CORRELATION BETWEEN CORE STRENGTH AND LOW BACK PAIN IN BHARATNATYAM DANCERS

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ABSTRACT

Bharatanatyam, a classical Indian dance form, demands high levels of physical endurance, flexibility, and postural control. Continuous practice involving repetitive spinal movements and prolonged postures often predisposes dancers to low back pain. Core muscles play a vital role in maintaining spinal stability and alignment during these movements. Understanding the link between core strength and low back pain can help in developing preventive and rehabilitative strategies for dancer. A cross-sectional study was conducted among Bharatanatyam dancers. Core strength was assessed using the Pressure Biofeedback Unit (PBU) test, and low back pain intensity was measured using the Visual Analogue Scale (VAS). Statistical analysis was performed to identify the correlation between PBU drop values and VAS scores. The findings revealed a negative correlation between core strength and low back pain, indicating that dancers with reduced core stability experienced higher levels of pain. This emphasizes the importance of core endurance in preventing spinal strain during dance movements. The study concludes that core muscle strength has a significant impact on the occurrence of low back pain in Bharatanatyam dancers. Strengthening the core through specific physiotherapy-based training can help minimize pain, enhance performance, and promote overall spinal health.

Keywords:
Core strength, Low back pain, Bharatanatyam dancers, Physiotherapy, Spinal stability, PBU, VAS.

INTRODUCTION

Bharatanatyam, widely regarded as one of the most ancient and distinguished classical dance forms originating in India, is celebrated for its precise and rhythmic sequences of movements that blend emotion, expression, and intricate footwork.[1,20] This dance form is characterized by a specific linear alignment of the body, often maintaining a half-sitting posture known as Araimandi (or Ardha Mandali) for extended periods, combined with structured geometric patterns and minimal upper body movement. Such demands necessitate a blend of flexibility, strength, balance, and control from the dancers [1]. The dynamic quality and disciplined rigor of Bharatanatyam require dancers to sustain labor-intensive positions, engage in repetitive complex movements, and demonstrate sustained muscular endurance, especially in the lower back and pelvic region. These demands, while enhancing artistic performance, place considerable biomechanical stress on the musculoskeletal system, especially on the lumbar spine and pelvic complex (1,3,18).

Studies have consistently highlighted that Bharatanatyam dancers are vulnerable to musculoskeletal disorders, with low back pain (LBP) ranking among the most common complaints affecting their functional capacity and performance quality^2,3. The persistent adoption of the Araimandi posture, involving a half-sitting squat with hips flexed and knees externally rotated, contributes to prolonged lumbar spine flexion and increased compressive load on the intervertebral discs [1,5]. This posture, as the foundation of many dynamic movements in Bharatanatyam, exposes dancers to risks of abnormal lumbar lordosis and anterior pelvic tilt, which may progressively alter their spinal biomechanics and

lead to pain or degenerative issues [1,6]. The flickering foot movements (Aligilas), turns (Kavitva), spins (Bhramari), and repeated jumps and landings compound the mechanical stress on the lower back, leading to acute and chronic injury risks[4,7].

Biomechanical analyses reveal that during Bharatanatyam movements such as Tatta Adavu (rhythmic foot tapping), dancers experience ground reaction forces up to 4-5 times their body weight. Such forces, coupled with inadequate conditioning or improper technique, elevate the chances of musculoskeletal strain, particularly in the lumbar spine and lower extremities. Further, the tradition of wearing ankle bells (ghungroos) adds to the repetitive loading on the ankle and foot complex, causing additional biomechanical challenges and contributing to postural instability and musculoskeletal fatigue among dancers [20].

The robust relationship between core muscle function and spinal health has gained increasing attention in the context of injury prevention and rehabilitation in dancers [10,11,16]. The core muscles—including the abdominals, erector spinae, multifidus, pelvic floor muscles, and diaphragm—function synergistically to stabilize the trunk, control spinal alignment, and absorb shock during high-demand movements [11,16]. Deficits in core strength or neuromuscular control can diminish the spine's ability to withstand mechanical loads, resulting in compromised posture, altered movement patterns, and increased susceptibility to low back pain [12]. Targeted core strengthening programs have demonstrated effectiveness in both reducing pain and improving functional outcomes in dancers, highlighting their central role in musculoskeletal health maintenance (10,13,14).

Additionally, improper technique, insufficient warm-up exercises, and lack of awareness about postural mechanics exacerbate the risk of injury in Bharatanatyam practitioners [5,15]. This underscores the necessity for integrating biomechanical insights and physiotherapy principles into dance training. Techniques borrowed from ballet and yoga, such as barre work and awareness of body alignment and symmetry, have been recommended to support dancers in acquiring strength, balance, and proper load distribution. Correcting faulty movement patterns early in training and ensuring adequate conditioning can mitigate long-term structural changes and chronic pain [14,15].

In parallel, the prolonged half-sitting Araimandi posture itself can induce significant musculoskeletal adaptations over time. Sustained compression of the lumbar spine and repetitive flexion movements may lead to structural modifications, such as increased lumbar lordosis or reduced intervertebral disc height, potentially causing chronic conditions like disc degeneration or facet joint arthropathy [1,3,6]. The compounding effect of these changes can diminish dancers' range of motion, endurance, and ultimately, their performance and quality of life [9,12].

Given these multiple factors—high mechanical loading during repetitive movements, sustained postures, and the critical role of core stability—it becomes imperative to emphasize comprehensive conditioning and rehabilitation approaches for Bharatanatyam dancers. These approaches should focus on enhancing core strength, correcting biomechanical faults, improving flexibility, and educating dancers about the importance of posture and musculoskeletal health (1,10,14,18).

In conclusion, the demanding physical requirements of Bharatanatyam, especially the maintenance of the Araimandi posture and execution of complex foot and trunk movements, predispose dancers to a heightened risk of low back pain. Core strength plays a pivotal role in maintaining spinal stability, managing mechanical loads, and preventing musculoskeletal injuries in this population. Bridging traditional dance practice with contemporary anatomical and biomechanical understanding will aid in developing effective preventive and therapeutic interventions that support dancers' health, longevity, and art form excellence [1,18].

NEED OF STUDY

The need for this study arises from the documented high prevalence of low back pain among Bharatanatyam dancers, which is attributed to the specific postures, movements, and techniques involved in this classical dance form. The Araimandi pose, along with rapid foot movements, spins, and repetitive jumps, places considerable mechanical stress on the lumbar spine, leading to a significant risk of low back pain that can impair dancers' functional abilities and performance quality. Core strength plays a vital role in maintaining spinal stability and distributing mechanical loads efficiently during these complex movements, thus acting as a key factor in the prevention and management of low back pain.

Understanding the correlation between core strength and low back pain in Bharatanatyam dancers is essential to guide targeted interventions. Strengthening the core muscles—which include the abdominals, back extensors, and pelvic floor muscles—can enhance spinal support, improve posture, and reduce injury risk. Investigating this relationship within the context of Bharatanatyam can inform the development of specific conditioning and rehabilitation programs to address this multifactorial issue specific to this population.

Despite evidence highlighting musculoskeletal problems in dancers generally, there is a significant gap in research focusing specifically on Bharatanatyam dancers. Existing literature tends to address injury prevalence and risk factors either broadly across various dance forms or within Western dance styles such as ballet or contemporary dance. The cultural, biomechanical, and postural demands of Bharatanatyam are distinct, necessitating study tailored to its unique attributes. This scarcity of research on Bharatanatyam dancers limits the ability to develop dance specific injury prevention protocols and rehabilitation strategies grounded in empirical evidence.

Therefore, this study aims to fill the knowledge gap by examining the core strength and its association with low back pain specifically in Bharatanatyam dancers, thereby contributing valuable insights for clinicians, physiotherapists, and dance educators to enhance dancer health and performance longevity.

METHODOLOGY

1. Study design- cross - sectional study
2. Targeted population - Bharatnatyam dancer in Pune
3. Sample size - 70

DISCUSSION

The present study aimed to measure core strength using a Pressure Biofeedback Unit (PBU) and assess low back pain and disability using the Modified Oswestry Disability Index (ODI) and Visual Analogue Scale (VAS) among Bharatnatyam dancers. The findings revealed that the majority of participants exhibited fair to weak core strength, with 14 participants showing good strength, 28 fair strength, and 28 weak strength. In terms of disability, 38 participants had moderate disability, while 32 reported minimal disability. A similar trend was observed in pain intensity where 36 participants experienced moderate pain and 34 mild pain. Correlation analysis indicated a very weak positive correlation between PBU Drop and ODI% ($r = 0.093$, $p = 0.446$) and no correlation between PBU Drop and VAS score ($r = 0.005$, $p = 0.965$), suggesting that core strength was not significantly associated with the level of disability or pain in this group.

These results suggest that although a reduction in core strength was present among many dancers, it did not strongly relate to their reported pain or disability levels. This could be due to compensatory strength of other stabilizing muscles, effective dance conditioning routines, or the high pain tolerance often developed by trained dancers. The findings indicate that factors other than core stability, such as

dance technique, training duration, or flexibility, may also play a major role in the development or prevention of low back pain in Bharatnatyam dancers.

Previous studies on classical dancers have shown mixed outcomes. Research by Roussel et al. (2009) and Sahoo and Singh (2020) highlighted that dancers often develop strong core endurance, which may protect against lumbar strain. Conversely, studies by Khan et al. (2018) and Shanmugam et al. (2021) reported that repetitive spinal movements and prolonged postures in Bharatanatyam could lead to muscle fatigue and back pain despite adequate conditioning. The weak correlation in the current study aligns with such findings, suggesting that low back pain among dancers may not be solely dependent on core strength, but rather on a complex interaction of biomechanical and training-related factors.

The study highlights the importance of individualized physiotherapy assessment and training programs for dancers. While maintaining core strength remains essential, comprehensive conditioning that includes postural training, flexibility work, and ergonomic education may be more effective in preventing and managing low back pain in Bharatnatyam performers. Dance instructors and physiotherapists can collaborate to integrate core stabilization and lumbar protection techniques into dance training regimes.

The study was limited by a small sample size and inclusion of only female participants from a specific dance style, which restricts the generalizability of the results. Additionally, the cross sectional design prevents establishing causality between core strength and low back pain. The use of subjective measures like VAS and ODI may also introduce reporting bias. Finally, training history, technique variations, and duration of dance practice were not controlled variables, which might have influenced the results.

CONCLUSION

The study concludes that core strength does not significantly influence the presence or severity of low back pain in Bharatnatyam dancers. Although many participants exhibited fair to weak core strength, this did not correspond to higher pain intensity or greater functional disability.

The findings suggest that low back pain in Bharatnatyam dancers is multifactorial, possibly influenced by prolonged postures, repetitive spinal movements, flexibility, technique, and endurance rather than core strength alone.

Therefore, preventive and rehabilitative strategies for Bharatnatyam dancers should focus on holistic training, incorporating postural correction, flexibility enhancement, endurance building, and overall conditioning, along with core strengthening to maintain spinal stability and reduce injury risk.

Although many dancers showed fair to weak core strength, this did not directly influence pain intensity or functional disability. These findings suggest that low back pain in classical dancers is multifactorial, emphasizing the need for holistic training and physiotherapy approaches that go beyond core strengthening alone.

DATA ANALYSIS

Data were entered into a Microsoft Excel spreadsheet and checked for completeness and accuracy before analysis. Statistical analysis was performed using GraphPad Prism (version 9.0) software. Descriptive statistics such as mean, standard deviation (SD), and range were calculated for continuous variables, while frequency and percentage were used for categorical variables.

The Shapiro–Wilk test was applied to check the normality of data distribution. Depending on the distribution pattern, either the Pearson's correlation coefficient (r) or the Spearman's rank correlation coefficient (ρ) was used to determine the relationship between core strength (measured using

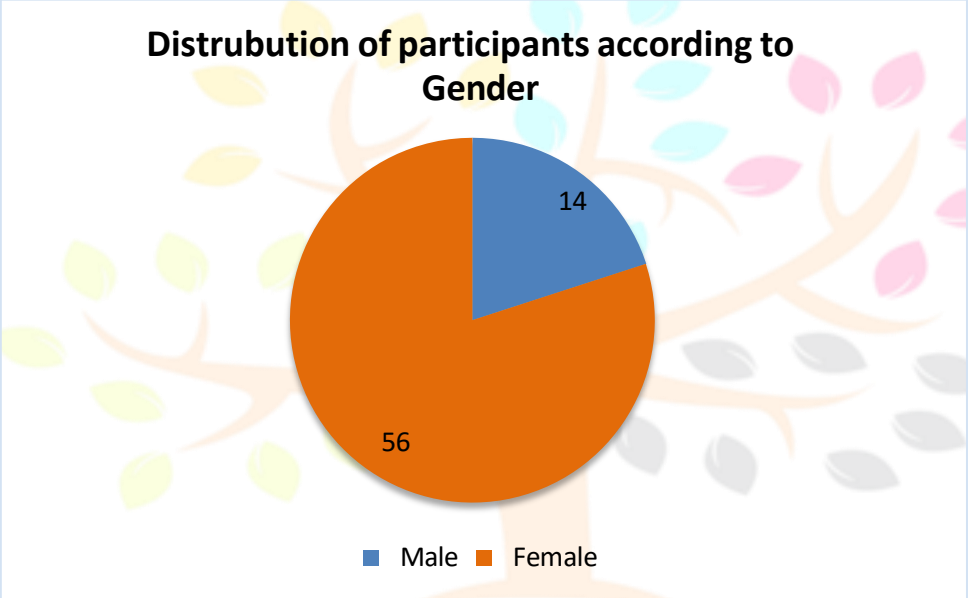
Pressure Biofeedback Unit) and low back pain/disability (measured using Visual Analog Scale and Modified Oswestry Disability Index) among Bharatanatyam dancers.

A p-value of less than 0.05 ($p < 0.05$) was considered statistically significant. All statistical results were presented in the form of tables and graphs for better interpretation and comparison.

Table no. 1 - Distribution of participants according to Gender

Gender	No. of Participants
Male	14
Female	56

Graph no. 1 - Distribution of participants according to Gender



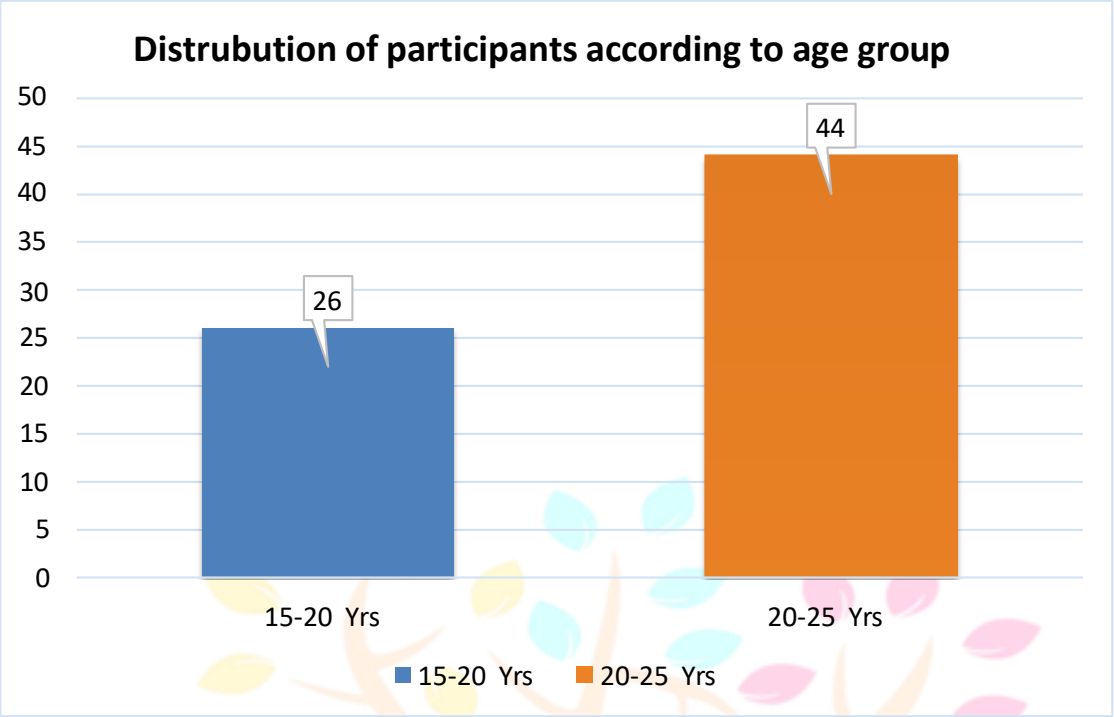
Interpretation –

According to the data, 14 participants (20%) were male and 56 participants (80%) were female. This shows that the majority of the participants were female Bharatnatyam dancers, reflecting the predominance of females in this classical dance form

Table no. 2 Distribution of participants according to age group.

Age Group	No. of participants
15-20 Yrs	26
20-25 Yrs	44

Graph no. 2 - Distribution of participants according to age group.



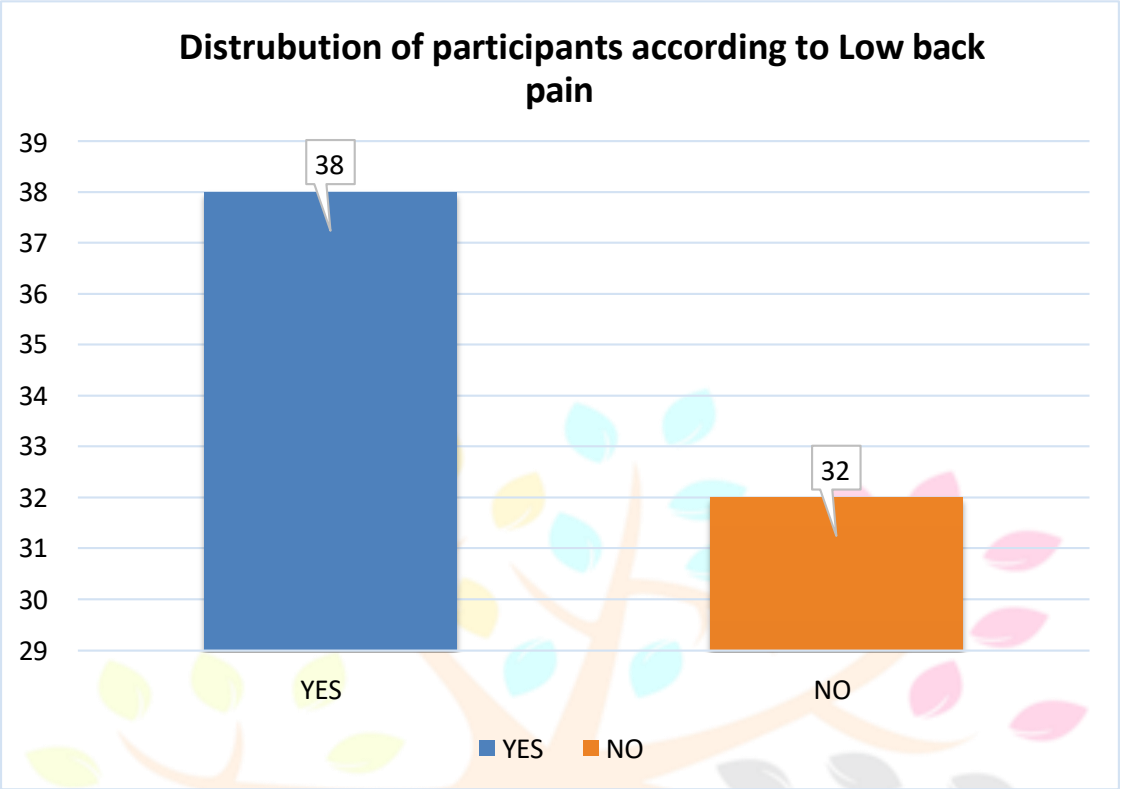
Interpretation

According to the data, 26 participants (37%) belonged to the 15–20 years age group, while 44 participants (63%) were in the 20–25 years age group. This indicates that the majority of the participants were young adults between 20 and 25 years, suggesting that most Bharatnatyam dancers in the study were in their active and advanced training phase.

Table no. 3 Distribution of participants according to low back pain

Yes/No	No. of Participants
YES	38
NO	32

Graph no. 3 - Distribution of participants according to low back pain



Interpretation –

According to the data, 38 participants (54%) reported experiencing low back pain, while 32 participants (46%) did not report any pain. This indicates that more than half of the Bharatnatyam dancers experienced low back pain, suggesting a higher prevalence of back discomfort possibly due to the repetitive movements and postural demands of Bharatnatyam dance.

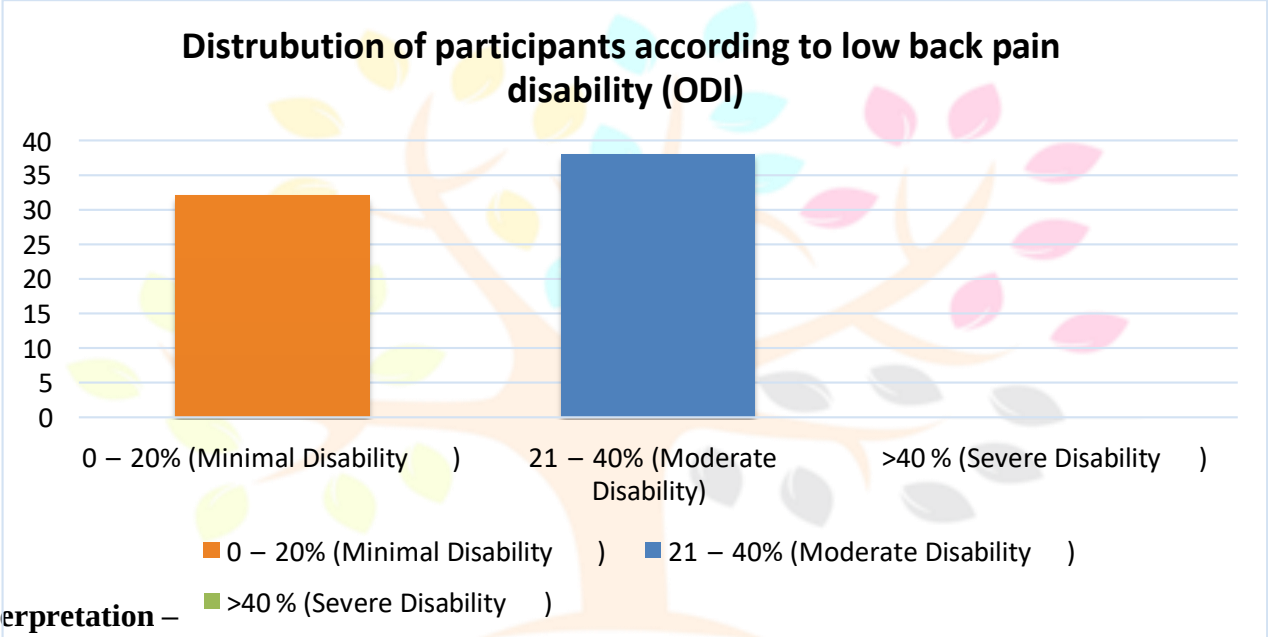
Table no. 4 Distribution of participants according to Core strength (PBU Drop (mmHg))

PBU Drop (mmHg)	No. of Participants
0 – 2 mmHg	14
3 – 5 mmHg	28
6 – 8 mmHg	28

Table no. 5 Distribution of participants according to low back pain disability (ODI)

ODI (%)	No. of Participants
0 – 20% (Minimal Disability)	32
21 – 40% (Moderate Disability)	38
>40% (Severe Disability)	0

Graph no. 5 - Distribution of participants according to low back pain disability (ODI)



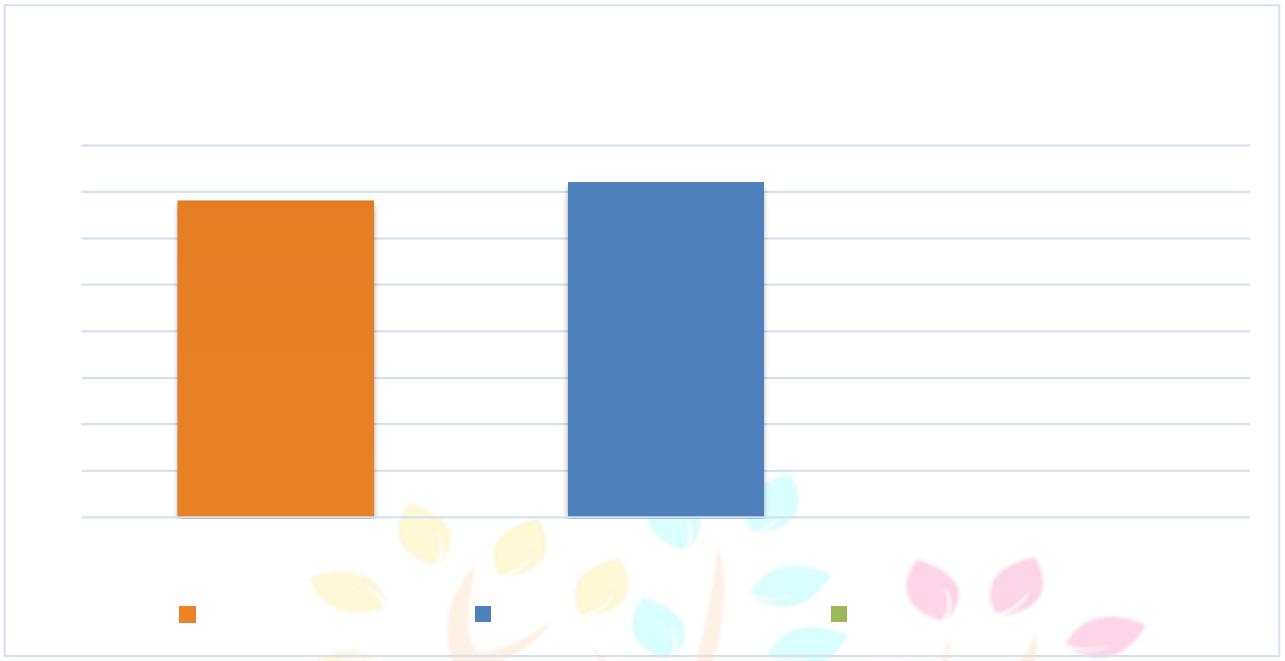
Interpretation –

According to the data, 32 participants (46%) had minimal disability with an ODI score between 0–20%, while 38 participants (54%) had moderate disability with an ODI score between 21– 40%. None of the participants showed severe disability (>40%). This indicates that the majority of Bharatnatyam dancers experienced moderate functional limitations due to low back pain, suggesting that core weakness and repetitive dance movements may contribute to a moderate level of disability in this group.

Table no. 6 Distribution of participants according to low back pain intensity

VAS Score	No. of Participants
0 – 3 (Mild Pain)	34
4 – 6 (Moderate Pain)	36
7 – 10 (Severe Pain)	0

Graph no. 6 - Distribution of participants according to low back pain intensity



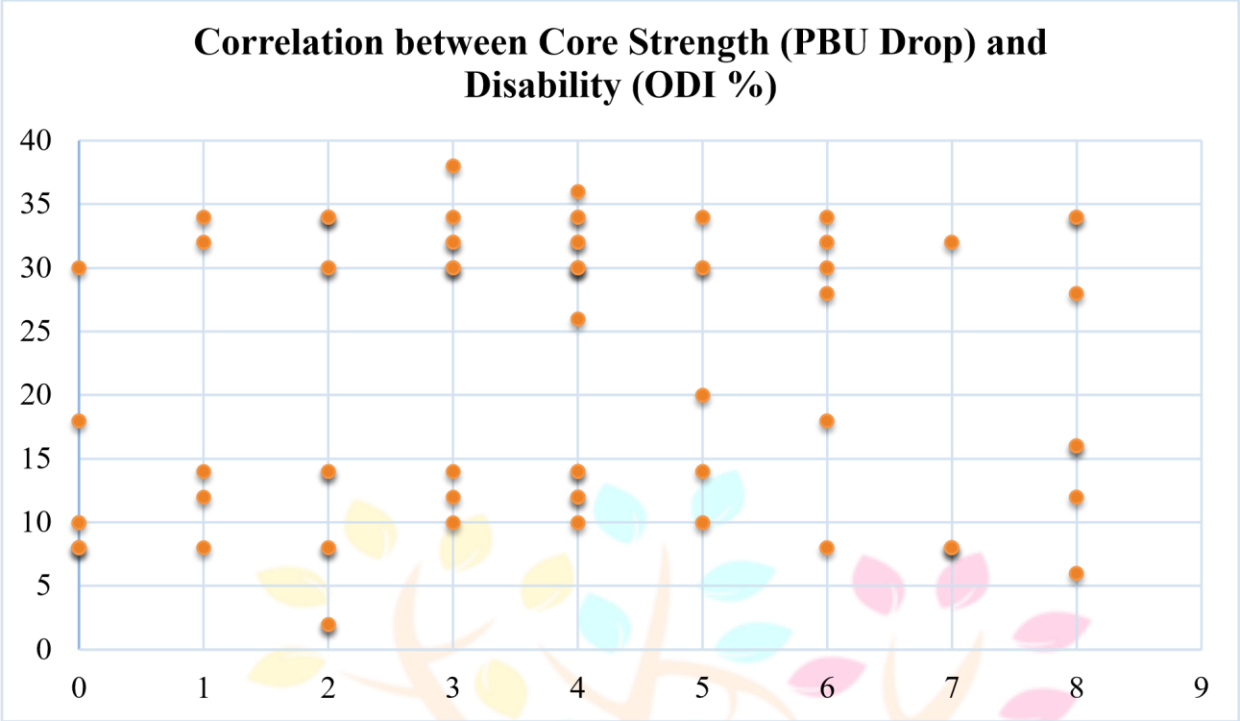
Interpretation –

According to the data, 34 participants (49%) reported mild pain with VAS scores between 0–3, while 36 participants (51%) experienced moderate pain with VAS scores between 4–6. None of the participants reported severe pain (7–10). This indicates that the majority of Bharatnatyam dancers experienced mild to moderate levels of low back pain, suggesting that although the pain was present, it was generally not severe enough to cause major functional limitations.

Table no. 7 Correlation between Core Strength (PBU Drop) and Disability (ODI %)

Correlation Pair	Pearson's r	p-value	Interpretation
PBU Drop (mmHg) vs ODI %	0.093	0.446	Very weak positive correlation (not significant)

Graph no. 7 - Correlation between Core Strength (PBU Drop) and Disability (ODI %)



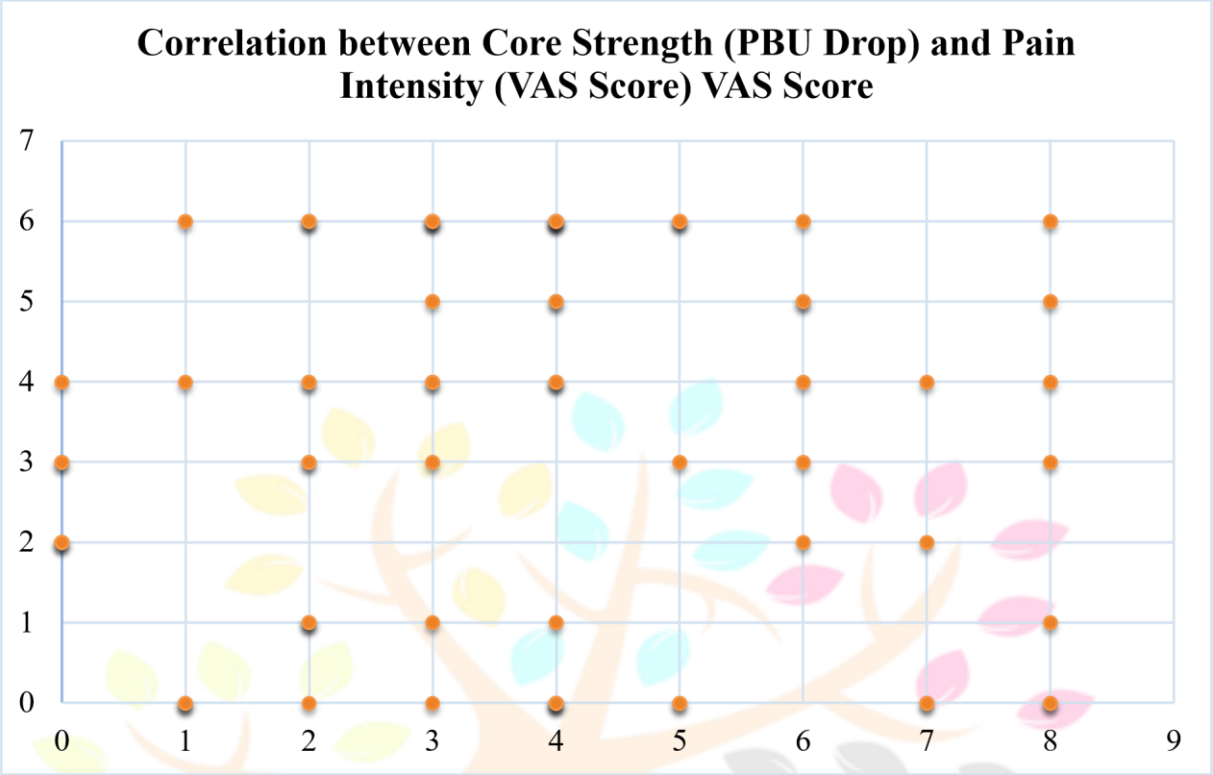
Interpretation –

The correlation between PBU Drop (mmHg) and ODI % shows a Pearson's r value of 0.093 with a p-value of 0.446, indicating a very weak positive correlation that is not statistically significant. This suggests that core strength (measured by PBU drop) has no meaningful relationship with the level of low back pain disability (ODI %) among Bharatnatyam dancers in this study.

Table no. 8 - Correlation between Core Strength (PBU Drop) and Pain Intensity (VAS Score)

Correlation Pair	Pearson's r	p-value	Interpretation
PBU Drop (mmHg) vs VAS Score	0.005	0.965	No correlation (not significant)

Graph no. 8 - Correlation between Core Strength (PBU Drop) and Pain Intensity (VAS Score)



Interpretation –

The correlation between PBU Drop (mmHg) and VAS Score shows a Pearson's r value of 0.005 with a p-value of 0.965, indicating no correlation and that the result is not statistically significant. This implies that core strength (PBU Drop) does not have any observable relationship with the pain intensity (VAS Score) among Bharatnatyam dancers in this study.

RESULTS

The present study was conducted to examine the relationship between core strength and low back pain among Bharatnatyam dancers. Core strength was assessed using a Pressure Biofeedback Unit (PBU), while pain and disability were evaluated using the Visual Analogue Scale (VAS) and the Modified Oswestry Disability Index (ODI).

The findings showed that most participants had fair to weak core strength. Based on the PBU readings, 14 participants demonstrated good core strength, 28 had fair strength, and 28 exhibited weak core strength.

Regarding pain and disability, 38 participants reported moderate disability and 32 had minimal disability on the ODI scale. Similarly, 36 dancers experienced moderate pain intensity, while 34 reported mild pain on the VAS scale.

The correlation analysis revealed a very weak positive correlation between PBU Drop and ODI % ($r = 0.093$, $p = 0.446$) and no correlation between PBU Drop and VAS Score ($r = 0.005$, $p = 0.965$). These results were statistically not significant, indicating that there is no meaningful relationship between core strength and the severity of low back pain or disability among the studied group.

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