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## RESEARCH ARTICLE

# BALANCE ASSESSMENT USING Y BALANCE TEST IN MIDDLE AGED WOMEN

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**ABSTRACT**

**Background**: A decline in balance function has been reported in women from 40 years of age onward. Dynamic balance tests are used to predict fall risk in elder women (Plisky *et al*., 2009; Shaffer *et al*., 2013; Gribble, 2012; Schmitz, 2007).
Objective: 1) To find Normative Y balance test value in Middle aged women and compare Y balance test value in age groups 41-50 and 51-60 years of females.
Method: 200 females age between 41-60 years were recruited from community of Charotar region and divided in groups1 & 2. After consideration of inclusion and exclusion criteria informed consent was taken. Details regarding demographic data of all subjects along with Berg Balance Test and Y Balance test was taken.
Result: There was no significant difference in Anterior reach distance between Right and left sides in both groups while Posteromedial direction had significant difference in group 2 (P= 0.006). Posterolateral reach distance showed significant difference in between right and left sides in both groups (P=0.02 & P=0.0064).
Conclusion: There is significant difference in the reach distance in both the age groups of females with distance comparatively less in the 51-60 year supporting the age related decline in flexibility and balance. Among the 3 directions Posterolateral direction showed significant difference in both the groups.



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## INTRODUCTION

Middle age is the period of age beyond young adulthood but before the onset of old age. It is usually considered to occur approximately between the age of 41 to 60 (CollinsDictionary.com, 2012). Muscle changes often begin in the 20s in men and the 40s in women. Compared with men, women are more prone to falls and have a higher predisposition to fall-related injuries (Himes, 2012). Falls are the major cause of fractures and head traumas in elderly individuals, especially in women (Alamgir, 2012). Middle-aged women have less postural control than younger women. The relationship between balance and lower-limb muscle strength may be important for both the identification of persons with an increased risk of falling and the development of fall-prevention training programmes (Muehlbauer, 2012). Aging is associated with diminished lower-extremity strength, although a decline in balance function has been reported in women from 40 years of age onward (Choy, 2003). Changes during middle age are such as reduced physical fitness, reduced aerobic performance and reduced strength and flexibility, posture and gait (Shephard, 1998).

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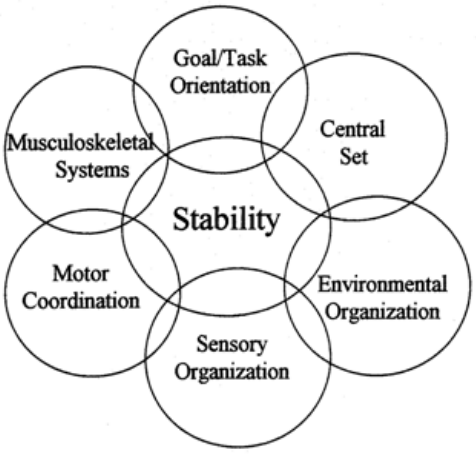
The joints become stiffer and less flexible. Fluid in the joints may decrease, and the cartilage may begin to rub together and erode. There are changes in the muscle tissue, combined with normal aging along with changes in the nervous system. Bone mass or density is lost as age increase, especially in women after menopause. Bones become more brittle and may break more easily. The bones lose calcium and other minerals. So chances of Osteoporosis, fractures is a common problem, especially for older women. Balance is the condition in which all the forces acting on the body are balanced such that center of mass is within the stability limits, the boundaries of the base of support. Reactive postural control occurs in response to external forces acting on the body. Balance emerges from a complex interaction of sensory system, motor system, CNS integration.

Mainly two types of balance

- Static
- Dynamic

Static balance is defined as balance in which the body maintains equilibrium for one position. Dynamic balance is the ability to maintain your equilibrium while moving through space.

**Systems Model of Balance**




With good dynamic balance you can climb a ladder, walk on the beach or go up and down stairs. Dynamic balance tests are used to predict fall risk in elder women. To assess the dynamic balance there are many dynamic balance tests available such as The Tinetti Balance and Gait Test, The Timed "Up and Go Test" (TUG), One-leg stance duration, The functional reach test, The Balance Evaluation Systems Test (BES Test) ,Berg balance scale, Star excursion test, Y balance test. To assess the dynamic balance we have used Y balance test.

The Berg Balance Scale (BBS) was developed as a clinical measure of functional balance specifically in older people. Balance impairment is a key risk factor for falls in older people with a threshold of ≤46, was inadequate for the identification of the majority of people at risk for falling in the future. The Star Excursion Balance Test (SEBT) is a widely accepted method of assessing dynamic postural stability. The Y Balance Test (YBT) is a commercially available device for measuring balance that uses 3 (anterior, posteromedial and posterolateral) of the 8 SEBT directions and has been advocated as a method for assessing dynamic balance. More time required in SEBT than Y balance test.

The Y Balance Test (YBT) is a tool used to test a female's risk for injury. Its protocol is based on research done on the Star Excursion Balance Test. In Y balance test female stand on one leg while reaching out in 3 different directions anterior, posteromedial and posterolateral with the other lower extremity just make a light touch and come to the center. Hip abduction strength was correlated with the posteromedial reach distance, and hip extension strength correlated with posterolateral reach distance on the SEBT. (Hubbard, 2007) The Y Balance Test could be evaluated for prediction of injury in different populations and establish acceptable reach distances for each population. LQYBT has identified athletes at increased risk for injury (Butler, 2013). The LQYBT showed good interrater test–retest reliability (ICC = 0.88-0.99) (Plisky, 2009; Shaffer, 2013).

The Y Balance Test™ has shown good to excellent reliability with the standardized equipment and methods. Plisky *et al* found good to excellent interrater reliability (intraclass correlation coefficient [ICC] equal to 99 to 1 with 95% confidence intervals [95% CI] ranging from .92 to 1) and intrarater reliability (ICC of .85-.91 with 95% CI ranging from .62 to .96). The advantages of the YBT are that it follows a standard protocol and has been shown to have high inter-(0.99–1.00) and intra-rater reliabilities (0.85–0.91) (Plisky, 2009).

## MATERIALS AND METHODS

Design : Observational study
Setting : Community
Sampling method: Purposive sampling
Sampling size : 200

**Inclusion criteria**

- Community females who can ambulate independently without walking aids.
- Age group between 41 to 60 years females.
- Berg balance score > 46 /56.
- Females who are normotensive.
- Willingness to cooperate with the study process and data collection.

**Exclusion criteria**

- Neurological problems like hemiplegia or Paraparesis.
- Visual problem
- Females having history of at least 1 fall in past 6 months
- Abnormal sensation in lower extremity
- Grade of less than 3 (Fair) of both lower limb on MMT.
- Limb length discrepancy more than 2cm.
- Musculoskeletal, Degenerative, traumatic, cardiovascular, vestibular, visual, or neurologic disorder (multiple sclerosis, vertigo, or dizziness).

**Procedure**

- Females were recruited from the community through personal contact.
- After analyzing the inclusion and exclusion criteria , subjects were selected and score of assessment tool measured.
- The subjects were given feedback about score of assessment tool.
- Berg Balance test was conducted to exclude females having scored less than 46.
- Y Balance Test
- The study participants were divided in two groups
  - Group 1: age 41-50 year , Group 2 : age 51-60 year
- A verbal and visual demonstration of the Y Balance test was provided to each participant by the investigator.
- Each participant was allowed to counterbalance with arms or trunk and measurement was taken from the toe of the reach leg to the toe of the stance leg.
- Participants were given warm up which includes walking 10m distance for 5 min followed by hamstring and TA self-stretching.
- Following the warm-up, each participant was asked to stand on her one limb in the center of the Combo grid.

- The Y Balance test was performed with the participants standing in the middle of a grid formed by three lines in which the posterior line is positioned 135° from the anterior line with 45° between posterior lines from each other. The participant was asked to reach as far as possible with other leg along each of the three lines, make a light touch on the line, and return the reaching leg back to the center, while maintaining a single-leg stance with the other leg in the center of the grid.
- Participants were instructed to make a light touch on the ground barefooted with the most distal part of the reaching leg and return to a double-leg stance without allowing the contact to affect overall balance.
- The terminology of excursion directions is based on the direction of reach in relation to the stance leg.
- The investigator recorded each reach distance with a mark on the tape as the distance from the center of the grid to point of maximum excursion by the reach leg.
- If the investigator felt the participant used the reaching leg for a substantial amount of support at any time, removed her foot from the center of the grid, or was unable to maintain balance on the support leg throughout the trial, the trial would be discarded and repeated.
- The test was concluded by a cool down session which would include again walking and stretching exercise for five minutes. (Gribble, 2012)
- Y test score was calculated using formula:

•Y test score $= \frac{\text{anterior+posteromedial+postrolateral}}{3*\text{Limb lenth}} * 100$

**Data collection tool**

1.Measure Tap
2.Strips
3.Protractor
4.Sphygmomanometer

**Data analysis**

($25^{th}$, $50^{th}$ and $75^{th}$ percentile of Y score) and inferential analysis. Descriptive statistics analysis of variance and ICC with 95% confidence interval. Mean of 3 trials was computed to find test value using descriptive statistics. A one way analysis of variance was performed on 3 excursions to determine age and side related differences. The significance level was set at $p < 0.05$.

## RESULTS

There were a total of 200 female participants in the study with group 1 including females of 41-50 year and group 2 had females of 51-60 year. The mean age of the females in group 1 was 45.5 and of group 2 was 55.5 years.

## DISCUSSION

The aim of the study was to find the normative data of Y balance test in females between 41 to 60 years. Plisky found that Y balance test has good to excellent intrarater and interrater reliability in athletes. But very few studies have been done using Y balance test in elderly. A study by Shirin Shakerian *et al*., 2013 used Y balance test as an outcome measure to assess dynamic balance and fall risk which concluded that dynamic balance was better in evening compared to morning and afternoon. Earl *et al*l in 2001 proposed individual role of hamstring and quadricep muscles in 3 Y balance directions.

The quadriceps was found to be most active in anterior direction while hamstring muscle found to be active in posteromedial and posterolateral direction. Moreover to obtain highest reach distance while performing posterolateral and posteromedial direction in test the participant required planter flexion and severe leg rotation. The knee flexors may contribute to a greater YBT Distance when body sway is converted from forward to backward motion. Earl and Hertel6 found that each reach direction activated the stance lower extremity muscles to a different extent. They reported that in the anterior reach direction the vastus medialis and lateralis were most active. During the posterolateral reach, the biceps femoris and anterior tibialis were most active in posterolateral direction.

**Table 1. Mean and standard deviation score in cm of 3 directions in both groups (as per age)**

| Groups | Rt ant | Rt Post medial | Rt Postlateral | lt ant | lt Post medial | lt Postlateral |
|---|---|---|---|---|---|---|
| Group 1(41-50 year) | 74.21± 2.35 | 69.66± 2.64 | 65.52± 3.30 | 73.73± 2.63 | 69.21± 2.78 | 64.59± 4.11 |
| Group 2 (51-60 year) | 70.84± 2.35 | 66.47± 2.92 | 61.78± 2.80 | 70.63± 2.02 | 65.75± 3.25 | 61.26± 3.38 |

**Table 2. T test result for within group comparison (Group 1)**

| DIRECTION | TOTAL Number | MEAN | 95%CL MEAN | STD | P VALUE |
|---|---|---|---|---|---|
| Rt/Lt anterior | 129 | 0.4832 | 0.0337 | 2.5803 | 0.0353 |
| Rt/Lt posteromedial | 129 | 0.4419 | -0.0553 | 2.8535 | 0.0810 |
| Rt/Lt posterolateral | 129 | 0.9328 | 0.1377 | 4.5642 | 0.0219 |

YBT normalized anterior reach performance for group 1 (74.21±2.35) and for group 2 (70.84±2.35), posteromedial reach (69.66±2.64) for group and group2 (66.47±2.92), posterolateral reach (65.52±3.30) for group 1 and group 2 (61.78±2.80). Lucinda E. Bouillon *et al.* 2011 study shows that college aged student were able to reach approximately 20 cm further than middle aged woman, which proves the age related decline in the reach distance.

**Table 3. T test result for within group comparison (group 2)**

| DIRECTION | TOTAL Number | MEAN | 95%CL MEAN | STD | P VALUE |
|---|---|---|---|---|---|
| Rt/Lt anterior | 71 | 0.2066 | -0.1248 | 1.4000 | 0.2179 |
| Rt/Lt posteromedial | 71 | 0.7230 | 0.3207 | 1.6997 | 0.0006 |
| Rt/Lt posterolateral | 71 | 0.5211 | 0.1514 | 1.5622 | 0.0064 |

**Table 4. Anova test for comparison between group 1 and group 2 for anterior mean**

| Source | DF | Type I SS | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Group | 1 | 957.4406573 | 957.4406573 | 166.93 | <.0001 |
| Side | 1 | 14.8225000 | 14.8225000 | 2.58 | 0.1087 |

**Table 5. Anova test for comparison between group 1 and group 2 for posteromedial mean**

| Source | DF | Type I SS | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Group | 1 | 1011.199197 | 1011.199197 | 124.28 | <.0001 |
| Side | 1 | 29.340278 | 29.340278 | 3.61 | 0.0583 |

**Table 6. Anova test for comparison between group 1 and group 2 for posterolateral mean**

| Source | DF | Type I SS | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Group | 1 | 1145.679708 | 1145.679708 | 92.36 | <.0001 |
| Side | 1 | 61.884444 | 61.884444 | 4.99 | 0.0261 |

**Table 7. Normalative value for 41-50 age group**

| SR NO | Direction | 25% | 50% | 75% |
|---|---|---|---|---|
| 1 | Rt anterior | 71.66 | 73.66 | 75.33 |
| 2 | Rt posteromedial | 67.33 | 69.33 | 71 |
| 3 | Rt posterolateral | 63.33 | 65.66 | 67.66 |
| 4 | Lt anterior | 71.66 | 73.66 | 75.33 |
| 5 | Lt posteromedial | 67.33 | 69.33 | 71 |
| 6 | Lt posterolateral | 62 | 65 | 67.33 |

**Table 8. Normalative value for 51-60 age group**

| SR NO | Direction | 25% | 50% | 75% |
|---|---|---|---|---|
| 1 | Rt anterior | 69.33 | 70.66 | 72.16 |
| 2 | Rt posteromedial | 65.33 | 66.66 | 68.33 |
| 3 | Rt posterolateral | 59.83 | 62 | 63.66 |
| 4 | Lt anterior | 69.5 | 70.66 | 71.66 |
| 5 | Lt posteromedial | 64 | 66 | 68.33 |
| 6 | Lt posterolateral | 59.33 | 61.33 | 63.5 |

The present study result found significant difference in between the Rt & Lt Anterior distance (0.0353), posterolateral distance in group 1 while there was a significant difference in group 2 in posteromedial and posterolateral directions. One way Analysis of variance test is used to compare means of 3 or more sample if the data are numerical. The test result showed significant difference in between group in anterior, posteromedial and posterolateral directions but difference between the sides was found only in posterolateral direction.

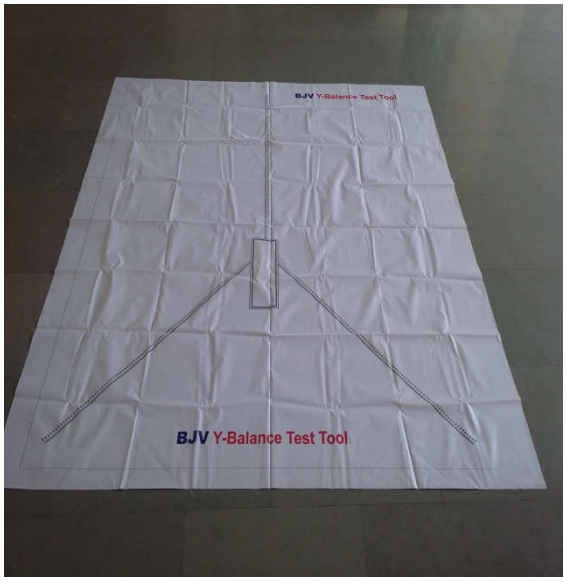



**Fig. 1. Data Collection Tool**

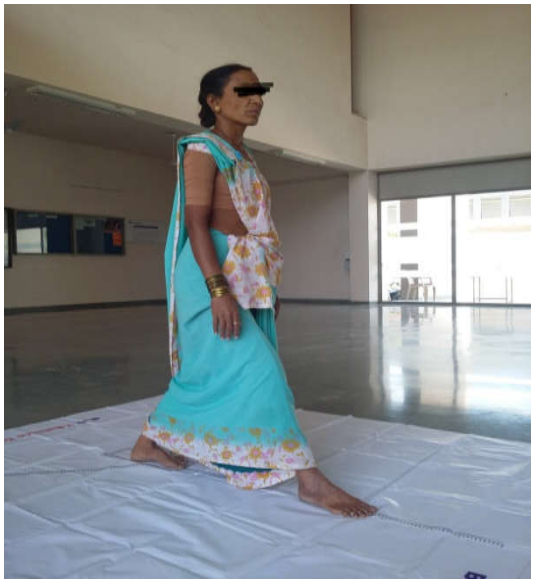


**Fig. 2. Anterior Reach**

**Fig. 3. Posterolateral Reach**

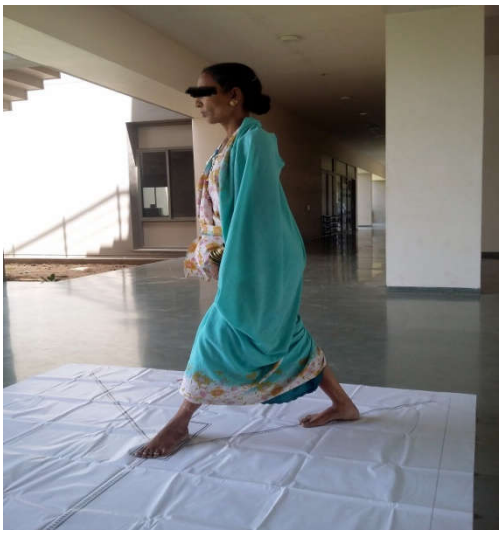


**Fig. 4. Posterolateral Reach**

(Table 6). There was a weak correlation between lower-limb strength (hip extensors, hip abductors, and knee flexors) and dynamic postural control as measured by the YBT. Dong-Kyu Lee *et al*. (2014) found that significantly strong relationship noted between knee flexor strength and performance in all three directions. The normative data for the 3 directions in both the groups was found at 25$^{th}$, 50$^{th}$, 75$^{th}$ percentile.

## Conclusion

There is a significant difference in the reach distance in both the age groups of females with distance comparatively less in the 50-60 year supporting the age related decline in flexibility and balance. Among the 3 directions Posterolateral direction showed significant difference in both the groups. The study found the normative Y balance test at for both the age group of females which can be used for further studies as reference values.

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