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To study the effect of body mass index on postural balance

Savita Tamaria*
Kulmani Sirohi**

ABSTRACT

The purpose of this study was to determine the correlation of BMI on postural balance. **Methods**: A sample of 30 male's subjects took part in the study. All the 30 male volunteer were randomly divided into three groups according to their body mass index as Underweight (Group A), Normal (Group B), and Overweight (Group C) then two balance tests were carried out to evaluate the correlation between body mass index and postural balance. **Results**: showed that high body mass index (BMI) demands more displacements to maintain postural balance. Thus "High body mass index (BMI) effect the postural balance". **Conclusion:** high body mass effects the postural balance

Key Words: Body Mass Index, Functional Reach Test, Time up & go Test

INTRODUCTION

Balance is defined as the process that maintains the centre of gravity within body's support base and requires constant adjustments that are provided by muscular activity and joint positioning. The ability to balance and maintain a stable posture is integral in the execution of most movements. Most nervous and musculoskeletal system diseases can alter this balance control.[1]

Maintaining postural balance requires sensorial detection of the body's movements, integration of sensory-motor information into the central nervous system and appropriate motor response. Muscular control and dynamic maintenance of balance involve the activity of coordinates of muscular kinetic chains[2]. Adipose tissue accumulation and body mass increase can cause a reduction in the body balance and be a major contributing factor concerning falls, particularly when combined with low muscular mass, which can generate biomechanical failure of muscular responses and loss of stability mechanisms[3].

The body mass index (BMI) or Quetelet index is a heuristic measure of body weight based in person's weight and height. It was invented between 1830and1850 by the Belgian polymath Adelphi Quetelet during the course of developing "social physics". Body mass index is defined as the individual's body weight divided by the square of his or her height. Its unit of measure is kg/m*m.[4] While the formula previously called as Quetelet index for BMI new term "body mass index " was published in 1972 in the journal of Chronic Disease by Ancel keys[5]. It is a diagnostic tool of classifying sedentary (physically inactivity) individuals with an average body composition.

A BMI of 18.5 to 25 may indicate of optimal weight, a BMI lower than 18.5 suggest the person is underweight while the value above 25 indicates the person is overweight[6] The BMI is generally used as a means of correlation between groups related by general mass and can serve as a vague means of estimating adiposity[7].

Multiple assessment instruments have been done and evaluated focusing on different aspects of physical performance. Among the physical

Author's Affiliation: *Leturer, **Student, Banarsidas Chandiwala Institute of Physiotherapy, New Delhi.

Reprint's request: Dr. Savita Tamaria, PT, Leturer, Banarsidas Chandiwala Institute of physiotherapy, Kalkaji, New Delhi, Email-savitameena@gmail.com, Phone No- 9818877255.

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performance test measure for body mass index, are the Functional reach test and Timed Up and Go test.

The Functional Reach Test is an assessment tool for balance first developed by Duncan et al in 1990. According to this study, the Functional Reach Test is the maximal distance one can reach forward beyond arm's length while maintaining balance over a fixed base of support. Age -related norms for functional reach have been determined for American population. Scores of less than 7 inches are indicative of a frail individual who is limited in mobility and activity of daily living skills and who demonstrates increased fall risk[8].

The Timed Up and Go test was developed by Podsiadlo and Richardson.Timing with a stopwatch begins when the patient is instructed with "go" and ends when the patient returns to the starting position in the chair. Low score of completion of task in less than 10 seconds correlates with good functional independence, and high score of completion of task in more than 20 seconds correlates with poor independence and higher risk of falls[9].

The purpose of this study was to find out the correlation between body mass index and postural balance.

AIM AND OBJECTIVES

To evaluate the correlation between body mass index and postural balance.

MATERIAL & METHODS

A sample of 30 male's subjects took part in the study. The subjects of this study were students of BanarsidasChandiwala Institute of Physiotherapy, Kalkaji, New Delhi.

All the 30 male volunteer were randomly divided into three groups according to their body mass index as Underweight (Group A), Normal (Group B), and Overweight (Group C) then Functional Reach Test & Time Up & Go Test was performed on them.

A Correlation study design was used in this study to compare the correlation between body mass index (BMI) and postural balance using Functional Reach Test (FRT) and Timed Get Up and Go Test (TUG).

INCLUSION CRITERIA

Age group of 20-30 years, No physical activity for minimum of six months, Absence of neurological, cardiovascular, metabolic, rheumatic or vestibular diseases, No injuries or previous surgery on the leg, The subjects must be ready to take the physical tests, during the course of study.

EXCLUSION CRITERIA

Less than 20 years of age, Less than 90 degree of shoulder flexion, Unable to follow a three step command, Unable to stand unassisted for 60 seconds, Hip or knee joint replacement, Weight bearing pain in the lower limb.

VARIABLES

The dependent variables for this study were Functional Reach Test (FRT), Timed Get up and go test (TUG). independent variables were Body Mass Index (BMI)

PROCEDURE

1. The purpose of the study was explained to the subjects and they were encouraged to participate in the study.

2. Subjects were taken in the study, only if they met the inclusion criteria.

3. The study was initiated only after taking an informed consent from the subject.

4. Subjects were randomly divided into three groups according to their body mass index as Underweight (Group A), Normal (Group B), Overweight (Group C).

5. Verbal description of the procedure was given to the subject. After this, the demographic data was collected, which included Age (years), Weight (kg), Height (cms), etc.

6. A base line assessment of the subject was done prior to the start of the study.

7. Following this, the Functional Reach Test (FRT)- A yardstick is attached to a wall at about shoulder height. The patient is positioned in front of this so that on flexing the shoulder to 90 degree and initial reading on the yardstick can be taken. The examiner takes a position 5-10 feet away from the patient viewing the patient from the side. Position the patient close to the wall so that they may reach forward along the length of the yardstick. The patient is instructed to stand with feet shoulder distance patient apart then make a fist and raise the arm up so that it is parallel to the floor. The examiner take an initial reading on the yardstick, usually the knuckle of the third metacarpal. The patient is instructed to reach forward along the yardstick without moving the feet .The therapist take a reading on the yardstick of the farthest reach attained by the patient without taking a step.[10] (Refer Fig 1) The initial reading is subtracted from final to obtain the functional reach score. and Timed Up and Go Test (TUG)- Performed with the patient wearing regular footwear and sitting back in the chair with arm rest. On the word, “GO” the patient is asked to stand up from the arm chair, walk 3 meters (in a line) then turn and walk back to chair and sit down again. was conducted according to the standardized protocol.[11]

· Subjects were instructed to inform immediately in case of any discomfort during the test. The therapist will record three readings, each reading has been taken at a gap of 5 minutes for both the tests (FRT & TUG) and a rest period of 10 minutes was given between the two tests. The data thus collected in data collection form was recorded.

Figure 1: Subject performing Functional Reach Test (FRT).

Figure 2: Subject performing Timed Get Up and Go test (TUG)

DATA ANALYSIS, CORRELATION COEFFICIENT(r)

Pearson product –moment correlation coefficient, also known as r, R, or Pearson's was used to measure the strength of the linear relationship between two variables that is defined in terms of the (sample) covariance of the variables divided by their (sample) standard deviations.

Formula:

r = "÷y"Nó÷óã

Where r = coefficient of correlation;

÷ = X – X i.e., derivation of the item of series X from the mean (X);

ã = Y –Y, i.e., derivation of the item of series Y from the mean (Y);

ó÷= standard derivation of series X;

óã= standard derivation of series Y;

N = number of pairs of observations.

RESULTS

Correlation of outcome variables of Group A (Underweight) Mean & SD FRT was 6.69 , 2.41 respectively for TUG Mean & SD was 8.48, 2.55 respectively.

Correlation of outcome variables of group B (Normal) Mean & SD FRT was 15.03, 4.58 respectively for TUG Mean & SD 7.51 2.20 respectively.

Correlation of outcome variables of Group C (Overweight) Mean& SD FRT was 8.35, 3.49 respectively for TUG Mean & SD 8.95, 1.59 respectively

Correlation coefficient of body mass index (BMI), Functional reach test (FRT) and Timed Up and Go test (TUG) in Group A, was TUG r = 0.855, FRT r = -0.48

Group B TUG r = 0.987, FRT r = 0.964

Group C TUG r = 0.811, FRT r = - 0.32

Fig 3: Correlation between BMI and TUG in Group A (Underweight)

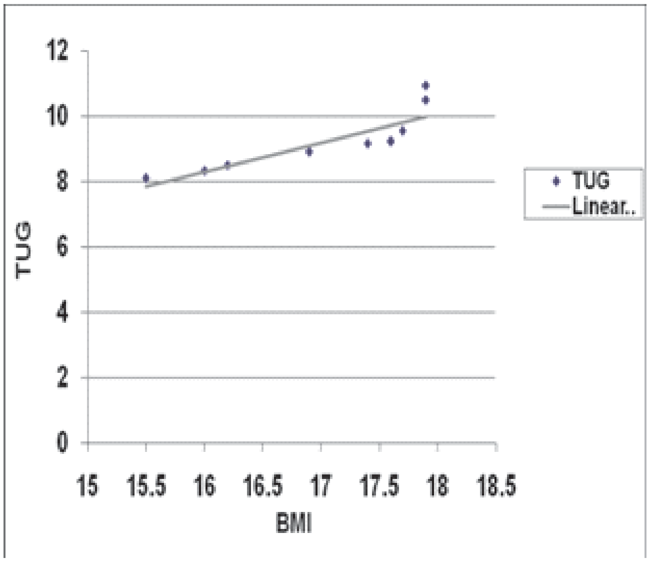


Fig 4: Correlation between BMI and FRT in Group A (Underweight).

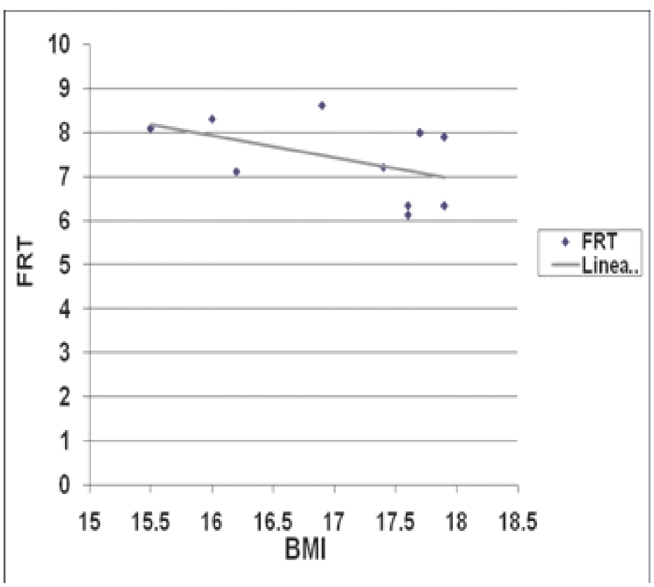


Fig 6: Correlation between BMI and FRT in Group B (Normal)

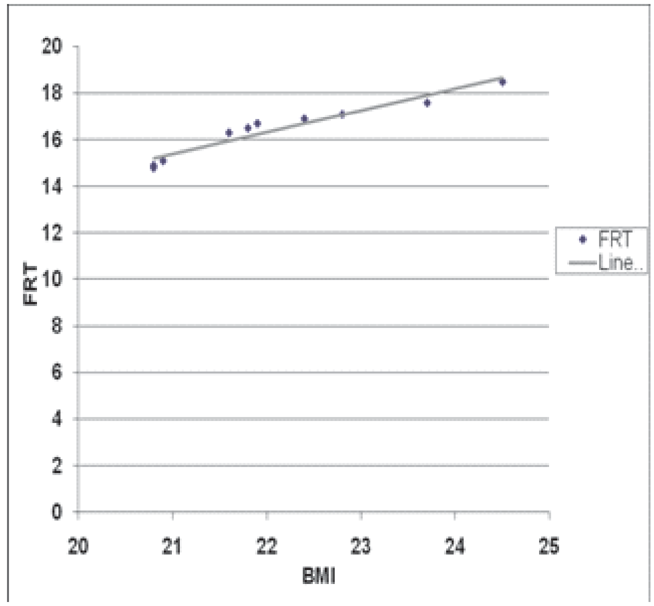


Fig 7: Correlation between BMI and TUG in Group C (Overweight).

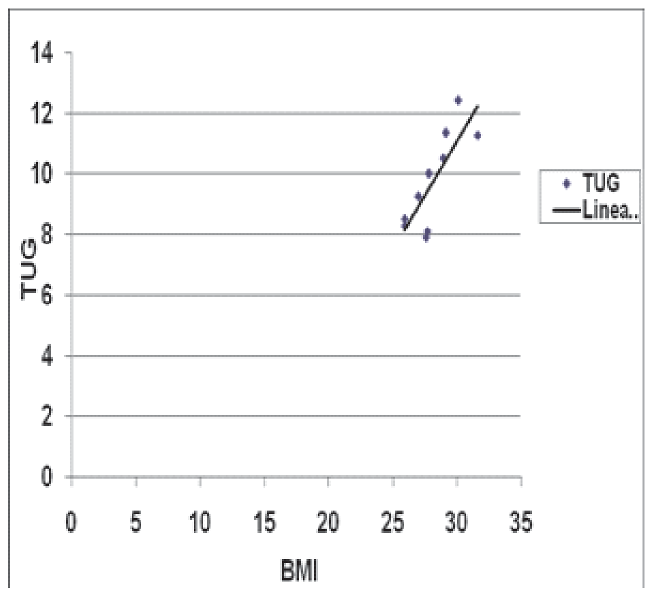


Fig 5: Correlation between BMI AND TUG in Group B (Normal).

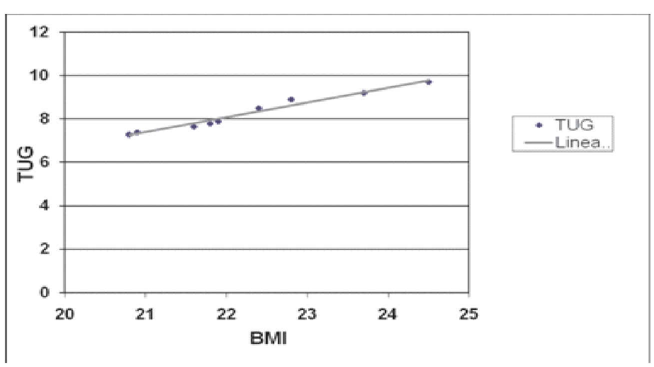
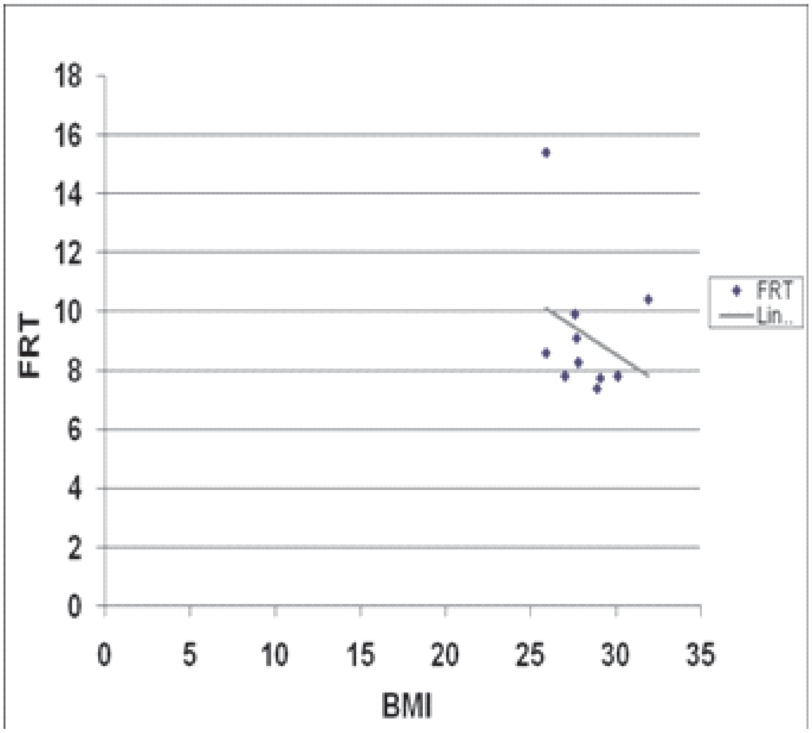


Fig 8: Correlation between BMI and FRT in Group C (Overweight).



DISCUSSION

Proper balance control is a key aspect of activities of daily living .Balance is the process that maintains the COG within the body's support base. Balance emerges from a complex interaction of sensory (afferent) systems, motor (efferent) systems and CNS integration processes[25]. Studies have demonstrated that have BMI is used to assess have much an individual's body weight departs from what is normal or desirable for a person of his or her height .Therefore, clinical assessment of individual's response to exercise is important, as it provides global examination of the sensory, motor and CNS system. Therefore, it is necessary to assess the BMI of individual, as we know that body weight is a strong used clinically to assess the postural balance. The most popular Functional Reach Test (FRT), The Berg Balance Scale, Timed Walking Test and Timed Get Up and Test (TUG).

Functional Reach Test and Timed Get Up and Test are the clinical tool that assesses balance in patients with difficulties in maintaining postural stability. There are many studies done clinically to determine that increase in the body weight leads to improper body mass index which may affect on their work posture and flexibility, but not much is done to determine these factor in healthy individual. Therefore, this study was undertaken to provide a statistical data regarding the correlation between body mass and balance in the adult population.

This study showed a positive correlation between body mass index and increased postural instability (greater shifts required in order to keep postural balance) and was in agreement with Hills (1991), who affirmed that excess weight and low level of physical activity increased postural instability[12]. The authors report that obesity (high body mass index) will affect the selection of motor strategies employed to maintain postural balance[13]

The result of the current study showed that the mean score of Functional Reach Test and Timed Get Up and Go Test for Group A (underweight) is 6.69 and 8.48 , Group B (normal) is 15.03 and 7.513 and Group C (overweight) is 8.38 and 8.95 . The mean difference indicate that high body mass index is significantly correlated with decrease score of Functional Reach Test and decrease in flexibility and the timed get up and go test duration was increased in these subjects when compared with normative data. The correlation coefficient between two indexes (TUG and BMI) in Group (A) and Group (C) is positive which indicate highly significant correlation between body mass and posture stability. The correlation coefficient between (FRT and BMI) in Group (A) and Group (C) is negative which indicate that with increase in body mass index, the score of FRT decreases results in decrease in flexibility and postural dysfunction .This correlation degree allows us to safely infer that the mechanical factor provided by the inertia of the body mass and the effort to balance it against the force of gravity through muscular action is an important element when maintaining posture[14].

These results safely suggest that incorporating the evaluation of body mass index, plus the subjects response to the functional balance tests, can help to understand and thus we use this correlation in order to prevent falls and others incapacities of individuals with high body mass index . A 20% increase in body mass reduces the ability to make adjustments in response to external disturbances in the orthostatic position and increase postural instability[15].

The author JasabantaSethi (2008) conducted a study to indentify the correlation between different body mass index with dynamic posture and flexibility of computer workers. A significant correlation was seen with high body mass index in computer workers with increase scores of dynamic posture and decrease flexibility because increase in body weight can cause alteration in the activity of coordinates of muscular kinetic chain .This study provides the insight to the therapist about the relationship between and posture and flexibility.[16]

Many studies have demonstrated that the anthropometric values such as height, arm's length, age, trunk length and shoulder length were found to affect functional reach score.

The author Veronica Southard conducted a study in 2008, to assess the effect of body mass index on postural stability in the healthy sedentary individuals. While determining the body mass index, the postural control was assessed by TUG test and it was concluded that TUG test duration was increased in these (high BMI) overweight subjects as their gait speed reduced due to the increase in the body weight. Another study states that residential and mobility status were also identified as the strongest predictors of TUG test performance.[17]

Excessive adiposity can also initiate the risk of slipping during walking .It has been demonstrated there is an exponential increase in ankle torque requirements as the body fat increases (Corbeil, Simoneau&Rancourt, 2001) .In addition increased body mass leads to increased moment of inertia about ankle joint (Corbeil, et al 2001), which may present as a disadvantage in the reactive –recovery phase of a typical slip –induced falls.

In year 2007 Angyan L and Teczely T conducted a study to examine the relation ship between body balance functions and body characteristics, motor abilities and reaction time .The results of the study concluded that the increase in body mass index, back muscle strength and endurance capacity is associated with better postural stability. But in contrast to this study many studies states that body weight is a strong predictor of postural stability (Olivier Hue, 2007).[18]

Thus, in support of many studies done in past and the current study it can concluded that the individual with high body mass index maintain shorter times in balance and longer times unbalanced as compared with non –obese individuals, such that obesity would influence the limits of postural stability.

CONCLUSION

Based on the results of the present study, it can be concluded that high body mass index (BMI) demands more displacements to maintain postural balance. Thus it was found that "High body mass index (BMI) effect the postural balance" holds true.

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