(ISSN: 0973-7049(P))

The Bioscan AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES 21(2): S.I (2), 22088-22109, 2026 www.thebioscan.com

A COMPARATIVE STUDY TO ANALYZE THE EFFICACY OF CORE STABILIZATION EXERCISES VERSUS TRADITIONAL PLANK PROGRAMME TO TREAT NONSPECIFIC LOWER BACK DISCOMFORT IN FAST BOWLERS

[1] Rajesh Kumar Tiwari, [2]Dr. Sourabh Soni, [3]Dr. Farukh Mohammad Ansari, [4]Dr. Jafar Khan, [5]Dr. Deepak Lohar, [6]Dr. Suhani Bhatnagar, [7]Dr. Hasnen Sheikh, [8]Dr. Prashnat Kumar Ramawat, [9]Dr. Dipika Balala, [10]Bhatt Harsh Kirankumar

[*1]M.P.Th. scholar, Pacific college of Physiotherapy, Pacific medical university, Udaipur, Rajasthan
[2]Assistant Professor, Pacific college of Physiotherapy, Pacific medical university, Udaipur, Rajasthan
[3]Professor, Pacific college of Physiotherapy, Pacific medical university, Udaipur, Rajasthan
[4]Dean & HOD, Pacific college of Physiotherapy, Pacific medical university, Udaipur, Rajasthan
[5]Professor, Pacific college of Physiotherapy, Pacific medical university, Udaipur, Rajasthan
[6]Assistant Professor, Pacific college of Physiotherapy, Pacific medical university, Udaipur, Rajasthan
[7]Assistant Professor, Pacific college of Physiotherapy, Pacific medical university, Udaipur, Rajasthan
[8]Assistant Professor, Pacific college of Physiotherapy, Pacific medical university, Udaipur, Rajasthan
[9]Associate Professor, Pacific college of Physiotherapy, Pacific medical university, Udaipur, Rajasthan
[10]M.P.Th. scholar, Pacific college of Physiotherapy, Pacific medical university, Udaipur, Rajasthan

DOI:https://doi.org/10.63001/tbs.2026.v21.i02.S.I(2).pp22088-22109

KEYWORDS

. Fast bowler's, core stabilization exercise, Traditional plank program, VAS (Visual Analog Scale), Modified Oswestry Low Back pain disability Questionnaire.

Article Info
Received: 13.03.2026

Accepted: 02.04.2026

Published: 10.04.2026

Abstract

Background: An injury occurs when the body's tissues, such as bones, muscles, tendons, or ligaments, are unable to tolerate the mechanical load placed upon them. In fast bowlers, the repetitive nature of bowling generates substantial forces on the musculoskeletal system, making bowling workload - particularly its intensity and volume- a major external risk factor for injury. Due to the repetitive high-intensity movements involved in bowling, the lower back is the most commonly affected region, making it one of the leading sites of injury in this group of athletes. In this study Core stabilization exercise and traditional plank program has been introduce to reduce pain and improve function.
Objective: The objective of the study is to i) Assess the efficacy of Core stabilization exercise in the treatment of non specific lower back discomfort in fast bowlers, ii) Assess the efficacy of traditional plank program in the treatment of non specific lower back discomfort in fast bowlers, iii) Assess the qualitative measures after back to sports, iv) Finally the study will compare the results of both intervention strategies in terms of improving dynamic function in fast bowlers diagnosed with non specific lower back discomfort.
Methods: 60 Fast bowler's diagnosed with the lower back discomfort by orthopedic OPD or physiotherapy department were initially assessed for the inclusion or exclusion criteria. Prior to the treatment procedure patient are oriented to the study. Participants are divided into 2 groups and both groups assessed for the pre test parameter.
Outcome measure: VAS (Visual Analog Scale), Modified Oswestry Low Back pain disability Questionnaire is used for measuring pre and post intervention evaluation.

Results: The Study was significant in reducing pain level and improving functional ability. At the end of eight week intervention, for both group: Group A (core stabilization exercise) and Group B (Traditional plank program) showed improvement in the symptoms. Based on the results the study supports research hypothesis that there was a significant improvement in the Pain and functional ability or ADL performance associated with lower back discomfort.
Conclusion: The findings of the study showed that both Core stabilization exercise and traditional plank exercise program is statistically significant improvements over a 8-week intervention period in terms of pain, lifting, walking, standing and overall functional performance. Particularly, the Core stabilization exercise group showed superior reductions in pain and reflecting better dynamic stability.

INTRODUCTION

fast bowlers consistently experience the highest rate of injuries. Due to the repetitive high-intensity movements involved in bowling, the lower back is the most commonly affected region, making it one of the leading sites of injury in this group of

athletes [1,2,3,4]. Sports injury research has evolved through the development of various models that help explain the complex interaction of factors contributing to injury[7]. These factors are generally categorized into intrinsic factors**,** which are related to the individual, and extrinsic factors[5,6], which are associated with the external environment. An injury occurs when the body's tissues, such as bones, muscles, tendons, or ligaments, are unable to tolerate the mechanical load placed upon them.In fast bowlers, the repetitive nature of bowling generates substantial forces on the musculoskeletal system, making bowling workload - particularly its intensity and volume- a major external risk factor for injury. At the same time, the ability of the body's tissues to withstand these repeated stresses is an important intrinsic factor influencing injury susceptibility[9]. Consequently, researchers have investigated factors such as bowling biomechanics, physical fitness, muscle strength, flexibility, and other musculoskeletal characteristics, along with workload across different formats of the game, to better understand the mechanisms underlying injury risk in fast bowlers[8,10]. Trunk muscle asymmetry has been associated with low back pain (LBP) in the general population, in athletes engaged in certain sports this asymmetry may actually serve an adaptive role, helping them to cope with the uneven demands of sport-specific movements. This is especially true in cricket, where fast bowlers rely on asymmetrical body motion to generate ball speed. However, fast bowling carries a significant risk of lower back injury, and the biomechanics of the bowling action have been identified as a key contributing factor. One factor linked to LBP is the increased counter-rotation of the shoulders during the delivery stride, which depends heavily on the control of trunk rotator muscles. The connection between trunk muscle symmetry or asymmetry, fast bowling, and the development of low back pain continues to be debatable[5,11] .The asymmetrical action of cricket fast bowling combines the movements of lumbar flexion, extension, rotation and side flexion, factors which have been identified generally in the aetiology of LBP. High volume of cricket bowling is also a risk factor for LBP and would encourage muscle asymmetry. Consequently asymmetry of lumbar muscles is commonly observed in cricket fast bowlers. In a group of cricket players including spinners, pace bowlers and batsmen, cross-sectional area of the quadratus lumborum (QL) and multifidus/erector spinae muscles on the

dominant side, and psoas major and obliquus internus abdominis (OI) muscles on the non-dominant side is greater than the contralateral muscle. Some aspects of trunk muscle asymmetry have been linked to pain and/or injury[5,10,11]. Lumbar stress injuries in fast bowlers develop as a result of multiple interacting factors rather than a single cause. Biomechanical characteristics such as excessive shoulder counter-rotation, pronounced lateral trunk movement, inadequate lumbopelvic stability, and repeated exposure to high ground reaction forces can substantially increase mechanical stress on the lumbar spine. In contrast, certain physical attributes, including adequate ankle dorsiflexion, may help reduce spinal loading and provide a protective effect. Sudden increases in bowling workload and individual differences in spinal movement patterns can further elevate the likelihood of injury, particularly among younger athletes whose musculoskeletal systems are still developing[12,13]. The location and pattern of lumbar stress injuries often differ between sporting activities, suggesting that sport-specific movement techniques influence the magnitude, direction, and distribution of forces acting on the spine. In cricket fast bowling, a unique technical requirement is that the bowling arm must remain extended during ball delivery. To achieve an effective release position while maintaining this rule, bowlers frequently adopt a considerable degree of trunk side flexion toward the side opposite the bowling arm. This movement becomes particularly important during the front foot contact phase of the bowling action, when peak ground reaction forces are generated. Because maximal contralateral trunk side flexion often occurs at the same time as these high impact forces, substantial loads may be transferred through the lumbar spine. Repeated exposure to these forces over time can contribute to the development of lumbar bone stress injuries. Recent evidence has highlighted a potential association between excessive contralateral thoracolumbar side flexion during front foot contact and the occurrence of lumbar bone stress injuries as well as other forms of lower back pain in fast bowlers. These linkages emphasize the importance of bowling technique and movement control in reducing spinal stress and minimizing injury risk[14,15]. The term core[16] generally refers to the lumbo-pelvic–hip region, which serves as the central link between the upper and lower extremities[17]. Stability within this region is provided by both passive structures(ligaments and joint capsules) and

active structures(surrounding musculature). Together, these components create a stable base that supports effectuve movement of the limbs and helps the body respond to the physical demands of daily and sporting activities. Effective core stability depends not only on muscular strength and endurance but also on precise neuromuscular coordination, allowing the trunk to maintain appropriate alignment over the pelvis and lower limbs while absorbing and distributing forces generated during movement.

Research has suggested that impaired neuromuscular control of the deep stabilizing muscles, particularly the transverse abdominis, may be associated with the development and persistence of nonspecific low back pain. Rather than a structural defect within the muscle itself, the problem often lies in the timing and coordination of muscle activation. Under normal conditions, the transverse abdominis activates before limb movement begins, preparing the spine and trunk for the upcoming task. However, in individuals with low back pain, this anticipatory activation may be delayed or altered, resulting in reduced spinal support during movement. When core stability is compromised, inefficient movement patterns and compensatory neuromuscular strategies may develop[18]. Because individuals must continue performing daily activities despite pain or dysfunction, these compensations can become habitual over time. Persistent abnormal movement patterns may place excessive or uneven stress on spinal joints and surrounding tissues, increasing the risk of recurrent episodes of low back pain. Such adaptations can further limit physical activity, reduce functional capacity, and negatively affect overall quality of life. Consequently, restoring proper core muscle function and neuromuscular control is considered an important component in the prevention and management of recurrent low back pain[19].

Repetitive stress is a well-known cause of soft tissue injuries, and in cricket this is seen very common. Among cricketers, fast bowlers are especially vulnerable because their action, pace, speed, and long run-up put a heavy load on the lower back. Even after following specific training programs, it is often observed that bowlers develop pain or discomfort in the lower back, particularly after long spells. This issue is not only common but, if it becomes frequent, it can gradually affect their performance and even shorten their career.Lower back discomfort reduces bowling speed, accuracy,

endurance, and overall participation in the sport. While general training and rehabilitation methods exist, very few studies have introduced a plan designed specifically for fast bowlers. The core muscles play an important role in maintaining spinal stability and protecting against injury. Traditional plank exercises are widely used to strengthen abdominal muscles, but sport-specific core strengthening may offer more targeted benefits for this group of athletes.With limited research available in this area, there is a clear need to compare these two approaches. This study, therefore, intends to evaluate the effects of traditional plank training and sport-specific core strengthening on lower back discomfort in fast bowlers.

2 MATERIAL & METHOD

Study Design: Comparative study

Sample Design: Simple random sampling

Sample Size: 60 fast bowler's having lower back discomfort will be randomized selected and Will be assessed for the pre-test parameter.

Study Setting: Patient were treated 5 times per week for 6 week at Department of physiotherapy, Pacific Medical college and hospital. UDAIPUR

Study Population: Fast bowlers with lower back discomfort, both male and female participants are included.

Study Duration: one year

Sample Size: 60 participants

Treatment Duration: single session 45-60 minutes for (5 days per week) for 6 weeks.

SELECTION CRITERIA:

Inclusion Criteria:

1. Mean age 18-40 years
2. Individual specifically fast bowlers with low back pain from 1 week to 12 weeks
3. Non- specific low back discomfort
4. Dull aching pain

Exclusion criteria

1. Persons with pain in upper and middle back pain
2. Lumbar vertebrae fracture
3. Radiating pain to the limbs
4. Malignancy
5. Any auto immune disorder

6. Any neurological or pathological condition

3 PROCEDURE

Permission for conduct Study is taken from the institutional ethical committee of PMCH (**Protocol no. PMU/IEC/MPT/2025/66**), Pacific medical university bhilo ka bedla Udaipur(RAJ).

Fast bowler's Diagnosed with lower back discomfort by the Physiotherapy department, Orthopedic department OPD; initially assessed for the inclusion or exclusion criteria. Prior to the treatment procedure, all participants were informed about the purpose, procedures, potential benefits, and possible risks of the study. Written informed consent was obtained from each participant prior to enrollment. Following the consent process, the participants were randomly allocated into two groups.

60 subjects were selected on the basis on inclusion criteria and randomly divided into Group-A and Group B.

- Group A (n=30) will be treated with core stabilization exercise.
- Group B (n=30) will be treated with Traditional plank program.

Group A (n=30) will be treated with core stabilization exercise.

Week (0-2)

Dead Bug → 3 (8 reps each side)

Bird Dog (hold 3–5 sec) → 3 (8 reps each side)

Glute Bridge Hold → 3 (20 sec hold)

Side-Lying Hip Lift (knees bent, short lever) → 2 (15 sec hold each side)

Week (3-4)

Dead Bug with Stability Ball (press ball with hands & knees) → 3 (8 reps)

Bird Dog with Elbow-to-Knee Crunch → 3 (8 reps each side)

Pallof Press (band) → 3 (10 reps each side)

Side-Lying Hip Lift (legs straight) → 2 (20–25 sec each side)

Week (5-6)

Medicine Ball Russian Twist (slow, controlled) → 3 SET (10 reps)

Cable/Band Anti-Rotation Press → 3SET (8–10 reps each side)

Bird Dog Row (resistance band/dumbbell) → 3 SET (6 reps each side)

Suitcase Carry (1 DB/KB, walk 15–20 m) → 3 SET (each side)

Week (7-8)

Medicine Ball Rotational Throw (standing, mimic bowling action) → 3 SET (6 reps each side)

Half-Kneeling Chop (band or cable) → 3 SET (8 reps each side)

Farmer's Carry (double KB/DB) → 3 x 20–30 m

Single-Leg Glute Bridge (hold 3–5 sec) → 3 SET (8 reps each leg)

Group B (n=30) will be treated with Traditional plank program.

Week (0-2)

Front Plank (elbows): 3 × 20–30 sec hold

Side Plank (each side): 2 × 15–20 sec hold

Plank with Knee Tap (alternate knees): 2 × 10 reps

Week (3-4)

Front Plank: 3 × 30–40 sec hold

Side Plank with Hip Drop (each side): 2 × 20–25 sec

Plank with Shoulder Tap: 2 × 10–12 reps

Reverse Plank Hold: 2 × 20–25 sec

Week (5-6)

Front Plank: 3 × 40–50 sec hold

Side Plank with Leg Lift (each side): 2 × 20–25 sec

Plank to Forearm/Push-up Transition ("Up-Down Plank"): 2 × 8–10 reps

Reverse Plank with Alternating Leg Lift: 2 × 8 reps

Week (7-8)

Front Plank: 3 × 60 sec hold

Side Plank with Rotation (each side): 2 × 8–10 reps

Plank with Arm Reach (forward reach): 2 × 8–10 reps

Dynamic Plank (walk forward & backward on elbows): 2 × 6–8 steps

4. DATA ANALYSIS AND RESULTS

The findings of the study showed that both Core stabilization exercise and traditional plank exercise program is statistically significant improvements over a 8-week intervention period in terms of pain, lifting, walking, standing and overall functional performance. Particularly, the Core stabilization exercise group showed superior reductions in pain and reflecting better dynamic stability. Group analysis further confirmed the greater effectiveness of Core stabilization exercise in comparison to traditional plank exercise program.

Patient participated in group A shows more significant changes. Group A result were found better than group B, results as data analysis showed VAS (Visual Analog Scale) of group A mean±SD is 6.82±0.85 improve to 3.05±0.57 post intervention. Group B VAS (Visual Analog Scale) data of pretest mean±SD is 6.80±0.82 improve to 4.89±0.66 post intervention. Data analysis of Modified Oswestry Low Back pain disability Questionnaire also significant for group A Compared to group B for group A pretest value of all component of Modified Oswestry Low Back pain disability Questionnaire is mean±SD is 56.50±7.03 improve to 22.73±5.44 in post test. The group B value of all component of Modified Oswestry Low Back pain disability Questionnaire before intervention mean±SD is 55.60±7.17 improve to 40.57±6.06 in post test. After comparing all the data it was observed that both Modified Oswestry Low Back pain disability Questionnaire and VAS (Visual Analog Scale) demonstrated significant improvement in both group.

TABLE 1: AGE DISTRIBUTION OF PARTICIPANTS

Age Group (Years)	Group A (n)	Group A (%)	Group B (n)	Group B (%)	Total (n)	Total (%)
18–22	7	23.3%	9	30.0%	16	26.7%
23–27	9	30.0%	8	26.7%	17	28.3%
28–31	7	23.3%	7	23.3%	14	23.3%
32–35	5	16.7%	4	13.3%	9	15.0%
36–40	2	6.7%	2	6.7%	4	6.7%
Total	30	50.0%	30	50.0%	60	100.0%

GRAPH 1: AGE DISTRIBUTION OF PARTICIPANTS

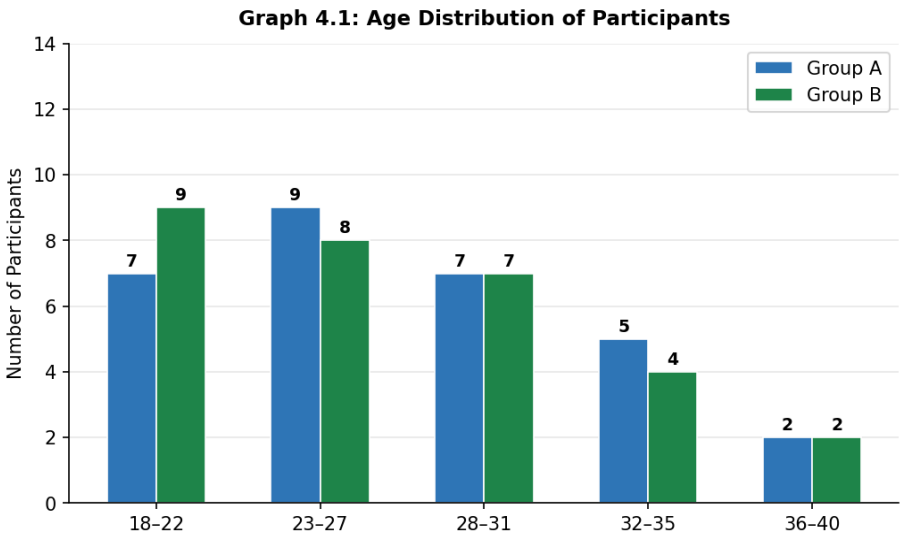

TABLE 2: GENDER DISTRIBUTION OF PARTICIPANTS

Gender	Group A (n)	Group A (%)	Group B (n)	Group B (%)	Total (n)	Total (%)
Male	16	53.3%	14	46.7%	30	50.0%
Female	14	46.7%	16	53.3%	30	50.0%
Total	30	100%	30	100%	60	100.0%

GRAPH 2: GENDER DISTRIBUTION OF PARTICIPANTS

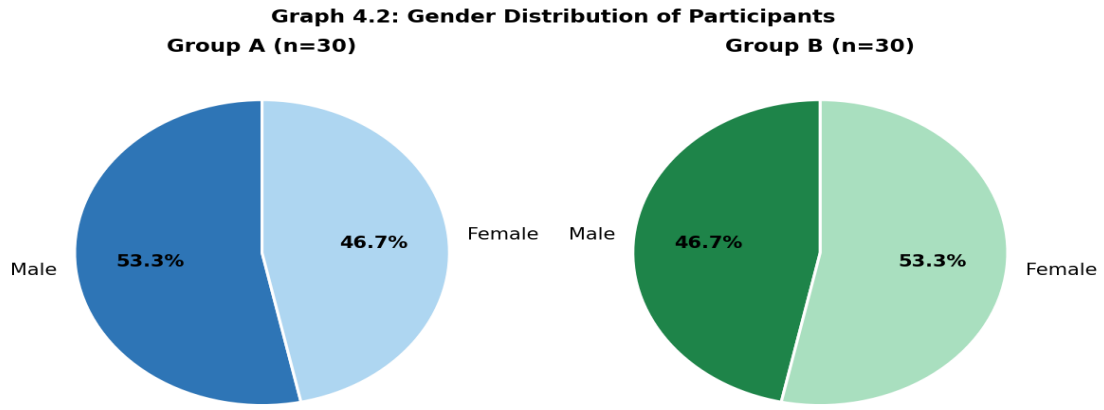

TABLE 3: BMI CATEGORY DISTRIBUTION

BMI Category	Range (kg/m²)	Group A (n=30)	Group B (n=30)	Total (n=60)
Underweight	< 18.5	0 (0.0%)	0 (0.0%)	0 (0.0%)
Normal	18.5–24.9	21 (70.0%)	22 (73.3%)	43 (71.7%)
Overweight	25–29.9	9 (30.0%)	8 (26.7%)	17 (28.3%)
Obese	≥ 30	0 (0.0%)	0 (0.0%)	0 (0.0%)

GRAPH 3: BMI CATEGORY DISTRIBUTION

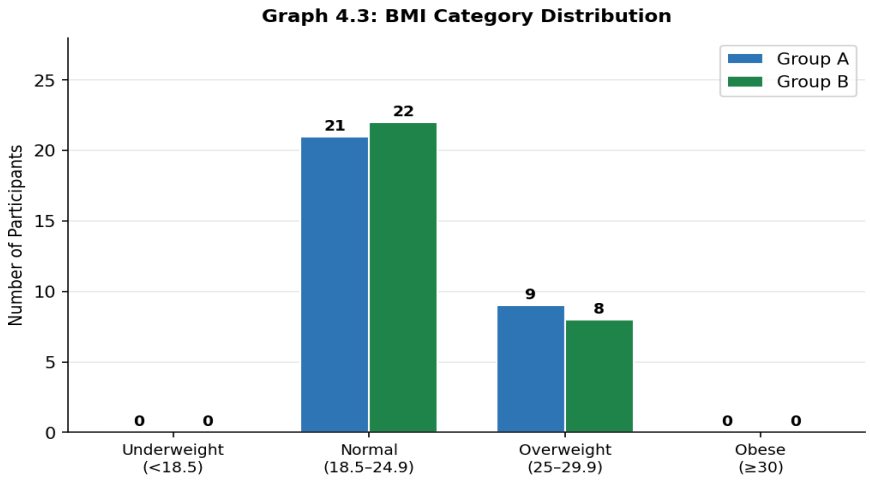

TABLE 4: GROUP A – VAS SCORE (0 WEEK vs 8 WEEKS)

Timepoint	N	Min	Max	Mean	Std. Dev.	t-value	p-value	Result
0 Week (Pre)	30	5.5	8.5	6.82	0.85	14.82	< 0.001	Significant
8 Week (Post)	30	2.2	4.2	3.05	0.57	–	–	–
Overall	60	2.2	8.5	4.93	0.73	–	–	–

GRAPH 4: GROUP A – VAS SCORE (0 WEEK vs 8 WEEKS)

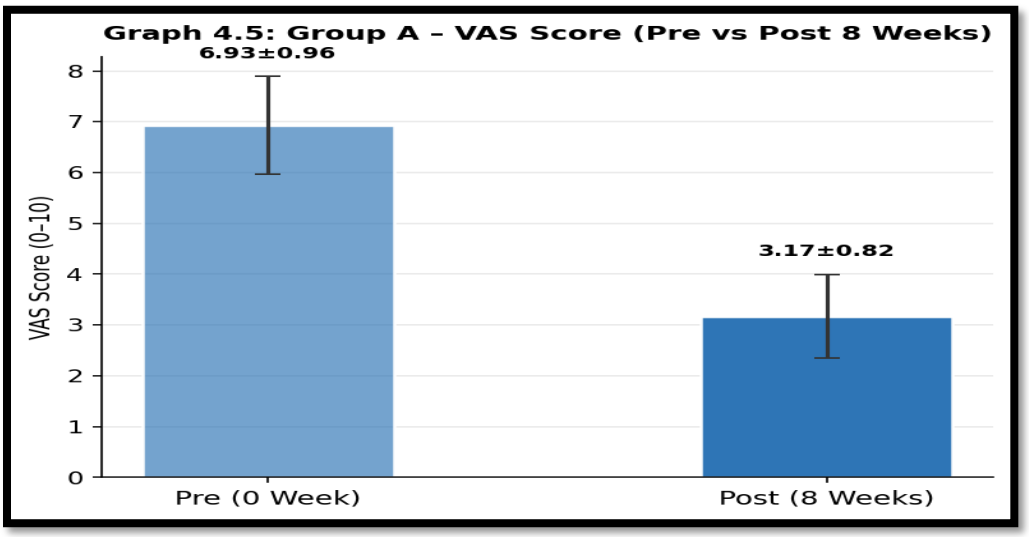

TABLE 5: GROUP A – MODIFIED OSWESTRY DISABILITY INDEX (0 WEEK vs 8 WEEKS)

Timepoint	N	Min	Max	Mean	Std. Dev.	t-value	p-value	Result
0 Week (Pre)	30	44.0	70.0	56.50	7.03	18.64	< 0.001	Significant
8 Week (Post)	30	16.0	35.0	22.73	5.44	–	–	–
Overall	60	16.0	70.0	39.62	6.28	–	–	–

GRAPH 5: GROUP A – ODI SCORE (0 WEEK vs 8 WEEKS)

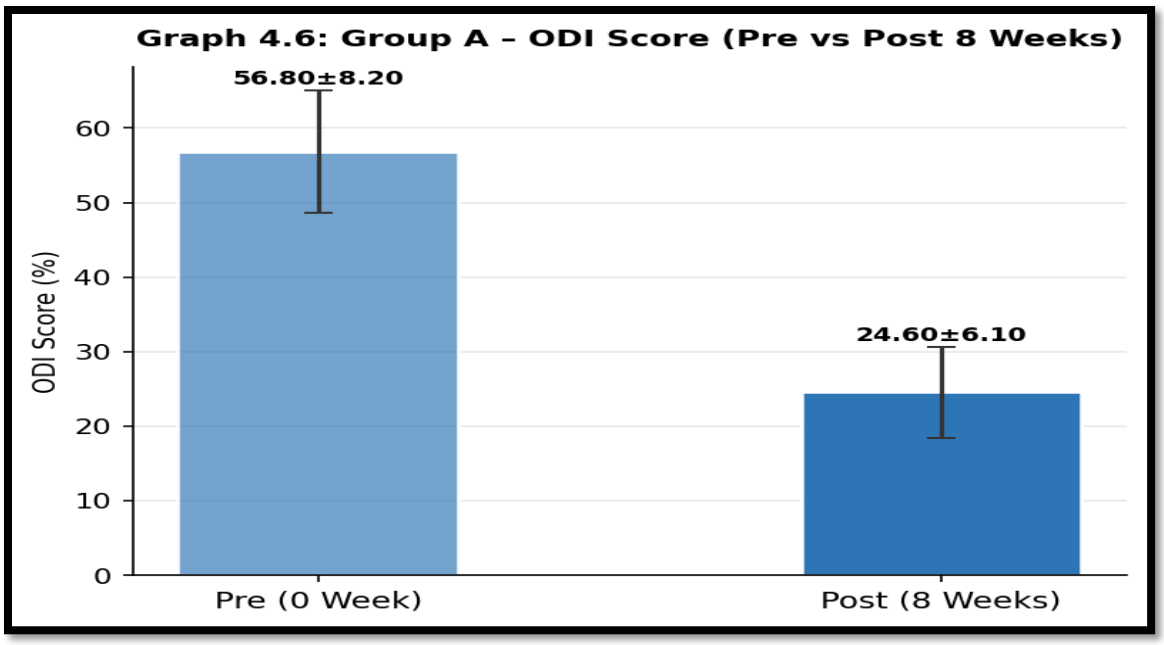

TABLE 6: GROUP B – VAS SCORE (0 WEEK vs 8 WEEKS)

Timepoint	N	Min	Max	Mean	Std. Dev.	t-value	p-value	Result
0 Week (Pre)	30	5.5	8.5	6.80	0.82	8.93	< 0.001	Significant
8 Week (Post)	30	3.8	6.2	4.89	0.66	–	–	–
Overall	60	3.8	8.5	5.84	0.74	–	–	–

GRAPH 6: GROUP B – VAS SCORE (0 WEEK vs 8 WEEKS)

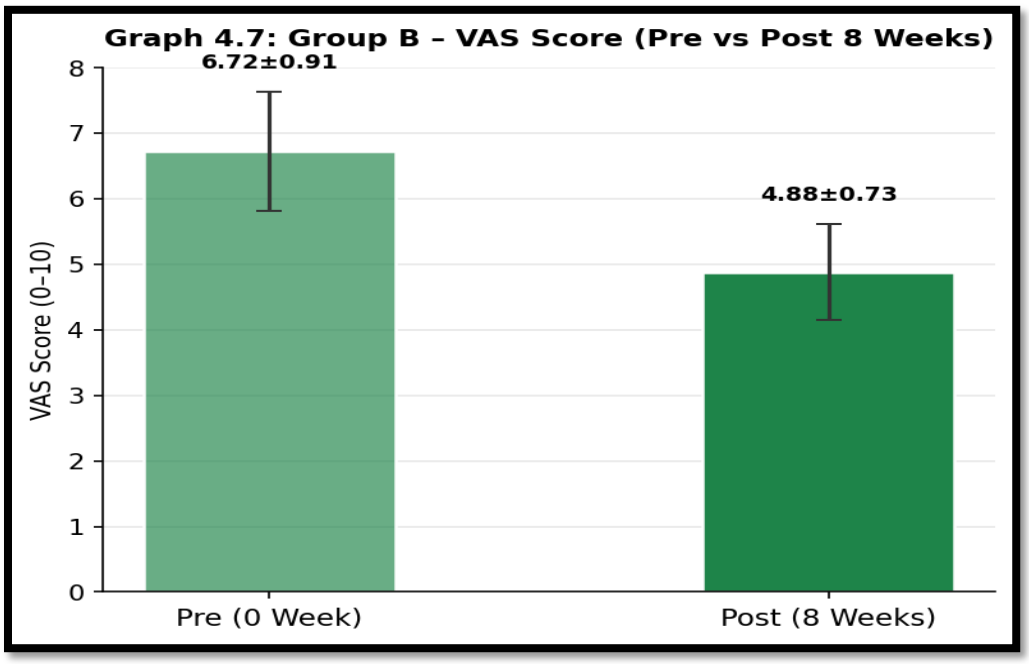

TABLE 7: GROUP B – MODIFIED OSWESTRY DISABILITY INDEX (0 WEEK vs 8 WEEKS)

Timepoint	N	Min	Max	Mean	Std. Dev.	t-value	p-value	Result
0 Week (Pre)	30	43.0	71.0	55.60	7.17	11.27	< 0.001	Significant
8 Week (Post)	30	31.0	54.0	40.57	6.06	–	–	–
Overall	60	31.0	71.0	48.08	6.64	–	–	–

GRAPH 7: GROUP B – ODI SCORE (0 WEEK vs 8 WEEKS)

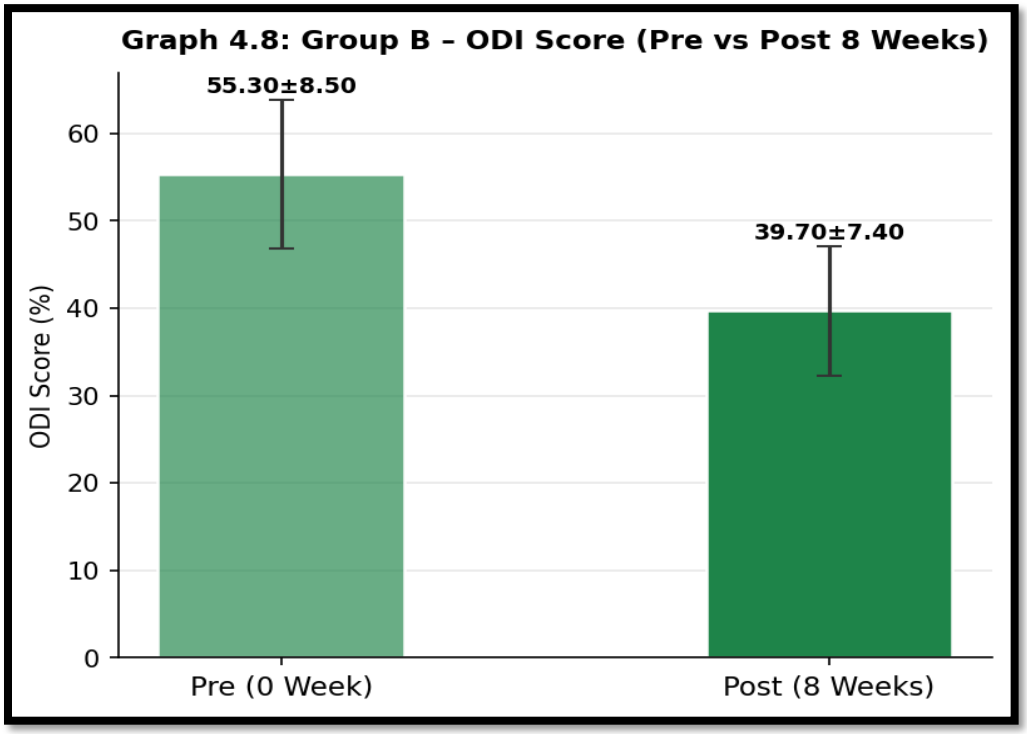

TABLE 8: BETWEEN-GROUP COMPARISON – VAS AT 8 WEEKS

Group	N	Mean	Std. Deviation	Std. Error Mean	Result
Group A (Experimental)	30	3.05	0.57	0.10	–
Group B (Control)	30	4.89	0.66	0.12	–

Independent Samples Test

t-value	df	p-value	Mean Difference	Result
9.81	58	< 0.001	1.84	Significant

TABLE 9: BETWEEN-GROUP COMPARISON – ODI AT 8 WEEKS

Group	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**	**Result**
Group A (Experimental)	30	22.73	5.44	0.99	–
Group B (Control)	30	40.57	6.06	1.11	–

Independent Samples Test

t-value	df	p-value	Mean Difference	Result
8.34	58	< 0.001	17.83	Significant

DISCUSSION

The present study was designed to compare the effectiveness of two widely implemented rehabilitation program core stabilization exercises and traditional plank exercise program in reducing pain, improving flexibility, enhancing muscle activity, and restoring overall functional performance among fast bowler's experiencing lower back discomfort or lower back pain. The study is based on the understanding that lower back discomfort in fast bowlers is a multifactorial condition influenced by several interrelated factors, including bowling mechanics, force generation, and ball release techniques. These bowling movements can be performed efficiently only when adequate trunk or core strength is maintained. The trunk plays a crucial role in providing spinal stability while facilitating mobility and effective force transfer between the upper and lower extremities. Similarly, optimal spinal mobility is closely linked to proper trunk function. Many factors may contribute to the development of lower back symptoms in bowlers, including reduced trunk mobility associated with inadequate activation of core musculature, particularly the transverse abdominis, deficits in neuromuscular control and timing, altered extremity alignment, impaired movement coordination, and decreased functional stability. Together, these impairments can increase mechanical stress on the lumbar spine and increase symptoms during bowling activities in fast bowlers. These relationships have been consistently reported in biomechanical, neuromuscular, and clinical research, providing the theoretical basis for this study.

Existing literature supports the view that an effective rehabilitation program for fast bowlers experiencing lower back discomfort should incorporate core and trunk strengthening and stabilization exercises. Reduced strength, endurance, and neuromuscular control of the core musculature have been identified as important contributing factors to the development of lower back symptoms. Therefore, interventions aimed at improving trunk stability and core function may help reduce spinal stress, enhance movement efficiency, and support recovery in this population. Previous published studies by Olivier FM ET.AL,(2024), Dash U et.al,(2024) and Dong K, Yu T, Chun B (2023) has demonstrated that strengthening programs integrating core stability strength and training produce superior improvements in pain, activity levels, and functional performance in athletes, pace bowlers and cricketers. Kachanathu SJ et.al,(2012) conducted a study to evaluate the effectiveness of core spinal stabilization exercises in pain and function activity of fast bowlers and findings of the study suggest that implementation of core spinal stabilization exercises in the management of low back pain have better result in fast bowlers in terms of pain and functional activity. These findings are consistent with the results of the present study and further support our outcomes. Similarly Soyuer F, Koku M(2024), highlighted in their systematic reviews that strengthening of core muscles with exercise programe is effective in the treatment of musculoskeletal problems and prevention of injuries. This body of work highlights the importance of choosing rehabilitation strategies that correct biomechanical faults while simultaneously improving neuromuscular control, load tolerance, and movement quality.

The decision to compare two distinct strengthening paradigms core stabilization program and traditional plank exercise program addresses a meaningful and previously underexplored clinical question, particularly in cricketers (fast bowlers) populations where mechanical load demands on the lower back are higher and movement patterns are more complex. Although the intervention period was limited to 8 weeks but both rehabilitation protocols produced satisfactory clinical improvements.

CONCLUSION

The present comparative study was conducted to evaluate the effects of the Core stabilization exercise and traditional plank program in the treatment of non specific

lower back discomfort in fast bowlers, with the primary aim of determining which intervention provides better functional outcomes. A total of 60 participants were included and assessed pre- and post-intervention using standardized outcome measures, the VAS (Visual Analog Scale) and the Modified Oswestry Low Back pain disability Questionnaire.

The findings of the study showed that both Core stabilization exercise and traditional plank exercise program is statistically significant improvements over a 8-week intervention period in terms of pain, lifting, walking, standing and overall functional performance. However, Core stabilization exercise consistently demonstrated greater improvements across most primary and secondary outcome measures. Based on these findings, it can be concluded that while both interventions are clinically safe and beneficial, Core stabilization exercise are more effective in improving functional outcomes and reducing pain in fast bowlers with lower back discomfort. Therefore, Core stabilization exercise should be prioritized in evidence-based rehabilitation programs to facilitate optimal recovery, improve functional outcome, and support a safe and efficient return to sport while reducing the risk of re-injury.

The findings and results of the present study are clinically important for physiotherapists involved in musculoskeletal and sports rehabilitation, as well as for rehabilitation professionals and rehabilitation specialists. The use of Core stabilization exercise may contribute to improving treatment strategies in back pain rehabilitation. Such insights will not only enhance training strategies but also contribute to safer sports participation, improved talent identification, and better long-term athletic development models. The results of this study can be applied clinically to assist healthcare professionals in the better management.

REFERENCE

1. LANGLEY B, Ranson C, Moore I. Five-year epidemiology of muscle injuries in professional cricket. Local Organising Committee. 2015:59.
2. Orchard JW, Blanch P, Paoloni J, Kountouris A, Sims K, Orchard JJ, Brukner P. Cricket fast bowling workload patterns as risk factors for tendon, muscle, bone and joint injuries. British journal of sports medicine. 2015 Aug 1;49(16):1064-8.
3. Alway P, Brooke-Wavell K, Langley B, King M, Peirce N. Incidence and

prevalence of lumbar stress fracture in English County Cricket fast bowlers, association with bowling workload and seasonal variation. BMJ open sport & exercise medicine. 2019 May 12;5(1).

4. Goggins L, Peirce N, Ranson C, McCaig S, Newman D, Langley B, Griffin S, Young M, McKay C, Stokes K, Williams S. Injuries in England and Wales elite men's domestic cricket: a nine season review from 2010 to 2018. Journal of science and medicine in sport. 2020 Sep 1;23(9):836-40.
5. Farhart P, Beakley D, Diwan A, Duffield R, Rodriguez EP, Chamoli U, Watsford M. Intrinsic variables associated with low back pain and lumbar spine injury in fast bowlers in cricket: a systematic review. BMC Sports Science, Medicine and Rehabilitation. 2023 Sep 20;15(1):114.
6. Olivier B, Stewart AV, Olorunju SA, McKinon W. Static and dynamic balance ability, lumbo-pelvic movement control and injury incidence in cricket pace bowlers. Journal of science and medicine in sport. 2015 Jan 1;18(1):19-25.
7. Olivier B, Stewart AV, Olorunju SA, McKinon W. Static and dynamic balance ability, lumbo-pelvic movement control and injury incidence in cricket pace bowlers. Journal of science and medicine in sport. 2015 Jan 1;18(1):19-25.
8. Olivier B, Taljaard T, Burger E, Brukner P, Orchard J, Gray J, Botha N, Stewart A, Mckinon W. Which extrinsic and intrinsic factors are associated with non-contact injuries in adult cricket fast bowlers?. Sports Medicine. 2016 Jan;46(1):79-101.
9. McNamara DJ, Gabbett TJ, Naughton G. Assessment of workload and its effects on performance and injury in elite cricket fast bowlers. Sports medicine. 2017 Mar;47(3):503-15.
10. Barry TJ. *A multi-factorial evaluation of lower back injury risk factors in fast bowlers* (Doctoral dissertation, Manchester Metropolitan University).
11. Gray J, Aginsky KD, Derman W, Vaughan CL, Hodges PW. Symmetry, not asymmetry, of abdominal muscle morphology is associated with low back pain in cricket fast bowlers. Journal of

Science and Medicine in Sport. 2016 Mar 1;19(3):222-6.

12. Arun C, Raman SA, Sivaraman A, Chelladurai A, SS N. Biomechanical Evolution in Longitudinal Analysis of Lumbar Stress Injuries in Fast Bowlers: A Systematic Review. Cureus. 2025 Dec 16;17(12).
13. Glazier PS, Wheat JS. An integrated approach to the biomechanics and motor control of cricket fast bowling techniques. Sports medicine. 2014 Jan;44(1):25-36.
14. Keylock L. *Lumbar vertebral adaptation and bone stress injury in adolescent cricket fast bowlers* (Doctoral dissertation, Loughborough University).
15. Alway P, Felton P, Brooke-Wavell K, Peirce N, King M. Cricket fast bowling technique and lumbar bone stress injury. Medicine and Science in Sports and Exercise. 2020 Sep 8;53(3):581-9.
16. Bak J, Shim S, Cho M, Chung Y. The effect of plank exercises with hip abduction using sling on trunk muscle activation in healthy adults. The Journal of Korean Physical Therapy. 2017 Jun 30;29(3):128-34.
17. Mulry TJ, Rodenhouse PE, Busconi BD. Core muscle and adductor injury. Clinics in Sports Medicine. 2021 Apr 1;40(2):323-38.
18. Soyuer F, Koku M. Core muscle activity in exercise. International Journal of Family & Community Medicine. 2024;8:73-5.
19. Hammill RR, Beazell JR, Hart JM. Neuromuscular consequences of low back pain and core dysfunction. Clinics in sports medicine. 2008 Jul 1;27(3):449-62.
20. Begum MR, Hossain MA. Validity and reliability of visual analogue scale (VAS) for pain measurement. Journal of Medical Case Reports and Reviews. 2019;2(11).
21. Baradaran A, Ebrahimzadeh MH, Birjandinejad A, Kachooei AR. Cross-cultural adaptation, validation, and reliability testing of the modified Oswestry disability questionnaire in Persian population with low back pain. Asian spine journal. 2016 Apr 15;10(2):215.
22. Hides J, Stanton W, Freke M, Wilson S, McMahon S, Richardson C. MRI study of the size, symmetry and function of the trunk muscles among elite cricketers with and without low back pain. British

journal of sports medicine. 2008 Oct 1;42(10):809-13.

23. Morton S, Barton CJ, Rice S, Morrissey D. Risk factors and successful interventions for cricket-related low back pain: a systematic review. British Journal of Sports Medicine. 2014 Apr 1;48(8):685-91.
24. Dash U, Dash P, Rout D, Pattanaik MR, Sahu S, Mohanty NR. Impact of Trunk Stabilization Training on Cricketers with Chronic Non-Specific Low Back Pain. Available at SSRN 5011365. 2024 Jun 6.
25. Gray J, Aginsky KD, Derman W, Vaughan CL, Hodges PW. Symmetry, not asymmetry, of abdominal muscle morphology is associated with low back pain in cricket fast bowlers. Journal of Science and Medicine in Sport. 2016 Mar 1;19(3):222-6.
26. Olivier B, Stewart AV, Mckinon W. Side-to-side asymmetry in absolute and relative muscle thickness of the lateral abdominal wall in cricket pace bowlers. South African Journal of Sports Medicine. 2013 Jan 1;25(3):81-6.
27. Hodges PW, Richardson CA. Contraction of the abdominal muscles associated with movement of the lower limb. Physical therapy. 1997 Feb 1;77(2):132-42.
28. Olivier FM, Olivier B, Mnguni N. The core of performance in adolescent cricket pace bowlers: Trunk muscle stability, maybe, but not strength-endurance and thickness. South African Journal of Sports Medicine. 2022;34(1):1-6.
29. Tomita N, Roy-Cardinal MH, Chayer B, Daher S, Attiya A, Boulanger A, Gaudreault N, Cloutier G, Bureau NJ. Thoracolumbar fascia ultrasound shear strain differs between low back pain and asymptomatic individuals: expanding the evidence. Insights into Imaging. 2025 Jan 15;16(1):18.
30. Lee D, Lee Y, Cho HY, Lee KB, Hong S, Pyo S, Lee G. Investigation of trunk muscle activity for modified plank exercise: A preliminary study. Isokinetics and Exercise Science. 2017 Aug;25(3):209-13.