Original Article

Comparison of Dynamic Balance between Male and Female Collegiates Using Star Excursion Balance Test

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Abstract

Background: This study aimed to compare the dynamic balance between male and female collegiates using star excursion balance test (SEBT). Anterior, posteromedial, and posterolateral balance of healthy male and female collegiates was assessed to see if there are gender variations in dynamic balance and whether fatigue exacerbates any possible disparities.

Methods: Twenty subjects age range between 17- 25 yrs were included in the study. The individuals were split up into two groups. Ten male participants made up group 1, and ten female subjects made up group 2. Demographic data was collected and recorded.

Results: The study showed that the maximum reach was measured in right posterolateral direction among all the participants. The minimum reach was measured in right anterior direction. Participants of group 1 showed maximum and minimum reach in right posterolateral and right anterior direction. Similarly, participants of group 2 showed maximum and minimum reach in right posterolateral and left anterior direction. The test showed that there was no significant difference between the two groups for all the six directions as the *p* value was >0.05.

Conclusions: The present study concludes that there is no significant difference between male and female collegiate concerning dynamic balance using SEBT. Hence, gender does not play significant role in dynamic balance. Another point that can be concluded is that the minimum reach among all the participants was right anterior and the maximum reach is in the right posterolateral direction. Hence, the participants can be more prone to injury in the direction of minimum reach.

Keywords: Star Excursion Balance Test (SEBT), Right-Anterior (RA), Right Posteromedial (RPM), Right Posterolateral (RPL), Left Anterior (LA), Left Posteromedial (LPM), Left Posterolateral (LPL)

Introduction

The ability to sustain one's body's position above its basis of support regardless of whether that base is stationary or transferring is called balance. Static balance refers to maintaining postural sway control under stable circumstances[1]. Dynamic balance refers to a degree of anticipated movement around a support base. This could entail actions like jumping or hopping to a new spot and trying to stay still as

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soon as you can, or trying to make controlled segment movements (reaching) without compromising the established base of support[2].

Clinically viable tests evaluating balance have become more common since lower extremity injuries have been linked to poor balance. Specifically, a well-liked clinical evaluation of dynamic balance and postural control is the Star Excursion Balance Test (SEBT)[3]. The SEBT consists of a series of single-limb squats in which the non-stance limb is extended to its maximum potential to contact a spot along one of eight marked ground lines. The lines are placed 45 degrees apart in a grid that radiates from a central point. Different combinations of sagittal, frontal, and transverse movements are needed for each reaching direction, which presents unique obstacles. The terms anterior, anteromedial, anterolateral, medial, lateral, posterior, posteromedial, and posterolateral refer to the reaching directions concerning the stance limb. The objective of the task is to have the person place the stance limb in the center of the testing grid, create a stable base of support there, and maintain it through a maximal reach excursion in one of the designated directions[2]. The extent to which the participant can go without breaking any of the specified rules is the measurement or result of the SEBT performance. The reach distance data serve as a dynamic postural control index; a greater distance reached denotes more effective dynamic postural control[2].

Test-retest reliability estimates were provided for the four diagonal reach directions of the test (anteromedial, anterolateral, posteromedial, and posterolateral). The intraclass correlation coefficients (ICCs) indicating the intratester reliability for each direction varied from 0.67 to 0.87[4]. There was a significant degree of shared variance among the eight reach directions noted alternatively, there was a strong correlation between a person's reaching distance in one direction and the remaining seven directions[5]. Only three reach directions—anterior, posteromedial, and posterolateral—should be executed as a result of this. The SEBT takes a lot less time now that this update has been implemented[6].

A study including recreationally active male and female participants concluded that the anterior, medial, and posterior performance of healthy men and women to see if there are gender variations in dynamic balance and whether fatigue exacerbates any possible disparities. The idea that there is no performance difference between the sexes was disproved by the finding that women outscored males in all three directions[7].

Recent evidence suggests that an increased risk of noncontact lower extremity injuries during a competitive American football season may be linked to poor SEBT performance[8]. Similarly, another piece of evidence concluded that male athletes seem to have better dynamic balance in the posteromedial direction than female athletes do when playing NCAA soccer and lacrosse. For female soccer and lacrosse players, adding posteromedial-focused dynamic balancing exercises may help prevent injuries to the lower extremities[9]. Therefore, it can be stated that individuals with poor lower limb balance are more prone to injuries.

Research on the comparison of the dynamic balance between male and female collegiates population is scarce. Thus, the study aims to use SEBT to compare the dynamic balance between male and female collegiates.

Methodology

Study design: Cross-sectional

Sampling method: Randomized Control Trial (RCT)

Sample size: 20 subjects (10 in each group)

Age: 17-25 years

Study duration: 6 Months

Study Place: Department of Physiotherapy, Teerthanker Mahaveer University, Moradabad

Inclusion Criteria

- Age:17-25 years
- Both male and female collegiates.

Exclusion Criteria

- Any recent lower limb surgery.
- Any recent lower limb injury.
- Any neurological deficit.
- Any deformity of lower limb.

Instrumentation

- Star Excursion Balance
- Inch tape
- Marker
- Calculator

Outcome Measure: The outcome measure used for the study is the Star Excursion Balance Test (SEBT).

Procedure

- All subjects participated voluntarily in the study.
- They were given clear instructions about the procedure of the study.
- Informed consent was obtained from each subject, and the rights of the subject were protected throughout the study.
- They were divided into two groups. Group 1 consisted of 10 male subjects and group 2 consisted of 10 female subjects based on the inclusion and exclusion criteria.
- Demographic details of the subject (gender, age, height, weight, and BMI) were collected.
- The dominance of the lower limb was known by throwing a ball toward the subject and asking him/her to kick the ball. The limb that the subject used first to kick the ball was considered dominant.
- The following steps were taken to note down the SEBT readings.
- The subject stands on one limb and extends their reaching limb as far as they can along each reaching line. They then return the reaching limb to the starting position in the center of the grid, resuming a bilateral stance, and gently touch the line with the most distal portion of their reaching foot without shifting their weight to or coming to rest on this foot.
- The trial is not deemed to be finished if the subject makes heavy contact with the ground with the reaching foot to keep balance, comes to rest at the touchdown point, or lifts or moves any portion of the stance limb's foot.
- Following four trials, a five-minute rest period was administered. The test was then resumed again with the dominant limb first followed by the other limb.
- The distance between the grid's center and the reach leg's greatest excursion point was measured by the investigator and marked on the tape for each reach distance.
- When reaching the lateral and posterolateral directions, the participants were required to reach behind the stance leg to complete the task.
- The reach started with the anterior direction and progressed to posteromedial and posterolateral directions.
- Three readings of each direction were taken and then the mean of each direction was calculated.

Flow Chart

Ten subjects in each group were recruited based on inclusion & exclusion criteria

⬇

The procedure was explained to the subjects

⬇

Demographic details (age, height, weight, BMI, leg dominancy) were collected

⬇

Three readings in each direction (anterior, posteromedial, posterolateral) were taken from right and left limbs one by one.

⬇

The mean of the readings taken was calculated for each direction

⬇

Data analysis using SPSS.

Data Analysis

- Data analysis was done using Statistical Package for Social Sciences (SPSS) version 29.0.1.0. The mean and standard deviation (SD) of age, height, weight, and BMI of all 20 participants were calculated.

- The mean of six directions [Right-Anterior (RA), Right Posteromedial (RPM), Right Posterolateral (RPL), Left Anterior (LA), Left Posteromedial (LPM), Left Posterolateral (LPL)] was also calculated for both the groups.
- The student's t-test was used to compare the dynamic balance between the male and female collegiates groups for all six directions.

Table 1. Mean and SD of age, height, weight, and BMI

n=20	Mean ± SD
Age (years)	21.55 ± 1.8
Height (m)	5.41± 0.23
Weight (kg)	56.25± 8.5
BMI (kg/m^2)	20.30± 3.11

SD: Standard Deviation

Table 2. Mean and SD of age, height, weight, and BMI of group 1 and group 2 are given below:

Group 1 (n=10)	Mean ± SD
Age (years)	20.9 ± 1.59
Height (m)	5.521 ±0.23
Weight (kg)	58.6 ±8.26
BMI (kg/m^2)	20.1 ±3.07
Group 2 (n=10)	**Mean ± SD**
Age (years)	22.2 ± 1.87
Height (m)	5.31 ±0.23
Weight (kg)	58.6 ±8.26
BMI (kg/m^2)	20.1 ± 3.07

SD: Standard Deviation

Table 3. Mean value of all three directions of reach by right and left limb is given below:

Mean	RA(cm)	RPM (cm)	RPL (cm)	LA(cm)	LPM (cm)	LPL (cm)
n=20	63.58	68.14	71.03	64.30	68.43	68.43
Group1 (n=10)	65.00	71.37	72.79	67.25	70.91	70.00
Group 2 (n=10)	62.16	65.46	69.28	61.36	65.95	66.86

Group 1: Male, Group 2: Female, RA: Right-Anterior, RPM: Right Posteromedial, RPL: Right Posterolateral, LA: Left Anterior, LPM: Left Posteromedial, LPL: Left Posterolateral.

Table 4. Gender based comparison of all the six directions.

Directions	Male		Female		n (20)	p^*
	Mean	SD	Mean	SD	t	
RA	65.00	8.92	62.16	10.41	0.65	0.52
RPM	71.37	12.11	65.46	8.24	1.27	0.21
RPL	72.79	12.05	69.28	9.34	0.72	0.47
LA	67.25	9.36	61.36	9.08	1.42	0.17
LPM	70.91	15.69	65.95	8.94	0.86	0.39
LPL	70.00	12.62	66.86	8.55	0.65	0.52

SD: Standard Deviation, RA: Right-Anterior, RPM: Right Posteromedial, RPL: Right Posterolateral, LA: Left Anterior, LPM: Left Posteromedial, LPL: Left Posterolateral, *level of significance =<0.05.

Result

The results of the study showed that the maximum reach was measured in right posterolateral direction among all the participants. The minimum reach was measured in right anterior direction. Participants of group 1 showed maximum and minimum reach in right posterolateral and right anterior direction. Similarly, participants of group 2 showed maximum and minimum reach in right posterolateral and left anterior direction.

The student's t test is used to compare the dynamic balance among male and female collegiates. The results of the test showed that there was no significant difference between the two groups for all the six directions as the *p* value was >0.05 i.e. non-significant.

Discussion

The study aimed to compare the dynamic balance between male and female collegiates using SEBT. The study's findings demonstrated no significant difference in dynamic balance between the two groups in any of the six orientations involving the left and right limbs. This suggests that gender may not be a determining factor in balance performance among healthy collegiate populations. The broader implications for college students include the potential for developing standardized training, assessment, and rehabilitation programs that do not need to be gender-specific. In the field of sports science and physical therapy, these results support a more individualized approach to balance training and injury prevention, contributing to more inclusive and evidence-based practices in collegiate health and performance programs. Another finding of the study, which reveals the consistent limitation in anterior reach, suggests a need for focused training to improve strength, flexibility, and neuromuscular control in the anterior direction. This could help address imbalances and enhance overall performance. These directional patterns can serve as benchmarks in regular balance assessments to monitor progress, detect early signs of dysfunction, or evaluate the effectiveness of training programs over time.

According to **Yasushi Kurihara et al (2024)** modified SEBT was used to compare the maximum reach among injury and non-injury groups and it was concluded that the results of modified SEBT were related to previous injury levels of lower limb i.e. the lower the reach distance of SEBT, higher the changes of pre-injury levels[10]. In the present study the participants were healthy male and female collegiates with no recent injury or surgery to the lower limb. Therefore, no such conclusions can be drawn from our study.

According to **Ava D. Segal et al (2023)** there was less dynamic balance in all three directions among healthy older adults compared to healthy young adults. The posterolateral direction showed the most variation, which suggests that poor balance can be used in clinical settings to identify balance decrement early on and recommend more effective treatment. Leg dominance and sex differences did not significantly alter the SEBT score[11]. The results are similar to our study as there was no significant difference between male and female collegiates groups in SEBT scores in all six directions i.e. gender does not affect the dynamic balance. Additionally, the leg dominance of all the participants of both groups was the same (right dominant). In the present study, the minimum reach distance in group 1 and group 2 was right anterior and left anterior respectively.

According to **Mikel R. Stiffler et al (2015)** there were gender differences in SEBT score among 393 healthy National Collegiate Athletic Association Division I collegiate athletes from 8 sports. There was an anterior directed significant sex-by-sport interaction. Women's ice hockey players reached the furthest across all teams, with notable variations seen in the posterolateral and posteromedial directions. The athletes who covered the greatest distances were wrestlers and men's ice hockey players[16]. The results of the current study are different from the aforementioned study because our study included healthy male and female collegiates in contrast to the participants of the above-mentioned study which included an athletic population from eight different sports. Additionally, the sample size the study was also small as compared to the above study.

According to **Robert J. Butler et al (2013)**, a simple dynamic balancing test conducted in the offseason was effective in identifying individuals who suffered an injury sustained during the season among American footballers. The results of this investigation provide support to the theory that lower scores on dynamic balancing tests are linked to a higher risk of injury. In our study, there was no significant difference between male and female collegiates concerning maximum reach on SEBT. But, the minimum reach was measured in the

right anterior direction, which concludes that there is increased risk of injury to participants in this direction[8].

Conclusion

The findings of the present study indicate that there is no statistically significant difference in dynamic balance performance between male and female collegiate students, as assessed through the Star Excursion Balance Test (SEBT). This suggests that gender is not a determining factor in dynamic balance capabilities within this population. Furthermore, the data revealed that the shortest reach distance across all participants occurred in the right anterior direction, while the longest reach was observed in the right posterolateral direction. These directional differences in reach performance may have important implications; specifically, the reduced reach in the anterior direction could point to a potential area of weakness or instability. As a result, participants may be at a greater risk of sustaining injuries when moving or bearing load in this direction. These insights underscore the need for targeted balance training and injury prevention strategies that address directional limitations, particularly in the anterior plane of movement.

Limitation

One of the main limitations of the study is the small sample size. Another limitation is that all the collegiates were from same college or department.

Future Recommendations

Future studies can be conducted with a large sample size and participants from various departments. Additionally, comparison of dynamic balance can be done between collegiates and other population like older adults or athletic population. Rehabilitation exercises can be incorporated with the assessment to improve the dynamic balance. Lastly, comparison between static and dynamic balance can be done with a study of lower limb muscle recruitment so that it can aid in rehabilitation process.

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

Informed Consent: Informed written consent was taken from the subjects (or volunteers) prior from explaining the procedure of this investigation.

Ethics: At the time of conducting the project, formal ethical clearance was not mandated by the institution for undergraduate classroom-based / non-invasive research projects. However, all standard ethical principles were followed, including obtaining informed consent from participants, ensuring confidentiality, and maintaining participants' safety throughout the study.

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