extensor endurance exercises contain a series of back care education guidelines, which include practical guidance on standing, sitting, lifting, and other routine household activities. The treatment consists of a course on particular repetitive lumbosacral motions in extension that lead to the centralization, lowering the symptoms ^[19].

Aim of the study

This study evaluates telerehabilitation and inpatient rehabilitation using the McKenzie protocol among IT professionals with non-specific low back pain, focusing on disability reduction and sleep disturbance. It also examines links between sleep quality and clinical outcomes, aiming to determine whether telerehabilitation can serve as a practical, evidence-based alternative that improves accessibility and expands physiotherapy options.

Materials and Methods

This research was an experimental study involving pre- and post-intervention measurements of pain and disability. A total of 40 participants will be recruited and divided into two groups:

- Group A: Tele-rehabilitation using the McKenzie protocol (20 subjects)
- Group B: Inpatient rehabilitation using the McKenzie protocol (20 subjects)

Subjects, number, and sources

- The study was targeting a population of non-specific low back pain patients aged 25 to 35 years.
- The sample size of 40 individuals, including both males and females, were recruited.
- Data were collected from the Department of Physiotherapy, Neeru Multispeciality Healthcare Centre, Delhi.

Sampling criteria

- Inclusion Criteria: Participants were IT professionals aged 25–35, diagnosed with non-specific low back pain lasting under three months. Both males and females were included, and those in the telerehabilitation group required internet access and a smartphone.
- Exclusion Criteria: Participants with spinal deformity, vertebral slippage, fracture, or tumor; diagnosed rheumatoid arthritis or ankylosing spondylitis; herniated disc, neurological involvement, or pregnancy; or prior treatment with NSAIDs, plasters, physical agents, or acupuncture were excluded.

Instrument and tools

The instruments employed in this study included:

1. Telerehabilitation tools were included smartphone applications and video conferencing platforms such as Zoom, Google Meet, and dedicated telehealth software. These tools enabled real-time supervision and interaction between patients and therapists.
2. The QBPDS was applied to evaluate pain severity and the extent of functional disability in individuals with low back pain
3. Throughout the intervention period, the GSQS was used to gauge individuals' subjective sleep quality.

Data collection procedure

Patients self-administered and completed a pen-and-paper questionnaire to gather data. Every operation was performed in compliance with accepted ethical norms, guaranteeing that patient involvement was voluntary, informed, and private.

Study Design: This investigation used an experimental research design.

- ❖ Type: It is a comparative study
- ❖ Duration: 0- 4 weeks intervention period
- ❖ Groups:
 - Group A: Tele-rehabilitation using McKenzie protocol
 - Group B: Inpatient rehabilitation using McKenzie protocol

Printed questionnaires were filled by the participants at two different times:

the baseline week (week 0) and after the intervention (week 4). The study employed two standardized questionnaires: the QBPDS to evaluate pain intensity and functional limitation, and the GSQS to evaluate subjective sleep quality. The data was manually filled by the researchers or therapist and later uploaded onto a secure spreadsheet for statistical analysis.

A sample of 40 participants from Delhi was selected after applying inclusion and exclusion criteria. Demographic details such as age, height, weight, occupation, and address were recorded. The study procedure was explained, and participants were educated about nonspecific low back pain. They were introduced to the QBPDS for assessing pain and function, and the GSQS for evaluating sleep quality, with clear instructions provided to ensure accurate completion of the forms.

This study used an experimental approach to check how well McKenzie static back extensor endurance exercises work when given through telerehabilitation and inpatient physiotherapy.

40 patients with non-specific low back pain were enrolled and evenly divided into two groups: one received McKenzie static back extensor endurance exercises via telerehabilitation, while the other underwent conventional in-person physiotherapy. Both groups participated in daily 40–45-minute sessions.

- Group A (Telerehabilitation Group): 20 patients did McKenzie static back extensor endurance exercises from home using a secure online platform for healthcare. The intervention had video sessions, online talks, and a mobile app to track progress. Patients did the exercises they were told to do while being watched from a distance and wrote down their symptoms every day to track how they were doing.

- Group B (Inpatient rehabilitation Group): 20 patients went to the inpatient physiotherapy sessions, where a therapist gave them McKenzie static back extensor endurance exercises. Each session had a check-up, guided exercise practice, and teaching on how to manage the condition on your own. Both groups participated in the intervention for 4 weeks.

McKenzie static back extensor endurance exercises were carried out with participants positioned prone on a treatment plinth. There were five distinct static workouts, differentiated by changes in upper and lower limb postures. When participants were able to maintain a given posture for 10 seconds, they progressed to the next exercise at their own pace, beginning the training program with the initial exercise position. Once they reached the fifth progression, they continued with it until the end of the workout program.

The following were the five exercise progressions:

1. In the prone position, the subject raised their head and trunk while maintaining spinal extension, keeping both arms by their sides.
2. The subject lay in a prone position, elevated the head and trunk off the plinth from neutral to extension, and flexed the elbows while abducting the shoulders to 90°. They took a deep breath and relaxed.
3. The subject lifted the head, trunk, and arms off the plinth from neutral to extension while lying in the prone position with both arms raised forward.
4. Subjects lay in a prone posture and elevated their head, torso, and contralateral arm and leg from neutral to extension.
5. The subject lay in a prone posture, abducted their shoulders and flexed their elbows to 90°, then lifted their head, trunk, and legs (with knees extended) off the plinth.

Statistical Analysis

The Shapiro–Wilk test was conducted to examine the normality of the dataset. The results confirmed that the data followed a normal distribution. Accordingly, an independent samples *t*-test was applied to compare demographic variables. The complete dataset was then utilized to perform comparisons between the telerehabilitation and inpatient rehabilitation groups.

The paired sample *t*-test, also referred to as the dependent *t*-test is a statistical method used to compare the means of two related sets of measurements in order to determine whether a significant difference exists between them. It is most commonly applied when the same group of participants is assessed at two different points in time, such as before and after an intervention, or under two distinct but related conditions.

Tests Applied

The analysis was conducted using the independent samples *t*-test, also known as the two-sample *t*-test, is used to compare the means of two distinct groups.

The independent samples *t*-test compares the mean values of two separate groups, such as telerehabilitation and inpatient rehabilitation, and determines whether the observed difference is statistically significant while accounting for variability within each group.

Formula: The test statistic for the Independent Samples *t*-test is calculated using the following formula:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

Where:

- $\bar{X}_1, \bar{X}_2$ = represent the group means (telerehabilitation and inpatient rehabilitation),
- s_1^2, s_2^2 = denote the variances of each group (square of the standard deviation),
- n_1, n_2 = correspond to the sample sizes of the respective groups.

The analysis was performed using the paired sample *t*-test, which is appropriate for comparing two related sets of measurements. The test statistic is calculated as:

$$t = \frac{\bar{d}}{s_d / \sqrt{n}}$$

Where:

- $\bar{d}$ = mean of the differences between paired scores
- s_d = standard deviation of the differences
- n = number of paired observations

Results

1. Baseline Demographic and Clinical Characteristics

A total of 40 patients diagnosed with mechanical low back pain were recruited and randomly allocated to either the telerehabilitation group ($n = 20$) or the inpatient physiotherapy group ($n = 20$). Table 1 presents the baseline demographic variables (age, height, weight) along with the initial clinical severity scores for both cohorts.

Table 1

The baseline demographic and clinical data outline participants' age, gender, occupation, and initial clinical measures, ensuring comparability between groups before intervention.

Characteristic	Tele rehab (N = 20) M ± SD	Inpatient (N = 20) M ± SD	Total Sample (N = 40) M ± SD
Age (years)	29.30 ± 3.79	30.00 ± 3.48	29.65 ± 3.61

Characteristic	Tele rehab (N = 20) M ± SD	Inpatient (N = 20) M ± SD	Total Sample (N = 40) M ± SD
Height	5.37 ± 0.33	5.37 ± 0.53	5.37 ± 0.44
Weight (kg)	67.25 ± 14.86	62.00 ± 10.47	64.62 ± 12.97
Baseline QBPDS Score	63.15 ± 10.68	65.45 ± 11.13	64.30 ± 10.83
Baseline GSQS Score	9.45 ± 1.73	8.90 ± 1.59	9.18 ± 1.66

Note. M = Mean; SD = Standard Deviation. Independent *t*-tests confirmed no significant baseline differences (all *p* > .05).

Statistical analysis demonstrated that the two treatment groups were comparable at baseline, showing no statistically significant differences were observed between the groups with respect to age (*p* = 0.546), height (*p* = 0.977), weight (*p* = 0.204), baseline back pain disability (QBPDS score: 63.15 vs. 65.45, *p* = 0.509), as well as baseline sleep disturbance (GSQS score: 9.45 vs. 8.90, *p* = 0.301).

2. Within-Group Treatment Efficacy (Pre vs. Post Comparison)

Paired samples *t*-tests were performed within each group to determine the extent of clinical improvements made from baseline to the post-treatment assessment. Table 2 below provides the pre-and post-treatment scores, mean clinical improvements, percentage reduction, and tests' statistics.

Table 2 Within-Group Pre- and Post-Treatment Comparison of Outcome Measures

Group	Outcome Measure	Pre-Treatment M (SD)	Post-Treatment M (SD)	Mean Improvement (SD)	% Improvement	t (df = 19)	p-value
Tele rehab (N = 20)	QBPDS (Disability)	63.15 (10.68)	24.10 (4.98)	39.05 (8.75)	61.6%	19.96	< .001
Tele rehab (N = 20)	GSQS (Sleep Quality)	9.45 (1.73)	5.15 (1.23)	4.30 (1.08)	45.6%	17.79	< .001
Inpatient (N = 20)	QBPDS (Disability)	65.45 (11.13)	31.85 (7.51)	33.60 (5.83)	51.6%	25.75	< .001
Inpatient (N = 20)	GSQS (Sleep Quality)	8.90 (1.59)	5.20 (1.28)	3.70 (1.22)	41.5%	13.58	< .001

Note. M = Mean; SD = Standard Deviation; df = Degrees of Freedom. Paired *t*-tests revealed highly statistically significant (*p* < .001) within each of the treatment groups.

Figure 1. Comparison of Pre- and Post-Treatment Quebec Back Pain Disability Scale (QBPDS) Scores Across Groups.

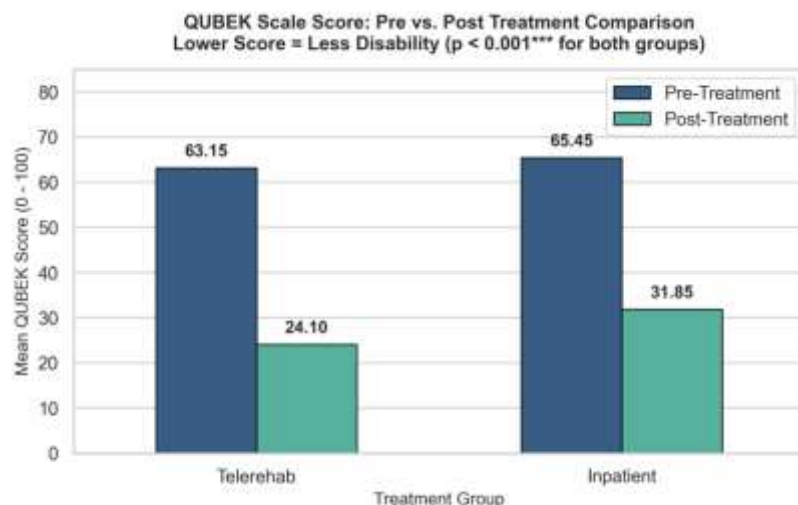
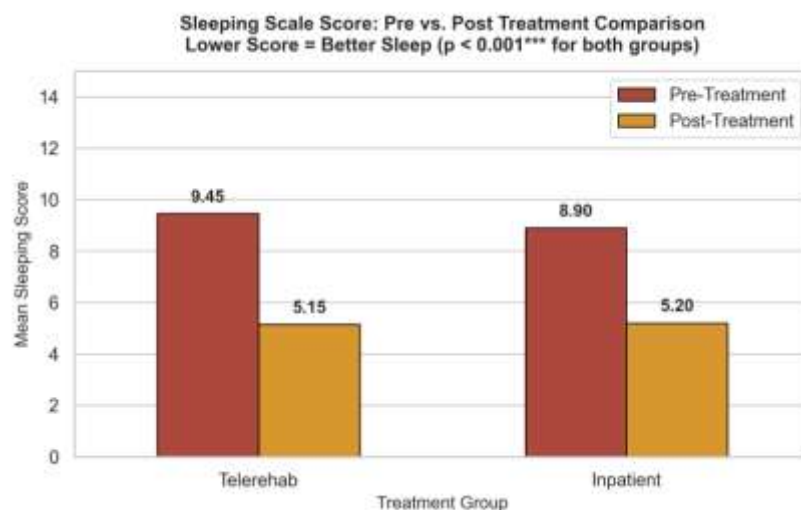


Figure 2. Comparison of Pre- and Post-Treatment GSQS Scores Across Groups.



Both therapeutic interventions resulted in profound, highly statistically significant improvements across all outcome parameters ($p < 0.001$ for all measures):

- **Telerehabilitation Protocol:** In the Telerehabilitation group, mean QBPDS scores decreased by 39.05 points (from 63.15 to 24.10, representing a 61.6% reduction; $t = 19.96$, $p < 0.001$). Sleep disturbance scores (GSQS) improved by 4.30 points (from 9.45 to 5.15, representing a 45.6% reduction; $t = 17.79$, $p < 0.001$).
- **Inpatient Physiotherapy Protocol:** In the Inpatient Physiotherapy group, mean QBPDS scores decreased by 33.60 points (from 65.45 to 31.85, representing a 51.6% reduction; $t = 25.75$, $p < 0.001$). Sleep disturbance scores (GSQS) improved by 3.70 points (from 8.90 to 5.20, representing a 41.5% reduction; $t = 13.58$, $p < 0.001$).

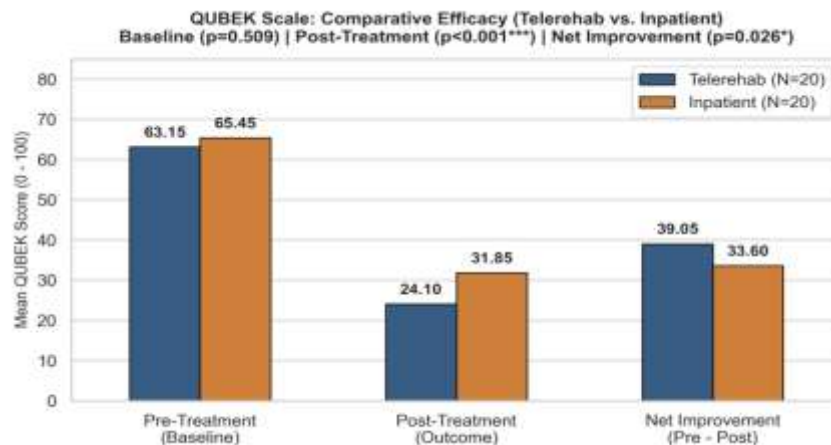
3. Between-Group Comparative Efficacy Analysis

To determine whether telerehabilitation differs in therapeutic efficacy compared to inpatient care, independent samples t-tests were conducted on raw post-treatment scores and net clinical improvement scores (Pre - Post). The analysis is divided into dedicated outcome tables for the QBPDS (Table 3A) and the Sleeping Scale (Table 3B).

Table 3A Between-Group Comparison for QBPDS Scale (Quebec Back Pain Disability Scale)

Timepoint / Metric	Tele rehab (N = 20) M (SD)	Inpatient (N = 20) M (SD)	Mean Diff	t (df = 38)	p- value	Clinical Finding
Pre-Treatment Score (Baseline)	63.15 (10.68)	65.45 (11.13)	-2.30	-0.67	0.509	Comparable at Baseline (p > .05)
Post-Treatment Score	24.10 (4.98)	31.85 (7.51)	-7.75	-3.85	< .001	Tele rehab Lower Disability (p < .001) ***
Net Improvement Score (Pre - Post)	39.05 (8.75)	33.60 (5.83)	+5.45	2.32	0.026	Tele rehab Superior Relief (p = .026) *

Note. M = Mean; SD = Standard Deviation; df = Degrees of Freedom. * p < .05, *** p < .001. Lower post-treatment score and higher net improvement indicate greater disability relief.

Figure 3. Between-Group Comparison of Baseline, Post-Treatment, and Net Improvement Scores on the QBPDS Scale.

As can be seen from Table 3A and Fig. 3, the Telerehabilitation group showed a clear statistical advantage over the Inpatient group in terms of reducing back pain disability:

- 1) Raw post-treatment disability was significantly lower in Tele rehab (24.10 ± 4.98) than in Inpatient (31.85 ± 7.51), representing a -7.75point advantage ($t = -3.85$, $p < 0.001$).
- 2) Net improvement scores showed that patients receiving Tele rehab had an impressive +5.45 additional points of disability reduction (39.05 ± 8.75 vs. 33.60 ± 5.83 ; $t = 2.32$, $p = 0.026$).

These results show that telerehabilitation is not just as good as traditional inpatient rehab, but actually better at reducing disability.

Table 3B Between-Group Comparison for GSQS (Sleep Quality / Disturbance)

Timepoint / Metric	Tele rehab (N = 20) M (SD)	Inpatient (N = 20) M (SD)	Mean Diff	t (df = 38)	p- value	Clinical Finding
Pre-Treatment Score (Baseline)	9.45 (1.73)	8.90 (1.59)	+0.55	1.05	0.301	Comparable at Baseline (p > .05)

Timepoint / Metric	Tele rehab (N = 20) M (SD)	Inpatient (N = 20) M (SD)	Mean Diff	t (df = 38)	p- value	Clinical Finding
Post-Treatment Score	5.15 (1.23)	5.20 (1.28)	-0.05	-0.13	0.900	Equally Effective (p > .05)
Net Improvement Score (Pre - Post)	4.30 (1.08)	3.70 (1.22)	+0.60	1.65	0.108	Comparable Improvement (p > .05)

Note. M = Mean; SD = Standard Deviation; df = Degrees of Freedom. Independent t-tests show equivalent post-treatment sleep recovery across both groups (p > .05).

Figure 4. Between-Group Comparison of Baseline, Post-Treatment, and Net Improvement Scores on the GSQS Scale.

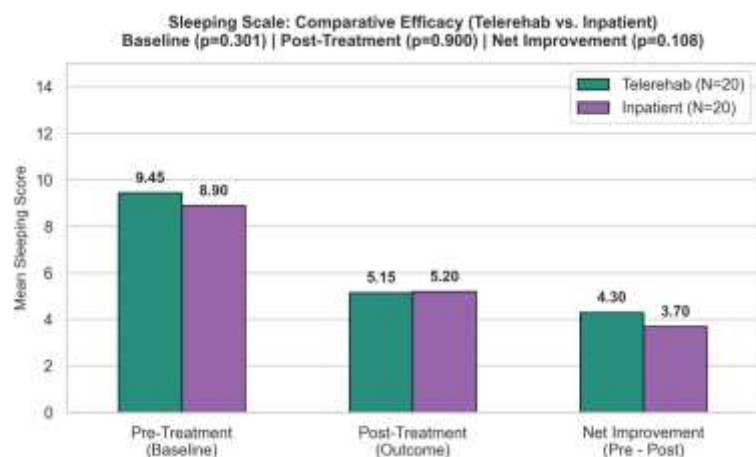


Table 3B and Figure 4 present the comparative evaluation of GSQS scores between the two groups. Both modalities achieved substantial, high-level restoration of sleep quality, with no statistically significant differences between groups:

- 1) Raw post-treatment sleep scores were nearly identical between Tele rehab (5.15 ± 1.23) and Inpatient (5.20 ± 1.28 ; $t = -0.13$, $p = 0.900$).
- 2) Net improvement scores were comparable between Tele rehab ($+4.30 \pm 1.08$) and Inpatient ($+3.70 \pm 1.22$; $t = 1.65$, $p = 0.108$).

These results establish that telerehabilitation delivers equivalent restorative benefits for sleep architecture as supervised inpatient care.

Discussion

This experimental research investigated the impact of telerehabilitation and inpatient rehabilitation using the McKenzie exercise protocol among IT professionals with non-specific low back pain, focusing on disability limitation and sleep disturbance. The average age of participants was 29.65 ± 3.61 years, placing them within the 25–35year age range where non-specific low back pain is commonly observed. Both male and female participants were included in the study.

This experimental study examined two rehabilitation approaches and found that both telerehabilitation and inpatient physiotherapy were effective in managing non-specific low back pain, leading to significant improvements in disability scores and sleep quality within each group. Importantly, the groups were comparable at baseline, which strengthens the accuracy of the outcome comparisons.

Between-group analysis revealed that telerehabilitation produced greater improvements in disability scores on the QBPDS. Inpatient rehabilitation, however, demonstrated added benefits in fostering independence, promoting better postural management, and enhancing adherence to treatment plans. In contrast, improvements in sleep quality were the same across all groups, suggesting that, pain relief—regardless of setting—translates into therapeutic sleep. These findings are consistent with prior research indicating that chronic LBP significantly affects sleep quality. Sleep disturbances represent a critical dimension of chronic pain and should be addressed as an integral component of comprehensive pain management strategies ^[20]. Moreover, the study highlights the potential of telerehabilitation to overcome barriers such as distance, time constraints, and clinic accessibility, while maintaining comparable clinical outcomes to traditional inpatient care.

TR using the McKenzie protocol produced outcomes comparable to inpatient therapy, confirming its effectiveness in managing non-specific low back pain. Technology-based McKenzie treatment enhances accessibility but cannot fully replace in-person care, especially since proper application requires specialized training. Mobile platforms serve as valuable supplementary tools, improving access while maintaining clinical reliability ^[21].

These results are consistent with prior studies demonstrating that telerehabilitation can deliver therapeutic benefits for people experiencing chronic LBP that are comparable to those achieved through conventional in-person rehabilitation. Additionally, Telerehabilitation enhances patient access, reduces travel costs, and delivers health outcomes equal to or better than traditional rehabilitation. It also improves satisfaction, adherence, and lowers hospital readmissions, collectively boosting cost efficiency. However, methodological variability limits the strength of current evidence. Governments should integrate telerehabilitation into routine care, especially in resource-limited settings, to maximize accessibility and cost-effectiveness as digital health expands ^[22]. However, some studies show similar effects on telerehabilitation. Remote physiotherapy has been shown to be safe, feasible, and acceptable to patients, with outcomes comparable to those of conventional in-person care. Delivering therapy remotely enhances access, particularly for individuals who face barriers such as distance or physical limitations. Digital platforms may also improve adherence by providing reminders and guidance on exercise routines. Nonetheless, remote delivery may not be suitable for all patients, and a hybrid model that combines in-person and remote sessions may represent the most effective approach ^[23]. Some previous study found that Clinical gains in chronic LBP patients were similar across telerehabilitation and traditional in-person rehabilitation. Telerehabilitation was shown to be non-inferior for disability but not for pain severity. According to these results, telerehabilitation might be especially helpful for people whose main objectives are self-management and functional improvement, while patients who present with more severe pain or who need hands-on therapeutic interventions might still benefit more from in-person rehabilitation ^[24].

In this study, the effects of telerehabilitation and inpatient rehabilitation were compared. Both groups followed the same structured rehabilitation program and received continuous supervision from qualified physiotherapists throughout the intervention period and were instructed to do exercise motions in real time using voice instructions. Additionally, On the baseline evaluation day, both groups were trained in proper exercise posture. The telerehabilitation group additionally learned to use communication devices and virtual exercise simulations, including camera setup and adjustments. They performed home exercises under real-time physiotherapist guidance. The rehabilitation program was designed to be simple, space-efficient, equipment-light, and based on widely available technologies, making it comfortable to perform at home. Additionally, our research revealed that the Tele rehabilitation group reduced waiting times for each rehabilitation program, eliminated transportation and lodging expenses, allowed patients to participate from home, overcoming obstacles related to distance, mobility, and scheduling, and increased patient satisfaction because of flexibility and individualized pacing. Some obstacles in the clinical rehabilitation group include the need for travel and set appointment times, which restricts participation; increased facility and patient operating costs; patients' increased reliance on therapist supervision, which limits their autonomy; long travel or waiting times, which may lower patient satisfaction; irregular attendance; and missed sessions, which lessen the effectiveness of treatment. Moreover, it improved pain, muscle strength, range of motion and back function comparable to the clinical group. A previous study compared the clinical and economic outcomes of telerehabilitation with clinic-based interventions for individuals with NLBP monitored across an eight-week duration. The incremental cost-effectiveness ratio indicated that telerehabilitation was both less costly and more efficient than clinic-based care, findings that are consistent with the results of the present study ^[19,24].

The results of this study align with earlier research, showing that remote physiotherapy is both safe, feasible and well-accepted, particularly among patients who encounter barriers related to distance, time, or physical limitations. Although telerehabilitation cannot fully substitute in-person care for individuals requiring direct manual

interventions, it serves as a valuable adjunct that enhances accessibility to rehabilitation services.

Conclusion

In my research, conducted among IT professionals with non-specific low back pain, demonstrated that both telerehabilitation and inpatient physiotherapy using the McKenzie exercise protocol produced significant improvements in pain intensity, functional limitations, and sleep quality. Baseline similarity between the two groups ensured valid comparisons. Telerehabilitation was particularly effective in reducing functional disability, while improvements in sleep were comparable across groups, confirming its role as a safe, accessible, and effective alternative to inpatient rehabilitation. These results suggest that incorporating organized telerehabilitation programs into standard physiotherapy services can be beneficial, especially for young working adults, as it helps improve their commitment to treatment and addresses challenges related to time and location.

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Author contribution list

Deepali Tamrakar: collected the data and paper writing.

Dr. Monika Sharma: conceived and designed the analysis, supervision, review and editing.

References

1. Drăgoi II, Popescu FG, Lăzurean PC, Anculia R, Ghigulescu M, Marin I, Păuncu EA. Back pain in a group of computer workers assessed in a physiotherapy unit. *Human Systems Management*. 2021 Jun 8;40(3):467-77.
2. Mohanty P, Singh A, Pattnaik M. Risk factors responsible for musculoskeletal pain among computer operators. *EC Orthopaedics*. 2017;6:15-31.
3. Koes BW, Van Tulder M, Thomas S. Diagnosis and treatment of low back pain. *Bmj*. 2006 Jun 15;332(75 55):1430-4.
4. Furtado RN, Ribeiro LH, Abdo BD, Descio FJ, Martucci Junior CE, Serruya DC. Nonspecific low back pain in young adults: associated risk factors. *Revista brasileira de reumatologia*. 2014 Sep;54:371-7.
5. Janwantanakul P, Pensri P, Moolkay P, Jiamjarasrangsri W. Development of a risk score for low back pain in office workers-a cross-sectional study. *BMC musculoskeletal disorders*. 2011 Jan 25;12(1):23.
6. Amila A, Syapitri H, Sembiring E. The effect of William flexion exercise on reducing pain intensity for elderly with low back pain. *International Journal of Nursing and Health Services (IJNHS)*. 2021 Feb 20;4(1):28-36.
7. Werneke MW, Deutscher D, Grigsby D, Tucker CA, Mioduski JE, Hayes D. Telerehabilitation during the COVID-19 pandemic in outpatient rehabilitation settings: a descriptive study. *Physical therapy*. 2021 Jul 1;101(7):pzab110.
8. Gustavson AM, Rauzi MR, Lahn MJ, Olson HS, Ludescher M, Bazal S, Roddy E, Interrante C, Berg E, Wisdom JP, Fink HA. Practice considerations for adapting in-person groups to telerehabilitation. *International Journal of Telerehabilitation*. 2021 Jun 22;13(1):e6374.
9. Russell TG. Telerehabilitation: a coming of age. *Australian Journal of Physiotherapy*. 2009 Jan 1;55(1):5-6.
10. Melikoglu MA, Kocabas H, Sezer I, Bilgilişoy M, Tuncer T. Validation of the Turkish version of the Quebec back pain disability scale for patients with low back pain. *Spine*. 2009 Mar 15;34(6):E219-24.
11. Speksnijder CM, Koppenaal T, Knottnerus JA, Spigt M, Staal JB, Terwee CB. Measurement properties of the quebec back pain disability scale in patients with nonspecific low back pain: systematic review. *Physical Therapy*. 2016 Nov 1;96(11):1816-31.
12. Reneman MF, Jorritsma W, Schellekens JM, Göeken LN. Concurrent validity of questionnaire and performance-based disability measurements in patients with chronic nonspecific low back pain. *Journal of Occupational Rehabilitation*. 2002 Sep;12(3):119-29.
13. Depreli SG, Başpınar MM, Basat O. Evaluation of Anxiety, Quality of Life and Quality of Sleep in Patients with Chronic Low Back Pain. *Turkish Journal of Sleep Medicine*. 2021 May 26.

14. Abbasi M, Kazemifar AM, Fatorechi H, Yazdi Z. Sleep quality, quality of life and insomnia among patients with chronic low back pain compared to normal individuals. *Sleep and Hypnosis (Online)*. 2018;20(3):184-9.
15. De Weerd A, De Haas S, Otte A, Trenité DK, Van Erp G, Cohen A, De Kam M, Van Gerven J. Subjective sleep disturbance in patients with partial epilepsy: a questionnaire-based study on prevalence and impact on quality of life. *Epilepsia*. 2004 Nov;45(11):1397-404.
16. Serrano-Fernández MJ, Boada-Grau J, Robert-Sentís L, Boada-Cuerva M, Vigil-Colet A, Assens-Serra J. Spanish Adaptation of the Groningen Sleep Quality Scale (GSQS-8). *Universitas psychologica*. 2020; 19:1-1.
17. Lowry M, Dean K, Manders K. The link between sleep quantity and academic performance for the college student. *Sentience*. 2010;3(2):16-9.
18. Machado LA, De Souza MV, Ferreira PH, Ferreira ML. The McKenzie method for low back pain: a systematic review of the literature with a meta-analysis approach. *Spine*. 2006 Apr 20;31(9): E254-62.
19. Fatoye F, Gebrye T, Fatoye C, Mbada CE, Olaoye MI, Odole AC, Dada O. The clinical and cost-effectiveness of telerehabilitation for people with nonspecific chronic low back pain: randomized controlled trial. *JMIR mHealth and uHealth*. 2020 Jun 24;8(6):e15375.
20. Marin R, Cyhan T, Miklos W. Sleep disturbance in patients with chronic low back pain. *American journal of physical medicine & rehabilitation*. 2006 May 1;85(5):430-5
21. Mbada CE, Olaoye MI, Dada OO, Ayanniyi O, Johnson OE, Odole AC, Ishaya GP, Omole OJ, Makinde MO. Comparative efficacy of clinic-based and telerehabilitation application of Mckenzie therapy in chronic low-back pain. *International journal of telerehabilitation*. 2019 Jun 12;11(1):41.
22. Shambushankar AK, Jose J, Gnanasekaran S, Kaur G, KS A. Cost-effectiveness of telerehabilitation compared to traditional in-person rehabilitation: a systematic review and meta-analysis. *Cureus*. 2025 Feb 14;17(2).
23. Hawley-Hague H, Lasrado R, Martinez E, Stanmore E, Tyson S. A scoping review of the feasibility, acceptability, and effects of physiotherapy delivered remotely. *Disability and rehabilitation*. 2023 Nov 6;45(23):3961-77.
24. Alahmri F, Alkhawajah HA, Nuhmani S, Muaidi Q. Effectiveness of telerehabilitation in managing chronic low back pain: a pragmatic randomized controlled non-inferiority trial. *International Journal of Medical Informatics*. 2026 Jun 10:106540.