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Star Excursion Balance Test and Leg Length in 6 to 14 Years Old School Children: A Correlational Study

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Abstract: ***Introduction: Balance is essential in many daily activities. The Star Excursion Balance Test (SEBT) is a simple, rapid, and affordable test that can be used in clinical and field settings to evaluate lower limb dynamic balance, monitor recovery, evaluate post-injury deficits, and identify athletes at high risk for lower extremity injuries. Many factors may affect the excursion distance such as muscle strength, leg length, height. This correlational study has been conducted to establish the relationship between values of SEBT and leg length for the purposes of injury prevention and rehabilitation in school-going children. Methodology: After ethical approval total 1308 children of 6 and 14yrs age from various schools were selected via simple random sampling. Both boys and girls with normal range of motion in lower extremity. Leg length was assessed by measuring tape from ASIS to Medial Malleolus. Participants with a history of lower extremity deformity, spinal dysfunction, recent surgery, ankle trauma, dizziness/vertigo, pre-existing inner ear disorder, visual loss, and any else affecting balance control were all excluded. Each child performed SEBT in all 8 directions with barefoot for right and left leg. Data analysis: Data was analysed using Software IBM SPSS 20. Descriptive statistics was used to obtain normative values. Conclusion: There is positive correlation between Leg length and SEBT distance. Both height and leg length has an effect on excursion distance on right and left. As leg length increases the SEBT excursion distance increases. Many factors may affect the excursion distance such as muscle strength, leg length, height.***

Keywords: SEBT, Leg length, Excursion, Correlation

1. Introduction

The Star Excursion Balance Test (SEBT) is a simple, rapid, and affordable test that can be used in clinical and field settings to evaluate lower limb dynamic balance, monitor recovery, evaluate post-injury deficits, and identify athletes at high risk for lower extremity injuries. This correlational study has been conducted to establish the relationship between values of SEBT and leg length for the purposes of injury prevention and rehabilitation in school-going children.(1, 2)

Postural control in children in stage like progression based on various systems involvement. Standing balance is regulated by a complex mix of systems, including the visual, vestibular, somatosensory, and musculoskeletal systems. (3,4)3-5 The ability of maintaining balance is influenced by complexity of various sensory inputs from visual, somatosensory and vestibular systems, strength, rage of motion (5)

Often maintaining balance requires functional task of compromising base of support. Few of the test assess the healthy, athletic pediatric population challenging dynamic postural control. (6)To assess dynamic postural control star excursion balance test has shown the reliability and validity(6,7) The research has shown evidence that SEBT is sensitive for musculoskeletal impairments, ankle instability, lack of strength in quadriceps. Similarly it has been shown that various anthropometric measurements play integral part in dynamic balance(3) This test requires maximizing lower extremity reach distance with one leg whereas maintaining balance on another leg. For reaching maximum distance factors such as height, leg length, hip ROM, Knee strength, weight and many other playsintegral role.

This correlational study has been conducted to establish the relationship between values of SEBT and leg length for the purposes of injury prevention and rehabilitation in school-going children.

2. Methodology

An ethical approval from the Institutional Ethics Committee (IEC) was obtained before the study began, and a simple random sampling was used to select the samples. This Correlational study measured the excursion values of SEBT from school-going children aged between six and fourteen in Loni, Ahmednagar, India between December 2021 and February 2023.

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The participants were school-going children between the ages of 6 and 14 with normal ranges of motion at their hips, knees, and ankles. Participants with history of lower extremity deformity, history of spinal dysfunction, recent surgery history of ankle trauma requiring medical attention within the previous two years, history of any dizziness or vertigo, a pre-existing inner ear disorder, a pre-existing bone or joint abnormality, participants with visual loss, and anyone else with conditions that could negatively affect balance control were all excluded from the study.

Total of 1350 school-aged children were screened and 1308 participants agreed to participate and signed the informed consent form, which includes permission to use their data and photographs for presentation and publication purposes, in their preferred language of Marathi, Hindi, or English. There were 444 males and 864 females among them. On the floor, a star-like pattern was drawn with lines 45 degrees apart in the following eight directions: anterior (A), posterior (P), medial (M), lateral (L), anteromedial (AM), anterolateral (AL), posteromedial (PM), and posterolateral (PL).

Procedure of the test:

Each child performed SEBT in all 8 directions with barefoot for right and left leg.

All of the participants were shown a test performed by the tester. Participants were instructed to stand with one foot in the centre of the star pattern and the other as far as they could before returning to the starting position by lightly touching the line with their big toe. All the testing and trials were performed barefoot. Participants maintained single leg stance while reaching with contralateral leg touched as far as on chosen line. Furthermost point is reached by distal part of the leg marked and measured by examiner. Each participant completed the test in all 8 directions with both feet (fig 1 & 2). Leg length was measured in supine from anterior superior iliac spine to ipsilateral centre of medial malleolus. (8)

Photographs: Star excursion Balance test

Figure 1

Figure 2

3. Data Analysis and results

Table 1: Right reach correlation with right leg length

SEBT		Leg Length (Right)	Leg Length (Right)
Right Anterior	Pearson Correlation	.146	.146
	Significance	.000	.000
Right Anteromedial	Pearson Correlation	.043	.043
	Significance	.060	.060
Right Medial	Pearson Correlation	.120	.120
	Significance	.000	.000
Right Posteromedial	Pearson Correlation	.162	.162
	Significance	.000	.000
Right Posterior	Pearson Correlation	.093	.093
	Significance	.000	.000
Right Posterolateral	Pearson Correlation	.106	.106
	Significance	.000	.000
Right Lateral	Pearson Correlation	.134	.134
	Significance	.000	.000
Right Anterolateral	Pearson Correlation	.178	.178
	Significance	.000	.000

Table 1: Left reach correlation with left leg length

SEBT		Leg Length (Right)	Leg Length (Right)
Left Anterior	Pearson Correlation	.181	.181
	Significance	.000	.000
Left Anteromedial	Pearson Correlation	.136	.136
	Significance	.000	.000
Left Medial	Pearson Correlation	.312	.312
	Significance	.000	.000
Left Posteromedial	Pearson Correlation	.132	.132
	Significance	.000	.000
Left Posterior	Pearson Correlation	.167	.167
	Significance	.304	.304
Left Posterolateral	Pearson Correlation	.206	.206
	Significance	.000	.000
Left Lateral	Pearson Correlation	.168	.168
	Significance	.000	.000
Left Anterolateral	Pearson Correlation	.339	.339
	Significance	.000	.000

The mean length of Right leg is 67.33 ± 21.55 inches with range 21.5 to 100 inches and the values for left leg are 67.37 ±21.53 inches with range 21 to 100 inches.

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SEBT reach for all anterior direction are correlated with leg length. In Anterior, anteromedial reach is affected by leg length right and left legs. The effect is similar for both leg lengths. Right leg length is negatively associated and left leg length is positively associated to Anterolateral reach. Right leg length is negatively associated with the medial reach in both directions. For Posteromedial SEBT in both directions, Leg length has significant association with Posteromedial reach. Right leg length is not associated with Posterior reach on right and left reach of SEBT. Left and have significant effect on Posterior reach in both directions. Right leg length has an effect on both sides reach. The Posterolateral reach as well as lateral is affected, Leg Length on both sides

4. Discussion

SEBT is widely used dynamic balance test for research and clinical set ups. Extensive research can be seen for validity of this test. It is highly used and representative non-instrumented dynamic balance test. It can be used in both healthy children as well as children with injuries. The performance of child varies with sport, gender, age BMI etc.

The results demonstrate that leg length is positively correlated for SEBT excursion distance. There are various factors affecting the excursion distance of the SEBT. There are also gender differences noticed along with impact of leg length, BMI.(3) the reliability and sensitivity of the test has been already established in literature (6,9). Previous literature (2) also supports our finding that there is correlation between, leg length and star excursion distance in SEBT. They further suggest that this correlation can be utilized to normalize data for both genders.

Literature also suggests that leg length is dependent on height (10–12). Hence both leg length and height has association with the increase in reach of excursion. Other factors may include isometric strength of leg, ankle and hp range of motion, dominance of the leg. Present study is supported by (8) study on normalizing parameters for SEBT, and systematic review by (13). Findings of the present study showed that leg length is strongly correlated with each other as increase in height increases leg length and thus affecting excursion distance.

5. Conclusion

This study provides the normative values for SEBT of school going children from 6 to 14 years for different leg length. SEBT excursion values in young adults increase with increase in height and leg length. It is advised that physical therapists and clinician should take into account the effects of height, leg length when the assessing with SEBT is done for children and young athletes. Also it can be assessed SEBT values in relation to the normative values. Other factors such as Knee strength, range of motion, BMI, also should be considered for interpretation of test.

6. Limitations of the Study

Data was only collected from one center and a nearby locality in the Indian population, so may not be generalized. Further correlation between BMI, strength foot type and SEBT value can be studied.

Ethical Approval: Approved (PIMS/DR/PhD/2020/COPT/107)

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Conflict of Interest: The authors declare no conflict of interest.

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