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A STUDY TO FIND OUT CORRELATION BETWEEN OBESITY AND BALANCE IN GERIATRIC POPULATION OF JALGAON CITY

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***Abstract**:*

Introduction: Balance plays a crucial role in the activities of daily living. Older Adults tend to have decreased balance and increase risk of fall. Obesity also have been related to complications such as decreased relative muscle strength, heart disease, breathing problem, increased body sway in upright stance. Considering both the factors together it is required to find out to how much extent the balance is impaired in obese elders. Hence, there is a need to find out the correlation between obesity and balance in geriatrics
Aim: To find out correlation between obesity and balance in geriatric population of Jalgaon city.
Method: A total of 56 subjects were selected all above the age of 65 years and BMI above 30 kg/m^2. The demographic data was taken and the balance was assessed using the berg balance scale, four square step test and functional reach test.
Result: The balance assessment tools i.e., berg balance scale (r= -0.39), four square step test (r=-0.52) and functional reach test (r=-0.402) all had a negative correlation with BMI.
Conclusion: In the present study it was noted that the obesity in geriatric population had a negative correlation with balance assessment test i.e., berg balance scale, functional reach test and four-square step test. The ability to complete the given functional tasks tends to decrease as obtained by the balance assessment tools. The above outcome measures evaluated the static and dynamic balance of the subjects in accordance with the obesity. Hence it is concluded that in obese elderly as the BMI increases the balance gets impaired.

Keywords: Balance, Body mass index, obesity.

INTRODUCTION

Obesity is a growing health problem in older adults. It is defined as an excessive accumulation of fat in the body. It is defined using body mass index which is calculated using an individual's weight and height and expressed in kg/m^2.Obesity according to BMI is classified as Class 1(moderate), class 2(severe) and class 3(very severe).In 2012, approximately 35% of the population above the age of 60 years was considered obese. By 2015, 75% of adults were estimated to be overweight, in which 41% were classified as obese.[1]

CLASS BMI

Table 1 Adopted from Sullivan 6th edition pg. 349.

I OBESITY	(MODERATE)	30-34
II OBESITY	(SEVERE)	35-39
II OBESITY	(VERY SEVERE) MORBIDLY OBESE	>40

Ageing in humans refers to a multidimensional process of physical, psychological, and social changes. Some dimensions of ageing grow and expand over time while other decline. Geriatrics are those individuals who are above the age of 65 years. They are classified as young old(65 to 74 years), older old(75-84 years)and oldest(85 years above).[35]

Obesity is a complex multifactorial disease associated with risk factors for various diseases and medical complications, including cardiovascular disease, atrial fibrillation, depression, stroke, and a reduction in quality of life. Along with the multisystem deterioration that accompanies old age, obesity comports functional decline, sensory deficits [2], and significantly reduced mass-relative lower extremity strength that precipitates fall. Compounding the age-related decrements are obesity’s increased mechanical demands that not only increase system constraints, but also prompt an interminable state of physiological and biomechanical compromise compensatory adaptations to offset the excess trunk mass. The excessive amount of fat modifies the body geometry by adding passive mass to different regions [3] and it influences the biomechanics of activities of daily living, causing functional limitations, and possibly predisposing to injury [4].

Balance is an integral component of activities of daily living. Balance is a complex function involving numerous neuromuscular processes [5]. It has been reported that obese adults carry an anteriorly displaced centre of mass that elicits greater trunk extension while standing in an effort to counteract the excessive weight and maintain balance [7,8]. Obesity has a profound effect on disability and quality of life[9]. Control of balance is dependent upon sensory input from the vestibular, visual and somatosensory systems. Balance impairments are associated with an increased risk of falls and poorer mobility measures in the elderly population. [10,11]

As the age increases the human body gradually undergoes the physiological changes which may include the organ system. Ageing is associated with a decline in the integrity of the physiological systems that contribute to the control of balance. Control of balance is essential in all postures and situations, both static and dynamic. Postural sway is often used as an indicator of static standing balance where bodily movement in both the antero-posterior (AP) and lateral direction is analysed, usually using force platforms. These expensive and are thus not appropriate for use in the clinical setting. Furthermore, falls and loss of balance most commonly occur during movement related tasks such as walking[13] and less frequently during static activities. It is therefore important that the evaluation of balance incorporates testing procedures that reflect the dynamic nature of such locomotor tasks, as static tests of balance are less able to identify individuals at risk of falls than dynamic tests [12].

Human aging causes physiological changes such as decreased postural balance, thus increasing the risk of falls. Postural control is considered to be a complex motor skill derived from interaction of multiple sensorimotor processes. Age-related changes in the peripheral and central components of the visual, somatosensory and vestibular systems can be expected to affect balance and mobility. One-third of people aged 65 years and over fall one or more times a year. Among community-dwelling older people, the cumulative incidence of falls ranges from 25 to 40%.

Fall have been correlated with a number of different risk factors. Some of these, like age or sex, cannot be altered. Prospective cohort studies have indicated that falls seem to be an independent determinant of functional decline and dependency in activities of daily living (ADLs) in a general elderly population.[14]

The purpose of this study is to find out how BMI based obesity is affecting the balance in geriatric population.

OBJECTIVE

- To assess the functional movement using the berg balance scale and functional reach test.
- To assess the balance using the four square step test.
- To find out relationship between obesity and balance.

METHODOLOGY

- Study type: Observational study
- Sample size: 56
- Minimum sample size (n) =53

To estimate correlation coefficient (r)

$n=\{(z_1+z_2)/Cr\}^2$

where r = correlation coefficient = -0.45

C_r=-0.48

Z_1=2.57 at α=1% level of significance

Z_2=0.84 at 80% power of test

$n= \{(0.25+0.84)/0.48\}^2$

n=53

Minimum sample size of the study was 53.

- Method of sampling: Purposive sampling method
- Place of study: Jalgaon city
- Study duration: 6 months
- Criteria Of Selection:

(A) INCLUSION CRITERIA**:**

- Both Males and females
- Age 65 years above
- Obese individuals according to BMI grades

(B) EXCLUSION CRITERIA:

- Acute illnesses
- Recent fractures
- Vestibular or vision disorder
- Musculoskeletal disorders RA, severe OA.
- Neurological disorders such as stroke, Parkinson's disease
- Cancer

- **Materials**
  - Pen
  - Paper
  - Measuring Tape
  - Chair
  - Weighing Machine

OUTCOME MEASURES

1.BERG BALANCE SCALE [Reliability=0.99]

The Berg balance scale has excellent inter-rater and intra-rater reliability (ICCs ¼0.98).

2. FUNCTIONAL REACH TEST

A clinical outcome measure and assessment tool for assessing balance in one simple task. [Reliability=0.98]

3. FOUR SQUARE STEP TEST

A clinical test of stepping and change of direction to identify multiple falling older adults. High reliability was found for interrater (n=30, intraclass correlation coefficient [ICC]=.99) and retest reliability (n=20, ICC=.98). The FSST also revealed a sensitivity of 85%, a specificity of 88% to 100%, and a positive predictive value of 86%.

PROCEDURE

Ethical clearance was taken from the ethical committee of Dr Ulhas Patil College of Physiotherapy Jalgaon prior to commencement of the study.

↓

Subjects were selected on the basis of inclusion and exclusion criteria.

↓

Consent taken from subjects and were explained about the procedure.

↓

Assessment taken:1.Berg balance scale 2. Four square step test 3.Functional reach test

↓

Data collected and statistical analysis done.

CLINICAL BALANCE ASSESSMENT

BERG BALANCE SCALE

- This includes 14 common movement tasks such as sit-to-stand, standing unsupported, sitting unsupported, stand-to sit, transfer, standing with eyes closed, stand with feet together, reaching forward, picking up object from floor, turning 360 degrees, turn to look behind, placing alternate foot on stool, standing in one foot in front and standing on one foot.
- The subjects performed the activities and were scored accordingly i.e., 0–4 point ordinal scale where “0” indicates the inability to perform the task and “4” indicates the ability to perform the task independently. Therefore, a total score of 56 indicates maximal independence.
- The score was measured according to the capability of the subject to perform the task and then at the end a sum was taken out of score of 56.

Standing unsupported

Standing unsupported with eyes closed

Sitting unsupported but feet supported on ground

Reaching forward with outstretched hand

Standing unsupported with feet together

Picking up object from the floor

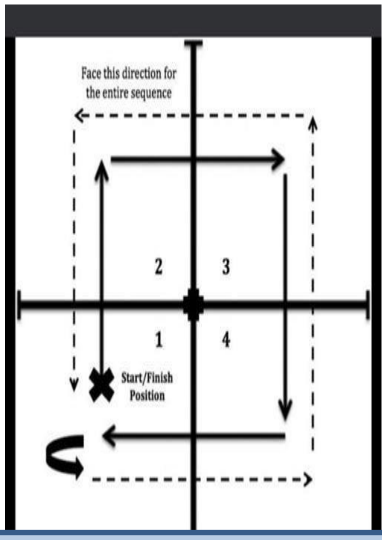
x

Turning towards left and right

Reaching forward with outstretched hand

FOUR SQUARE STEP TEST

- In this test the subjects were first explained about the test and then demonstrated.
- The tape was placed in the crossed manner so that the four squares are formed with sufficient distance. The square was numbered 1,2,3,4 as per convenience.
- The subject was asked to stand in square 1 such that they were facing the north side.
- Then the subjects were asked to move in clockwise direction from square no. 2-3-4-1and then counter clockwise direction i.e. 4-3-2-1. The Subjects were asked to repeat the trial three times.
- The best of three time was recorded in second. The Cut-off time of 15sec was noted and the subjects were classified as non-multiple faller (≤15 sec) and multiple fallers(>15sec). The time was calculated with the stop watch and started when the subject placed his/her foot in the square 2.



Four square step test

FUNCTIONAL REACH TEST

- The FRT was administered while the patient was in standing position. The subject was instructed to stand next to, but not touching a wall and position the arm that was closer to the wall at 90 degree of shoulder flexion with a closed fist.
- The starting position was marked at the 3rd metacarpal end of the straight upper limb. The patient was instructed to "Reach as much forward as he/she can without taking a step". The location of the 3rd metacarpal was again recorded.
- Scores were determined by assessing the distance covered by the hand till the third metacarpal head and three trials were measured in inches.
- The average of best two was taken in the end.

Functional reach test

STATISTICAL ANALYSIS

- Statistical analysis was done using Minitab 13 software.
- The correlation of the balance assessment tools with BMI was found using the Karl Pearson's coefficient.

RESULTS

- Herein 56 subjects were selected for the final analysis which comprised of 21 male and 35 female. This is shown in table 2.

Table 2

Variable	Groups	Frequency	Percentage
Gender	Male	21	37.50
	Female	35	62.50

The percent wise distribution was 37.50% male and 62.50% female and depicted in the fig 1.

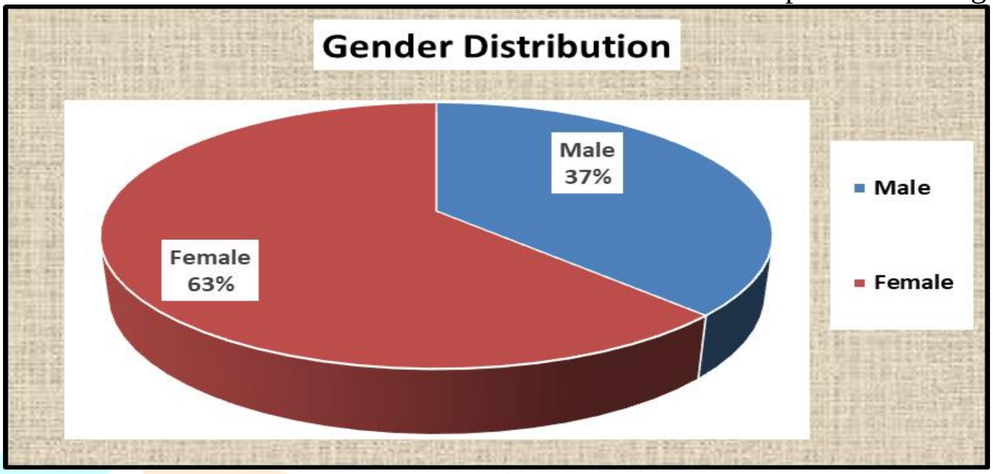


Fig 1

- The average age of the participants was 67.55 years with standard deviation of 3.27 years.
- The average BMI of the participants was 31.30kg/m^2 with standard deviation of 1.39kg/m^2.

The above data is shown in Table 3

Variables	Mean	SD
Age (Years)	67.55	3.27
BMI	31.30	1.39

Table 3

The table 4 shows the mean and standard deviation values of the berg balance score, functional reach test distance and four-square step test time.

Variable	Mean	SD
Berg balance score	45.58	5.81
Functional reach distance	24.26	5.82
Four square step test time	24.46	12.08

Table 4

Correlation of BMI with BERG BALANCE SCALE.

Table 5 **Correlation – BMI with BBS score**

	r value	p value
BMI with BBS Score	**-0.39**	**0.003**

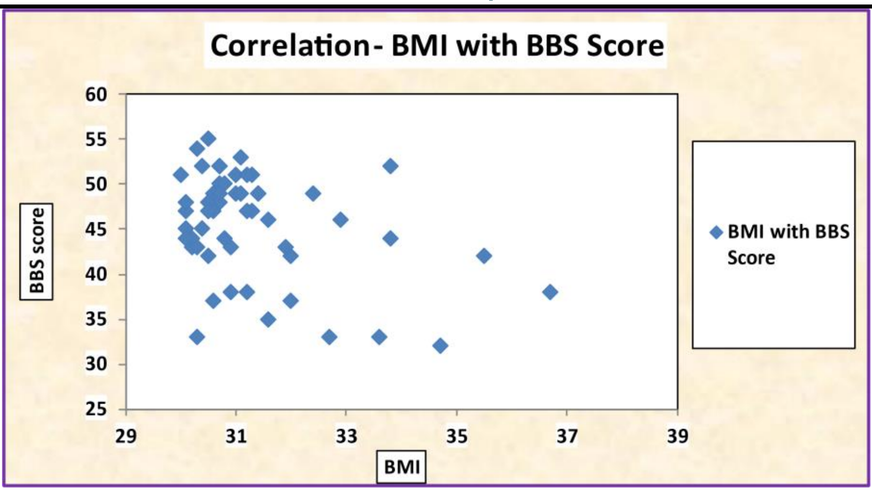


fig 2

The correlation between BMI with BBS Score was found with KARL PEARSON'S Correlation coefficient. The correlation coefficient value was -0.39 with p value 0.003 as shown in table 5 .
Here the r value is -0.39 which shows significant negative correlation between BMI with BBS score.
This concludes that as BMI increases BBS SCORE will decrease significantly.

Correlation - BMI with FSST Time

Correlation – BMI with FSST Time Table 6

	r value	p value
BMI with FSST Time	-0.52	0.000

Table 6

* p value less than 0.05, shows the significant correlation.

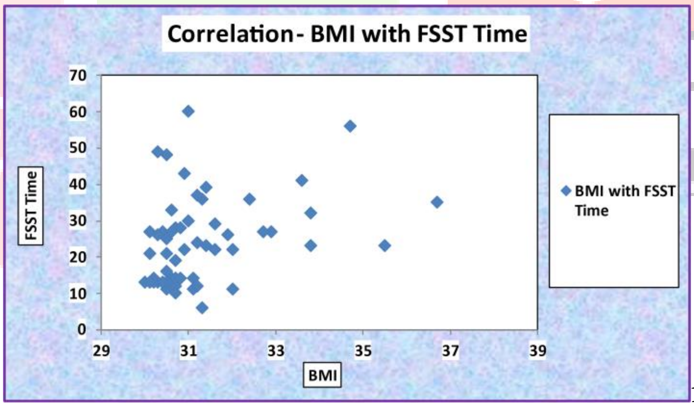


fig 3

The correlation between BMI with FSST time was found with Karl pearson's corelation coefficient.
The correlation coefficient value was -0.52 with p value 0.000 as shown in table 4.
Here the r value -0.52 shows a significant negative correlation.
This concludes that as BMI increases the four-square step test time decreases.

Correlation of BMI with FUNCTIONAL REACH TEST Distance

Table 7 **Correlation - BMI with FRT Distance**

	r value	p value
BMI with FRT Distance	**-0.402**	**0.002**

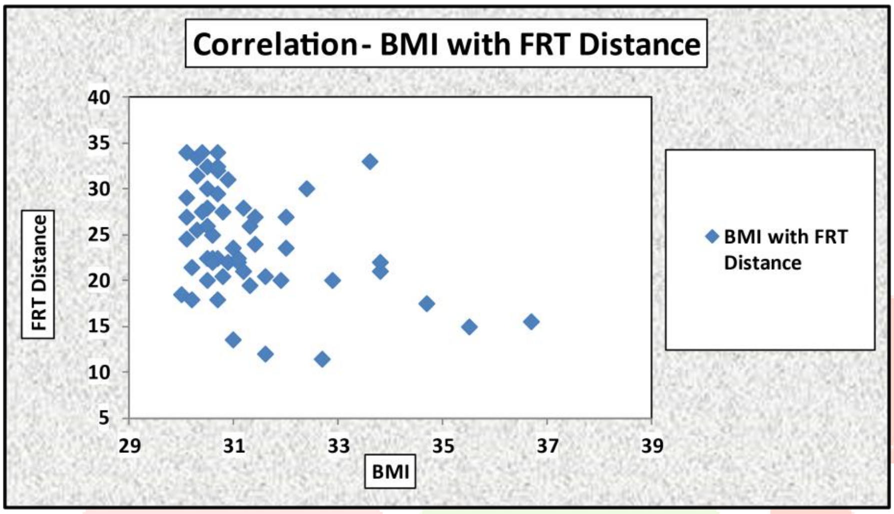


Fig 4

The correlation between BMI with FUNCTIONAL REACH TEST was found with KARL PEARSON'S correlation coefficient.
The correlation coefficient value was -0.402 with p value 0.002 as shown in table7.
Here the r value -0.402 shows the significant negative correlation.
This concludes that as BMI increases the Functional reach distance decreases.

DISCUSSION

- The study was designed in order to find out correlation of obesity with balance in the geriatric population. The study included 21(37.5%) male and 35 (62.5%) female. The mean age of the subjects was 67.55±3.27 years and BMI was 31.30±1.39 kg/m^2. The present study on comparing the BMI with the balance assessment tools found out that when BMI was compared with berg balance scale, functional reach test and foursquare step test with p value 0.003,0.002 and 0.000 respectively and the r value -0.39, -0.402 and -0.52 respectively. The p value was less than 0.05 and negative r value which had a significant negative correlation with the balance assessment tools.
- In the study carried out by Jae Joon Lee et al. (2020) on Relationship between obesity and balance in community dwelling elderly population-a cross sectional analysis found that the mean score out of 56 in BBS was 52.52 points in obese individuals and in accordance with the present study the mean score of BBS of the subjects was 45.58 points. The score obtained in the present study suggested for fall risk i.e. ranging from 45 to 51 points.[27] Even the r value of present study which was -0.39 shows a negative correlation.
- The balance in geriatrics is observed by the ability of the subject to complete the task without losing the balance and getting scored accordingly. This included the static and dynamic balancing skills to perform the task.
- In accordance with the study carried out by Rafi Mohammad et al.(2020)about The influence of age, gender and BMI on balance and mobility performance in Indian community dwelling older

population when compared the BBS with BMI has a p value of 0.71 which is more than 0.05 and FRT distance with BMI has a p value 0.78 which is also more than 0.05.In the present study the BMI was correlated with FRT distance which had a significant negative correlation with (p=0.002 , r =-0.402) and also related to BBS(p=0.003,r=-0.39) .[29] Postural control is associated with dynamic balance or movement. The arm movement are coupled with stabilizing postural activity of trunk and arm. The above has been shown in accordance with a study carried out by Pamela Duncan et al. of title Functional reach: A new clinical measure of balance. This interprets that as age increases the functional reach distance decreases which relates with the present study that with increase in BMI FRT distance decreases.

- In accordance with the study a carried out by Kimberly Cleary (2017) about Predicting falls in older adults using the Four-square step test, subjects at high risk for falling (as determined by 15 sec threshold score) were more likely to experience the decreased balance or fall[28].

- In the present study FSST time shows a negative correlation with the BMI r value=-0.52. It had an average time of 24.46 sec which stated the time ≥15 sec for subjects was under high risk of fall or losing the balance. The clinical test of performing the task with quick change of direction and foot coordination helps in the assessment of the ability to control the body balance with the change in the base of support and body direction.
- In accordance to a study carried out by Maxime Dutil et al(2012) The impact of obesity on balance control in community-dwelling older women the study suggested that posture control is affected by obesity. As postural instability or balance control deficits are identified as a risk factor for falling, our results also suggest that obesity in older women could be considered as another potential contributing factor for falling.[16]
- The reduced plantar sensitivity from a hyperactivation of the plantar mechanoreceptors due to the continuous pressure of supporting a large mass. The greater mechanical demand due to the large body mass per se and a nonnegligible proportion of body mass further away from the axis of rotation (i.e.), Ankle joint assuming an inverted pendulum model) that causes a greater gravitational torque. Consequently, to maintain upright stance, this gravitational torque that accelerates the body must be countered by muscular torques.[16]
- Combining the mechanical constraints and the reduced plantar mechanoreceptor sensitivity of obese individuals with the known altered sensory capabilities of older persons it was studied that older over Weight or obese individuals would have even greater difficulty controlling balance than normal weight older persons. Because balance control disorders have been identified as a risk factor of falling.[16]

CONCLUSION

1. In the present study it was noted that the obesity in geriatric population had a negative correlation with balance assessment test i.e. berg balance scale, functional reach test and four square step test.
2. The ability to complete the given functional tasks tends to decrease as obtained by the balance assessment tools.
3. The above outcome measures evaluated the static and dynamic balance of the subjects in accordance with the obesity.
4. Hence it is concluded that in obese elderly as the BMI increases the balance gets impaired.

SUGGESTION

1. The Comparison of balance and functional mobility can be done between normal BMI and obese individuals .
2. The study could be carried out on a large sample size.
3. The study could have been carried out only on either male or female.
4. The study could be carried out on the basis of specific grade of BMI or old age.

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