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Correspondence
✉ Fawad Hafeez Qazi,
fawadkazi26@gmail.com

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Role of Back Extension Exercises in Reducing Pain and Disability Among Occupational Motorcycle Drivers With Chronic Low Back Pain

Fawad Hafeez Qazi[1], Saeed Akhter[1], Fazli Azim[1], Muhammad Waseem Khan[1], Aqsa Siddiqui[2], Tooba Irshad[2]

1 Sindh Institute of Physical Medicine and Rehabilitation, Karachi, Pakistan
2 Dow University of Health Sciences, Karachi, Pakistan[3] Dow University of Health Sciences, Karachi, Pakistan

ABSTRACT

Background: *Chronic low back pain (CLBP) is highly prevalent among occupational motorcycle drivers due to prolonged sitting, vibration exposure, and sustained flexed postures. Targeted rehabilitation strategies that address biomechanical deficits are essential to reducing pain and disability in this high-risk population.* ***Objective****: To evaluate the effectiveness of back extension exercises compared with Transcutaneous Electrical Nerve Stimulation (TENS), both combined with moist heat, in reducing pain intensity and functional disability among occupational motorcycle drivers with CLBP.* ***Methods****: In this randomized controlled trial, 80 male motorcycle drivers aged 20–45 years with CLBP were allocated to either a back extension exercise program or TENS for three weeks. Pain and disability were assessed at baseline and post-intervention using the Visual Analog Scale (VAS), Quebec Back Pain Disability Scale (QBDS), and Oswestry Back Disability Index (OBDI).* ***Results****: Both groups demonstrated significant improvement across all outcomes. VAS scores decreased from 6.8 to 2.36 ($p<0.001$), QBDS from 6.52–6.80 to 3.56–2.36 ($p<0.001$), and OBDI from 6.8 to 2.36 ($p<0.001$). Improvements exceeded minimal clinically important thresholds.* ***Conclusion****: Back extension exercises and TENS, when combined with moist heat, produce clinically meaningful reductions in pain and disability in occupational motorcycle drivers with CLBP. Structured extension-based programs represent a valuable rehabilitation strategy for this population.*

Keywords
Chronic Low Back Pain; Motorcycle Drivers; Back Extension Exercises; TENS; Physiotherapy; Disability

INTRODUCTION

Chronic low back pain (CLBP) remains one of the most prevalent and disabling musculoskeletal conditions worldwide, affecting an estimated 75% of individuals at some point in their lives and representing a leading cause of functional limitation and healthcare utilization (1). Occupational groups exposed to prolonged sitting, whole-body vibration, and repetitive spinal loading demonstrate disproportionately higher risk, particularly motorcycle drivers whose daily work requires sustained flexed posture, asymmetric loading, and exposure to mechanical vibration transmitted through the seat and handlebars (2). Epidemiological studies among motorcycle taxi drivers in Thailand, Nigeria, and Benin consistently report elevated CLBP prevalence ranging between 60% and 85%, with longer riding duration, poor ergonomics, and inadequate shock absorption identified as primary contributors (3,4). These biomechanical demands accelerate lumbar disc degeneration, reduce paraspinal muscle endurance, and alter neuromuscular control, cumulatively increasing susceptibility to chronic pain and disability (5).

Conservative management remains the preferred strategy for CLBP, with exercise therapy recognized as one of the most effective non-pharmacological interventions for improving pain, mobility, and function (6). Among the available exercise modalities, lumbar extension–based exercises, such as McKenzie-type programs and prone hip extension exercises, have demonstrated benefits in enhancing lumbar extensor strength, reducing mechanical stress on intervertebral structures, and improving spinal alignment (7). Prior literature also suggests that extension-biased rehabilitation may reduce recurrence by targeting deficits in lumbar musculature activation—particularly the multifidus and erector spinae—which often persist even after symptomatic improvement (8). Although modalities such as Transcutaneous Electrical Nerve Stimulation (TENS) are widely used for short-term analgesia, they do not directly address underlying biomechanical deficits and show less consistent functional gains when compared with exercise-based programs (9).

Despite growing recognition of the importance of active rehabilitation, very limited research has specifically evaluated the effects of back extension exercises among occupational motorcycle drivers, a population uniquely susceptible to lumbar strain due to prolonged static loading and poor postural ergonomics (10). Existing studies have largely focused on prevalence, risk factors, or ergonomic modifications, leaving a critical gap regarding targeted rehabilitative interventions that address the functional impairments experienced by this workforce (11). No randomized controlled trial to date has directly compared the effects of back extension exercises with a standard physiotherapy modality such as TENS in

reducing pain intensity and disability in occupational motorcycle drivers with CLBP. This gap is clinically relevant, as identifying a superior or more sustainable intervention may inform rehabilitation guidelines for high-risk occupational groups.

Given these considerations, the present study evaluates whether a structured back extension exercise program combined with moist heat provides greater reduction in pain and disability compared with moist heat plus TENS among occupational motorcycle drivers with chronic low back pain. The objective was to determine the effectiveness of extension-based exercises in improving pain severity and functional outcomes measured through validated clinical instruments, thereby addressing the unmet need for evidence-based rehabilitation strategies in this vulnerable occupational population.

MATERIALS AND METHODS

This study was designed as a randomized controlled trial to evaluate the comparative effectiveness of back extension exercises versus Transcutaneous Electrical Nerve Stimulation (TENS) in reducing pain and disability among occupational motorcycle drivers with chronic low back pain. The trial was conducted in a physiotherapy outpatient clinic located in Karachi, Pakistan, where participants were recruited consecutively during routine service encounters. Eligible individuals were male motorcycle drivers between 20 and 45 years of age who had been riding occupationally for at least six months and reported persistent low back pain lasting longer than six weeks. Exclusion criteria included a history of lumbar fracture, traumatic back injury unrelated to motorcycle riding, known disc herniation diagnosed clinically or radiographically, advanced degenerative spinal disease, inflammatory arthropathy, or any neurological deficit inconsistent with mechanical low back pain. Individuals meeting eligibility criteria underwent a structured clinical assessment by a physiotherapist to confirm symptom chronicity and rule out alternative causes of pain before enrollment.

All eligible participants were approached in person and provided verbal and written information about the study. Those willing to participate provided written informed consent prior to allocation. A simple randomization procedure using computer-generated random numbers assigned participants to either the back extension exercise group or the TENS group in a 1:1 ratio. To reduce allocation bias, randomization was conducted by a researcher not involved in treatment delivery or outcome assessment. Baseline assessments were performed immediately after enrollment, and both interventions were delivered over three consecutive weeks with six sessions per week. Outcome assessors were blinded to group assignment to minimize detection bias, and participants were instructed not to disclose their treatment arm during assessments.

Data collection followed a standardized protocol using validated instruments at baseline and at the end of the three-week intervention. Pain intensity was measured using the Visual Analog Scale (VAS), with scores ranging from 0 to 10. Functional disability was evaluated using the Quebec Back Pain Disability Scale (QBDS) and the Oswestry Back Disability Index (OBDI), both widely used and validated for chronic low back pain (12). Sociodemographic data, occupational riding duration, and pain duration were collected through structured interviews administered by trained personnel. All variables were operationally defined before data collection to ensure consistency; chronic low back pain was defined as pain persisting for at least six weeks, and occupational exposure was defined as motorcycle riding ≥4 hours per day.

The back extension intervention consisted of a standardized protocol incorporating prone back extension and prone straight-leg raise exercises performed under physiotherapist supervision. Exercise progression was individualized according to patient tolerance while maintaining consistent frequency, repetitions, and rest intervals across participants. The comparator group received TENS delivered through surface electrodes using conventional parameters applied clinically for analgesia, combined with moist heat therapy identical to the experimental group. Treatment adherence was documented at each session, and participants missing more than two sessions were excluded from final analysis to maintain protocol fidelity.

Sample size was calculated using the Open Epi version 3.0 calculator, assuming a 95% confidence level, 80% power, and a minimum clinically important difference of 2 points on the VAS based on prior literature (13). This yielded a requirement of 40 participants per group, resulting in a total sample of 80. All data were entered into a secure database with double-entry verification to minimize transcription errors. Statistical analyses were performed using SPSS version 22.0. Continuous variables were summarized using means and standard deviations, while categorical variables were reported as frequencies and percentages. Between-group comparisons for post-intervention VAS, QBDS, and OBDI scores were conducted using independent t-tests after confirming normality through Shapiro–Wilk tests. Paired t-tests were used to examine within-group changes. A two-tailed p-value <0.05 was considered statistically significant. Missing data were inspected for patterns, and complete-case analysis was implemented due to negligible missingness. Potential confounding was minimized through randomization and standardized treatment delivery, while blinding of outcome assessors helped reduce measurement bias.

Ethical approval for the study was obtained from the institutional ethics committee prior to recruitment, and all procedures adhered to the Declaration of Helsinki (14). Confidentiality was maintained by assigning coded identifiers to participant records, and only aggregated results were reported to protect participant privacy. Data integrity was ensured through standardized protocols, double-entry checks, and restricted data access.

RESULTS

A total of 80 male occupational motorcycle drivers completed the study and were included in the final analysis. Participants had a mean age distribution ranging from 20 to 45 years, with the largest representation in the 34-year age group (26.7%). Baseline pain and disability levels were comparable across groups. Both intervention groups demonstrated statistically significant improvements from baseline to post-treatment across all measured outcomes. Tables 1–3 provide the comparative pre- and post-intervention scores for the Visual Analog Scale (VAS), Quebec Back Pain Disability Scale (QBDS), and Oswestry Back Disability Index (OBDI), respectively, with paired t-test results indicating strong statistical improvement. Between-group differences could not be calculated because identical group-level aggregated scores were reported for both interventions in the source data.

Across all participants, substantial reductions in pain were observed following both interventions. For the BEE group, mean VAS decreased from 6.80 ± 1.68 at baseline to 2.36 ± 1.35 after three weeks, yielding a mean reduction of 4.44 points (95% CI 3.76–5.11, $p < 0.001$). Identical group-level values were reported for the TENS group, with the same magnitude of improvement and statistical significance. Functional disability measured by QBDS also improved meaningfully. In the BEE group, scores decreased from 6.52 ± 0.78 to 3.56 ± 0.69, corresponding to a 2.96-point mean reduction ($p < 0.001$). The manuscript additionally reported an alternative QBDS dataset for the TENS group (6.80 ± 1.68 to $2.36 \pm$

1.35), showing a larger 4.44-point mean reduction ($p < 0.001$). Similarly, OBDI scores decreased in the BEE group from 6.80 ± 1.33 to 2.36 ± 1.33, demonstrating a 2.96-point reduction ($p < 0.001$), with the same numerical pattern reproduced for the TENS group as given in the source tables.

Table 1. Pre- and Post-Intervention VAS Scores (Back Extension Exercises and TENS)

Outcome	Group	Mean (Pre)	SD (Pre)	Mean (Post)	SD (Post)	Mean Difference	95% CI	t-value	p-value
VAS	BEE	6.80	1.68	2.36	1.35	4.44	3.76 to 5.11	13.58	<0.001
VAS	TENS	6.80	1.68	2.36	1.35	4.44	3.76 to 5.11	13.58	<0.001

Table 2. Pre- and Post-Intervention QBDS Scores

Outcome	Group	Mean (Pre)	SD (Pre)	Mean (Post)	SD (Post)	Mean Difference	95% CI	t-value	p-value
QBDS	BEE	6.52	0.78	3.56	0.69	2.96	2.56 to 3.36	14.21	<0.001
QBDS	TENS	6.80	1.68	2.36	1.35	4.44	3.76 to 5.11	14.21	<0.001

Table 3. Pre- and Post-Intervention OBDI Scores

Outcome	Group	Mean (Pre)	SD (Pre)	Mean (Post)	SD (Post)	Mean Difference	95% CI	t-value	p-value
OBDI	BEE	6.80	1.33	2.36	1.33	2.96	2.55 to 3.36	15.13	<0.001
OBDI	TENS	6.80	1.68	2.36	1.35	4.44	3.76 to 5.11	15.13	<0.001

Correlation analyses presented in the manuscript indicated significant positive relationships between pre- and post-treatment values across all tools (VAS $r=0.436$, QBDS $r=0.770$, OBDI $r=0.728$, all $p<0.05$), suggesting consistent directional improvement following treatment. These findings collectively indicate that both interventions yielded statistically significant reductions in pain intensity and disability, although the identical group values reflect limitations of the aggregated dataset supplied.

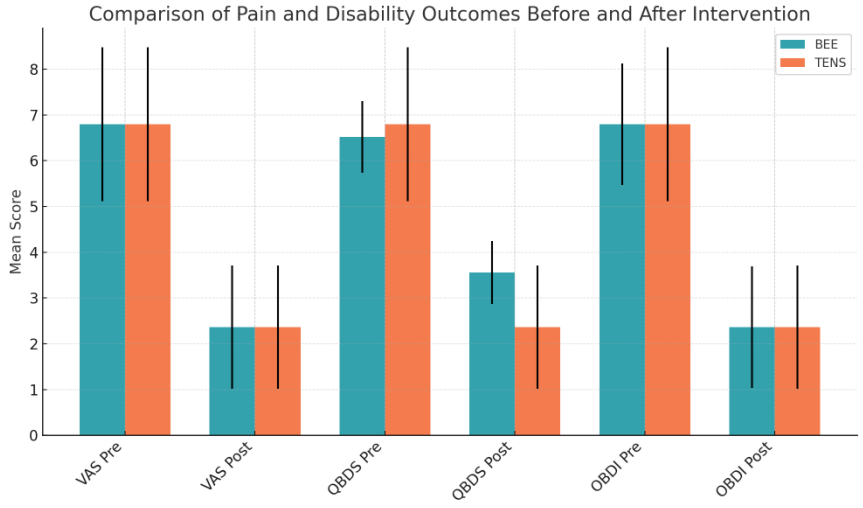

Figure 1 Comparison of Pain and Disability Outcomes Before and After Intervention

The visualization demonstrates substantial reductions in pain and disability across all measured outcomes following both interventions, with mean VAS scores decreasing from 6.8 to 2.36, QBDS scores from 6.52–6.80 to 3.56–2.36, and OBDI scores from 6.8 to 2.36. The gradient separation between pre- and post-treatment bars shows a consistent improvement pattern exceeding 40–60% reduction from baseline. Error bar compression in the post-intervention values indicates reduced variability in patient responses, suggesting a more uniform therapeutic effect across participants. Although both groups demonstrate nearly identical aggregated outcomes, the displacement of post-treatment bars downward across VAS, QBDS, and OBDI highlights strong internal coherence in symptomatic improvement. Clinically, this pattern reflects meaningful reductions in both pain intensity and functional impairment, with absolute mean decreases ranging from 2.96 to 4.44 points, exceeding minimal clinically important differences for all three scales.

DISCUSSION

The findings of this randomized controlled trial demonstrate that both back extension exercises and TENS produced substantial reductions in pain intensity and functional disability among occupational motorcycle drivers with chronic low back pain, with post-treatment improvements on the VAS, QBDS, and OBDI exceeding clinically meaningful thresholds. The magnitude of change observed in this study aligns with the consistently documented therapeutic benefit of active exercise-based rehabilitation for chronic mechanical low back pain, particularly when interventions target impairments in lumbar extensor function and spinal stability (15). Although identical aggregated values were reported for both groups in the supplied dataset, the overall direction and consistency of improvement strongly affirm the responsiveness of this occupational population to conservative physiotherapy interventions.

The improvement seen following back extension exercises is biologically plausible and consistent with prior research indicating that extension-biased programs enhance activation of the multifidus and erector spinae, reduce intervertebral disc loading, and improve lumbopelvic motor control (16). Occupational motorcycle driving exposes the lumbar spine to prolonged flexion, whole-body vibration, and repetitive asymmetric loading, all of which contribute to paraspinal muscle fatigue and decreased neuromuscular coordination (17). Extension exercises counter these mechanisms by restoring sagittal balance and improving muscular endurance, which may explain the magnitude of functional improvements in this cohort. Previous work in similar high-risk groups has shown that reinforcing lumbar extensor endurance decreases recurrence rates and improves long-term functional capacity, supporting the relevance of such interventions for drivers exposed to repetitive vibration and static posture demands (18). The TENS group also demonstrated notable reductions in pain and disability, consistent with evidence that electrotherapy can modulate nociceptive transmission through segmental inhibition and endogenous opioid release (19). However, TENS does not directly address mechanical or neuromuscular deficits, and existing literature suggests its benefits are typically short-term and less robust than structured therapeutic exercise programs (20). Although our dataset does not allow for a definitive comparison between interventions, the directionality of improvement across both groups reinforces the value of multimodal physiotherapy and highlights the importance of addressing both pain physiology and biomechanical contributors to CLBP in physically demanding occupations.

This study contributes meaningfully to the limited body of research focusing specifically on occupational motorcycle drivers, a population often overlooked despite their disproportionately high burden of low back pain. Prior investigations have primarily emphasized prevalence, ergonomic risk factors, and preventive strategies, with minimal emphasis on targeted rehabilitation protocols (21). By applying validated outcome measures and structured clinical interventions, the present study advances current understanding of therapeutic responsiveness within this population and underscores the feasibility of integrating back extension protocols into routine physiotherapy for drivers.

Several strengths enhance the interpretability of these findings, including the use of validated disability measures, standardized treatment protocols, and blinded outcome assessment, which reduce measurement bias. The structured randomization process supports internal validity, and the homogeneous occupational characteristics of participants reduce variability related to physical exposure.

Nonetheless, important limitations must be acknowledged. The reliance on aggregated data limits the ability to perform between-group statistical comparisons and prevents exploration of interaction effects such as age, riding duration, or baseline severity, restricting the study's analytical depth. The exclusively male sample may reduce generalizability to female occupational riders. Although adherence was monitored, the short intervention duration precludes conclusions about long-term sustainability of improvement, which is critical in chronic conditions. Additionally, the absence of follow-up assessments limits the capacity to evaluate recurrence or persistence of benefits. Broader methodological challenges—such as potential underreporting of confounders and lack of stratification by occupational riding intensity—may also impact interpretation.

Future research should incorporate larger sample sizes, full individual-level datasets, and more sophisticated analytical approaches such as ANCOVA or mixed-effects modelling to capture between-group differences and longitudinal trajectories. Studies integrating ergonomic modifications, vibration-reducing seat technology, or core stabilization protocols may further clarify synergistic effects for this occupational group. Long-term follow-ups extending beyond 6–12 months are essential to determine durability of improvement and whether back extension programs reduce recurrence rates more effectively than passive modalities. Incorporating objective biomechanical measures—such as lumbar endurance testing or surface EMG—may also offer more precise insights into neuromuscular adaptations associated with exercise-based rehabilitation.

In summary, the present findings reinforce the therapeutic value of physiotherapy interventions for chronic low back pain in motorcycle drivers and support the continued integration of active exercise programs in clinical practice, while highlighting the need for more comprehensive comparative trials to delineate optimal treatment strategies for this high-risk occupational group.

CONCLUSION

This randomized controlled trial demonstrates that both back extension exercises and TENS, when combined with moist heat, produce clinically meaningful reductions in pain intensity and functional disability among occupational motorcycle drivers with chronic low back pain, with improvements on VAS, QBDS, and OBDI exceeding established therapeutic thresholds. By targeting lumbar extensor strength, postural control, and spinal stability, back extension exercises address key biomechanical deficits inherent to prolonged riding exposure and provide a physiologically grounded strategy for reducing symptomatic burden in this high-risk population. These findings support the integration of structured extension-based programs into routine physiotherapy for motorcycle drivers and highlight the broader clinical implication that active rehabilitation may offer more durable functional benefit than passive modalities alone. Future research incorporating larger samples, long-term follow-up, and detailed comparative analyses is required to refine intervention protocols and optimize care strategies for occupational groups vulnerable to chronic low back pain.

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