WebLog Journal of Physical Therapy and Rehabilitation

Research Article
Published: 03 Mar, 2026

Correlation Between Core Muscle Endurance and Dynamic Balance in Silambam Practitioners

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Abstract

Background: Silambam is a conventional Indian marital art that demands high levels of posture control, core stability and dynamic balance due to its high velocity directional shifts and complex movement pattern. core muscle endurance plays a ciritical role in perceiving trunk stability, which may directly impact dynamic balance performance in athelets.

Objective: To evaluate the relationship between core muscle endurance and dynamic balance among silambam practitioners.

Methods: A correlation-based study design was conducted among 30 competitive silambam participants with age of 15- 25 years with a minimum of 1 year of regular training experience. Core muscle endurance was evaluated using the plank test and side plank test, while dynamic balance was evaluated using the Y balance test and star excursion test. The descriptive statistical analysis was used to summarize the data, and Pearson's correlation coefficient was employed to analysis the relationship between core muscle endurance and dynamic balance.

Result: The findings indicated a statistically significant positive correlation between core muscle endurance and dynamic balance performance ($p<0.05$), indicating that participants with higher core endurance demonstrated superior dynamic balance.

Conclusion: The study conclude that core muscle endurance is statistically significantly associated with dynamic balance in silambam practitioners. Implementing structured core endurance training may improve balance performance and potentially reduced injury risk in population.

Keywords: Core Muscle Endurance; Dynamic Balance; Silambam Practitioners; Plank Test; Y Balance Test; Star Excursion Test; Trunk Stability; Marital Art Performance

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Received Date: *30 Jan 2026*
Accepted Date: *02 Mar 2026*
Published Date: *03 Mar 2026*

Citation:
Sappani Muthu M, Nisarudeen M. Correlation Between Core Muscle Endurance and Dynamic Balance in Silambam Practitioners. WebLog J Phys Ther Rehabil. wjptr.2026.c0306. https://doi.org/10.5281/zenodo.19068139

Introduction

Silambam is one of the oldest and traditional art of India which originated in Tamil Nadu. It is mainly using a long bamboo stick which has been practices many countries. It primarily involves a coordinated hand movements, flexibility, agility and good body control. Unlike other sports rather than silambam trains whole body by combining strength, endurance, balance and coordination in a single activity. While practicing silambam, the performer has to maintain proper posture and balance while performing fast movements, rotations and single leg positions. Therefore, physical factors such as core muscle endurance and dynamic balance are most important for good performance and injury prevention.

Core muscle is the support and stabilizes the trunk and pelvis. These muscles include rectus abdominals, transverse abdominals, internal and external oblique, erector spine, multifidus, pelvic floor muscles and the diaphragm. These muscles work together to connect upper and lower parts of the body. Core muscle endurance indicates that the ability of these muscles to work continues for a long time without getting tired. In dynamic balance, sports like silambam enhance good core endurance helps in maintaining posture, controlling movements and transferring force during sessions like competition or practice.

Dynamic balance is the ability to maintain body stability while the body is moving or position changing. It depends on the proper functioning of the visual system, vestibular system and proprioceptive system along with good muscle control. In silambam, performers often perform spins,

lunges, jumps and fast weight shifts while holding and controlling the stick. All these movements highly need on dynamic balance.

Many studies in different sports like football, gymnastics have shown a relationship between core muscle endurance and balance. A strong and enduring core muscle is stable base for limb movements. The balance, movement control can be affected due to core muscles are fatigue, it can decrease the performance and high peak in injury. Therefore, the relationship between core muscles and dynamic balance is most essential for better training program and risk of injury prevention.

Silambam is a physically demanding art that needs continuous use of core muscles to stabilize trunk during fast and rapid movements. while performing this movement, they must maintain stable spine and proper posture. Good core muscle strength allows the body to maintain proper posture for longer time and transferring force from the legs to the arms through trunk. While poor endurance leads to early easily fatigue, reduced balance during silambam matches.

Dynamic balance in silambam is demand due to fast rotation, uneven stances and the additional load of the stick. Many techniques are performed on a narrow base or on one leg. Good dynamic balance helps to maintain control, perform movements smoothly. Poor balance leads to increase risk of falls and lower limb injuries.

Several studies concluded that athletes with better core endurance have better balance and postural control. Core endurance training leads to improve balance, agility and overall functional performance. Physiotherapy plays an important role in improving sports performance, injury prevention and helps in rehabilitation. Understanding the relationship between core muscle endurance and dynamic balance can help physiotherapists to plan specific exercise program. this program improves posture, performance and movement control and reduce the injuries. the result shows may also support the sport specific training methods of arts.

Although silambam is becoming a traditional sport and physical activity, scientific research related to silambam is still limited. The relationship between core muscle endurance and dynamic balance in silambam practitioners will understand the physical needed of this art and provide a base of future research.

The aim of this study is to find the relationship between core muscle endurance and dynamic balance in silambam trainers. Core muscle endurance will be assessed by standard endurance test and dynamic balance will be assessed by functional balance test. The study will determine better core endurance is associated with better dynamic balance.

In conclusion, core muscle endurance and dynamic balance is essential for good performance in silambam. The dynamic and continuous movements of the traditional game place an increase need on trunk balance and stability. Studying the relationship between these factors will improve training methods and rehabilitation strategies.

Aim of the Study

The aim of the study to determine the "correlation between core muscle endurance and dynamic balance in silambam practitioners".

Need for the Study

Silambam requires high level of dynamic balance and core muscle stability for effective performance and to prevent the injuries. To making this study as necessary because there is limited scientific evidence exists on the relationship between the core muscle endurance and dyanamic balance in silambam practitioners**.**

Statement of the Study

The study on "Correlation between core muscle endurance and dynamic balance in silambam practioners**".**

Objective of the Study

- To assess core muscle endurance in silambam practitioners.
- To assess dynamic balance in silambam practitioners.
- To determine the correlation between core muscle endurance and dynamic balance among silambam practitioners**.**

Hypothesis

Null Hypothesis

There is no significant correlation between core muscle endurance and dynamic balance among silambam practitioners**.**

Alternative Hypothesis

There is a significant correlation between core muscle endurance and dynamic among silambam practitiors.

Review of Literature

Co-relationships between core endurance, hip strength and balance in athletes

D. P. Bhura et al.,

2023

This study examined the co-relationships between core endurance, hip strength, and balance in 50 athletes. Core endurance was assessed using the Plank Test (seconds), hip strength with a hand-held dynamometer (kg), and balance using the Y-Balance Test (cm reach distance). Pearson's correlation revealed a significant positive relationship between core endurance and balance ($r = 0.62$, $p < 0.01$), hip strength and balance ($r = 0.58$, $p < 0.01$), and core endurance with hip strength ($r = 0.54$, $p < 0.05$), indicating that athletes with stronger core and hip muscles demonstrate better balance. These findings support incorporating core and hip strengthening in athletic training to enhance postural stability and performance

Relationship between core muscle strength and dynamic balance among hospital staff

Nawaf Almutairi et al

2022

The study **"Relationship between core muscle strength and dynamic balance among hospital staff"** found a **positive association** between core muscle strength and dynamic balance in 27 healthy male hospital employees. Core strength measured by the plank test showed **weak to moderate significant correlations** with several Modified Star Excursion Balance Test reach directions, especially the anterior and composite scores, while no relationship was seen in posterolateral reaches. The results suggest that **better core strength supports improved dynamic balance**, although the relationship varies by movement direction

Correlation of core stability with balance, agility and upper

limb power in badminton players: a cross-sectional study

Sohel Ahmed, et al

2021

The study examined how **core stability relates to balance, agility, and upper limb power** in 36 male professional badminton players (mean age 21.19 ± 1.95 years), measuring core stability with **stabilizer pressure biofeedback**, dynamic balance with the **Y Balance Test**, agility with the **T-test**, and upper limb power using a **medicine ball throw**; results showed **significant positive correlations between core stability and dynamic balance** for both right and left legs ($r \approx 0.460$), a **significant negative correlation between core stability and agility time** ($r = –0.579$), and a **fair positive but non-significant correlation with upper limb power**, indicating that better core stability is linked to improved balance and agility performance and may also relate to upper limb power in badminton players.

Effects of core training on dynamic balance stability: A systematic review and meta-analysis

2022

Ekaitz Dudagoitia Barrio et al,

Core stability strongly influences dynamic balance stability (DBS). This meta-analysis reviewed 13 studies (10 in the meta-analysis; 226 participants) to examine core training effects on DBS. Core training showed a moderate positive effect (ES = 0.634, $p < 0.001$), with greater improvements in interventions ≤6 weeks (ES = 0.714), high-volume and frequent sessions (ES = 0.787), and younger participants ≤18 years (ES = 0.832). Bodyweight exercises were more effective than medicine ball, Swiss ball, or band-resisted exercises. Core training enhances DBS in athletes and non-trained populations by creating a stable base for better lower extremity movement. Optimal effects occur with ≤6-week programs, >2 sessions/week, >17 total sessions, bodyweight exercises, and younger participants.

Correlation of Core Strength with Agility and Dynamic Balance in College-Level Kabaddi Players

Zeel Chauhan et al,

2025

This study on 40 college Kabaddi players examined the correlation of core strength with agility and dynamic balance. Core strength was measured by the Plank Test, agility by the Illinois Agility Test, and balance by the Y-Balance Test. Pearson's correlation showed core strength was positively related to balance ($r = 0.68$, $p < 0.01$) and inversely related to agility time ($r = -0.55$, $p < 0.05$), suggestimg stronger core improve both balance and agility.

Effect of Instability Resistance Training on Core Muscle Strength among Athletes: A Systematic Review

Jianxin Gao et al.,

2024

This study examined the co-relationships between core endurance, hip strength, and balance in 50 athletes. Core endurance was assessed using the Plank Test (seconds), hip strength with a hand-held dynamometer (kg), and balance using the Y-Balance Test (cm reach distance). Pearson's correlation revealed a significant positive relationship between core endurance and balance ($r = 0.62$, $p < 0.01$), hip strength and balance ($r = 0.58$, $p < 0.01$), and core endurance with hip strength ($r = 0.54$, $p < 0.05$), indicating that athletes with stronger core and hip muscles demonstrate better balance. These findings support incorporating core and hip strengthening in athletic training to enhance postural stability and performance.

The Reliability of the star excurtion balance test and lower quarter Y balance test in healthy adult: Systematic review

C. Powden et al.,

2019

This systematic review examined the reliability of the Star Excursion Balance Test (SEBT) and the Lower Quarter Y-Balance Test (YBT-LQ) in healthy adults. Multiple studies were analysed to evaluate intra-rater, inter-rater, and test–retest reliability. Results showed that both tests demonstrate good to excellent reliability (Intraclass Correlation Coefficient, ICC = 0.75–0.99), with the Y-Balance Test being more time-efficient and easier to standardise. These findings support the use of SEBT and YBT-LQ as reliable tools for assessing dynamic balance in healthy adults.

Exploring the role of the core in sports performance: a systematic review of the effects of core muscle training

Juan Sebastian Bustos Carvajal et.al

2025

This systematic review explored the role of core muscles in sports performance by analysing the effects of core muscle training across multiple studies. Evidence indicates that core training significantly improves dynamic balance, stability, agility, and trunk endurance, which in turn enhances sport-specific performance. Interventions using bodyweight, Swiss ball, or resistance exercises demonstrated moderate to large effects (ES = 0.50–0.83), particularly in younger or less-trained athletes. Overall, core muscle training is a valuable component of athletic conditioning programs to optimise performance and reduce injury risk.

The Relationship Between Core Muscle Endurance, Dynamic Balance, and Some Physiological Factors in Young Football Players with Genu Varum

Mohammad Seyedahmad, et al

2024

The study investigated how genu varum (bow-legged alignment) affects core muscle endurance, dynamic balance, and other physiological performance factors in 42 young male football players (21 with genu varum and 21 without), using the Y Balance Test to assess dynamic balance, the McGill Side Plank Test for core muscle endurance, the Sargent Jump Test for lower body strength, the 9×4 m agility test for agility, and a 36-meter sprint for speed; results showed that players with genu varum had significantly lower dynamic balance in all directions (anterior, posterior-medial, posterior-lateral), reduced core endurance, weaker lower body strength, slower sprint speed, and poorer agility compared to those without the condition, indicating that genu varum negatively influences balance, core endurance, and key athletic performance components.

Effects of Short-Term Core Stability Training on Dynamic Balance and Trunk Muscle Endurance in Novice Olympic Weightlifters

Rafał Szafraniec et.al

2020

This study examined the effects of short-term core stability training balance ($p < 0.01$) and trunk endurance ($p < 0.01$), suggesting that even short-term on dynamic balance and trunk muscle endurance in 30 novice Olympic weightlifters. Participants completed a 4-week core program, 3 sessions per week. Outcomes measured with the Y-Balance Test and Plank/Side-Plank Tests showed significant improvements in dynamic core training enhances balance and core strength in beginner weightlifters.

Effect of Silambam Practice on Body Composition, Agility and Cardiovascular Endurance among College Girls

Mohanavalli P et.al

2013

This study examined the effect of Silambam practice on body composition, agility, and cardiovascular endurance in 30 college girls. Participants practised Silambam for 6 weeks, 3 sessions/week. Results showed significant improvements in body composition (reduced body fat, $p < 0.05$), agility (Illinois Agility Test, $p < 0.01$), and cardiovascular endurance (12-minute run, $p < 0.01$), indicating that Silambam can enhance physical fitness components in young females.

Core Endurance Relationships with Athletic and Functional Performance in Inactive People

Marta Silva Santos et.al

2019

This study investigated the relationship between core endurance and athletic and functional performance in 40 inactive adults. Core endurance was measured using the Plank and Side-Plank Tests, while athletic performance was assessed with agility (Illinois Agility Test) and functional performance with Y-Balance Test. Pearson's correlation revealed significant positive relationships between core endurance and dynamic balance ($r = 0.61$, $p < 0.01$) and a moderate negative correlation with agility time ($r = -0.53$, $p < 0.05$), indicating that stronger core endurance is associated with better balance and faster functional movement even in inactive individuals.

Design and Methodology

Study Design

This study is cross sectional correlational study.

Study Setting

The study will conducted at TAMILAR POORKALAI SILAMBAM centre in TIRUNELVELI.

Study Population

The study population includes male silambam practitioners who involved in 1 year of regular silambam practice.

Sample Size

30 silambam practitioners with 1-year regular practice.

Sampling Method

Convenience sampling technique will be used.

Creteria for Selection

Inclusion Creteria

- Male silambam practioners.
- Age between 15 -25 years.
- Minimum 1-year silambam practitioners.
- Willing to participate in the study.

Exclusion Criteria

Histroy of recent musculoskeletal injury (last 6 months).

- Female silambam practitioners.
- Neurological or balance disorders.
- Recent surgery or acute pain.
- Any condition that affects the balance or core function.

Outcome Measure

Core Muscle Endurance

- Plank test.
- Side plank test.

Dynamic Balance

- Y balance test.

Variables of Study

Independent Variable

- Core muscle endurance.
- Assesed by plank test, side plank test.

Dependent Variable

- DYNAMIC BALANCE: Y balance test.

Procedure

Ethical Approval & Consent

The study procedure was explained to all the participants and written inform consent was given.

Study Setting & Participants

The study was conducted at TAMILAR PORKALAI Silambam training centers.

Healthy Silambam practitioners aged 15–25 years with a minimum of 1 year of regular practice.

Participant Preparation

Demographic data such as age, height, weight, training experience, and leg dominance were recorded. Participants were instructed to wear comfortable sports attire and perform a 5–10 minute warm-up before testing.

Participants were assessed for

- Core muscle endurance
- Dynamic balance

Measurement of Core Muscle Endurance

Core muscle endurance was assessed using:

- Plank Test

- Side plank test

For the plank test

Equipment Required

- Stopwatch
- Exercise mat

Participant Position

- Prone lying on the mat
- Elbow flexed to 90degree, postioned under shoulder
- Forearm resting on mat, palm facing down
- Legs extended with toe supporting the body
- Body aligned should be straight from head to heel

Procedure

- Participant should be in correct plank position
- On command "start" the subject lift the body off the mat
- Maintain the plank position straightly as long as possible.
- Stopwatch starts when correct position achieved
- The test end when the participant move from plank position, voluntarily stops.
- Record the total holding time in seconds.

Scoring

Score= maximum time (in seconds) the position held correctly.

Normal Value

- Untrained adult: 30-90 seconds
- Trained participant: 90- 240 seconds

Data Recording

Data was recorded in assessment sheet.

For the side plank test

Equipment Required

- Exercise mat
- Stopwatch

Participant Position

- Side lying position on the mat
- Elbow of the lower arm is placed directly under the shoulder (90-degree elbow flexion)
- Legs fully extended, feet stacked one over other
- Upper arm rest along the body or on the hip
- Head, trunk, and legs should be in straight line.

Procedure

- On the command "start", the Participant lift the pelvis off the mat
- Body should maintain straight from head to heel
- Participant should hold that position
- Stop watch must be started after the participant in correct position
- The test should be stopped wheather any changes in the position
- Same for procedure for opposite side

Scoring

Score = time (seconds) position held correctly

The average value of each side in seconds should be noticed.

Rest Interval

2-minute rest between sides.

Normal Value

- Normal adult: 60 – 75 seconds
- Trained participant: 90-120 seconds

Notice:

Difference between right and left should be greater than or equal to 5 % -10%.

A difference may indicate lateral core weakness.

Data Collection

The collected should be marked on the assessment sheet.

The average value between two sides should be recorded.

Measurement of Dynamic Balance:

Dynamic balance was assessed using the

- Y balance test

For the Y balance test

Test Direction

- Anterior
- Posteromedial
- Posterolateral

Equipment Required

- Y balance test kit or measuring tape
- Marker
- Tape measure marked in Y shape

Test Position

- Participants stand on barefoot
- Stance foot placed at center
- Hands on hip
- Non stance leg reaches in 3 directions
- Stance heel remains flat.

Procedure

- Measure limb length – ASIS to medial malleolus
- Provide practice trail (3 direction)
- Perform 3 record trails in each direction

- The subject lightly pushes the reach indicator and returns to start.
- Record the maximum.

Scoring

- Normalized reach distance =reach distance (cm) / limb length (cm) multiplies by 100
- Composite score = anterior + posterolateral+ posteromedial / 3 *limb length
- Composite score is < 94 % → increase risk of injury
- Anterior reach asymmetry > 4cm → increase risk of injury
- Side to side difference >4cm → clinically significant

Rest Intervals and Safety

- 30 -60 seconds rest was given between test
- Testing stopping if pain, fatigue or dizziness occurred
- All measurements were taken by the same examiner to reduce bias

Data Recording

Data was recorded.

Mean value was entered in assessment sheet.

Statistical Analayis

Correlation between core muscle endurance and dynamic balance in 30 silambam practitioners with 1 year of regular silambam practice.

n= 30 participants.

See Table 1.

Correlation

See Table 2.

SCATTER PLOTS

Y BALANCE – SIDE PLANK

See Figure 1.

Y BALANCE TEST – PLANK TEST

See Figure 2.

Result

The findings indicated a statistically significant positive correlation between core muscle endurance and dynamic balance performance ($p<0.05$), indicating that participants with higher core endurance demonstrated superior dynamic balance.

Limitations of the Study

- The study was conducted by the limited number of practitioners and that may affect the generalizing ability of the results to the entire population of the practitioners.
- Participants were selected from single team silambam members.
- The study included only the silambam practitioner
- Cross- sectional design prevents casual inference.
- Field based tests may not assess deep core muscles accurately.
- Fatigue, training load, and motivation were not controlled.

Table 1:

Descriptive Statistics			
	Y BAL	PLANK	S. PLANK
Valid	30	30	30
Missing	0	0	0
Mean	94.19	131.8	86.25
Std. Deviation	4.704	20.95	12.12
Shapiro-Wilk	0.974	0.969	0.983
P-value of Shapiro-Wilk	.657	.524	.897
Minimum	86.00	95.00	63.50
Maximum	103.0	170.0	109.0

Table 2:

Pearson's Correlations				
			Pearson's r	p
S. PLANK	-	Y BAL	0.989	< .001
Y BAL	-	PLANK	0.991	< .001

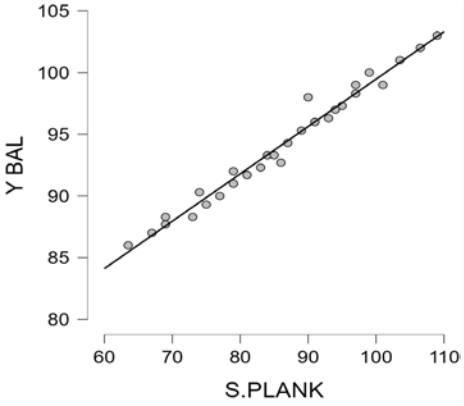

Figure 1:

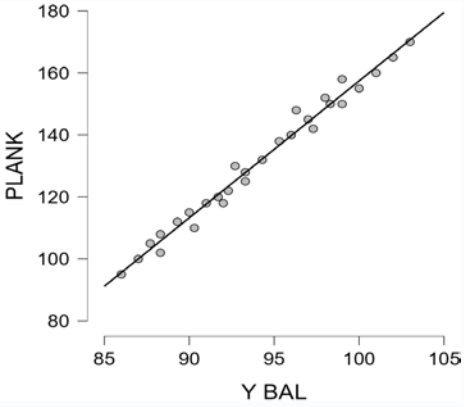

Figure 2:

Recommendations

- Include a larger and diverse sample in future studies.

- Apply longitudinal and global study approaches.
- Include more objective outcome measurement tool such as electromyography etc.
- Implement structured core endurance training programs.
- Integrate core stability exercises into regular silambam training.

Discussion

The current investigated the relationship between core muscle endurance and dynamic balance among silambam practitioners. The study demonstrated a significant positive correlation, indicating that practitioners with greater core endurance revealed superior dynamic balance. This aligns previous literature proposing that a strong and maintained core endurance supports trunk stability, which is essential for performing high velocity, complex directional movement typical of martial arts. Enhanced core endurance likely promotes improved motor control, proprioception and postural alignment adjustments, contributing to optimal balance performance. These results highlight the significant of intergrating focused core strengthing exercise in training regimens for silambam athelets. Furthermore, improving core endurance may reduce the risk of lower limb injuries by providing a stable base for multidirectional movements. Limitation of the study include a small size and the cross-sectional study design, which constrains causal. Further longitudinal studies with larger participants groups are warranted to further explore the impact of core training on dynamic balance and performance outcome.

Conclusion

The present study concludes a significant relationship between core muscle endurance and dynamic balance in silambam practitioners. Participant with better performance in core endurance tests (plank and side plank) also showed higher scores in Y balance test, indicating that strong core muscles enhance postural stability, coordination, and dynamic balance, these are essential for marital arts performance.

Core muscle endurance helps to control the trunk and pelvic during dynamic movements, used to enable the participant to maintain balance. The result highlights the core muscle endurance can directly enhance balance and reduce risk of injury during training. These findings used to improve the core strength exercise into silambam training program used to improve their fitness.

In conclusion, core muscle endurance is the fundamental factor influence dynamic balance, highlighting the need for core focused training in marital arts and other sports requires stability and coordination.

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