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CORRELATION BETWEEN BODY MASS INDEX AND STATIC BALANCE, DYNAMIC BALANCE AND AGILITY IN VARIOUS AGE GROUP: AN OBSERVATION STUDY

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ABSTRACT

Background: Balance refers to an individual's ability to maintain their line of gravity within their base of support. Agility can be defined as the ability to change direction rapidly. With age, individuals display impaired balance control, particularly those that are frail and/or have sensory deprivations. High body mass index value has also been linked to balance and agility but there is deaths of studies performed to link and establish concrete association between body mass index, balance and agility among people of various age groups.

Objectives: To determine the correlation of body mass index with static balance, dynamic balance and agility in various age groups.

Methodology: A total number of 120 subjects of age between 15 to 60 years were analyzed by standing stork test, star excursion test and quadrant jump test to assess the static balance, dynamic balance and agility respectively.

Result and conclusion: The results of this study suggest that there is significant level of correlation of BMI with static balance in 31-45 age group, no significant correlation with dynamic balance and significant level of correlation of agility at 15-30 and 46-60 age groups of healthy individuals. The current study suggests that significant correlation was found for underweight BMI group for static balance and overweight BMI group for dynamic balance in anteromedial direction, posterior direction and anteromedial direction when all the age groups are combined and divided into BMI categories.

Keywords: Static Balance, Dynamic Balance, Agility

INTRODUCTION

Balance refers to an individual's ability to maintain their line of gravity within their base of support. It maintains a stable posture with body mass centre in the domain of base of support while simultaneously counteracting external or internal conflicts.[1] Equilibrium is classified into two groups which consist of static equilibrium which is at rest and dynamic equilibrium which is the state of sound motion. Musculoskeletal and nervous systems along with the associated contextual effects maintain the balance control in an individual.[2] The position of the body and control of the movements is controlled by the visual, somatosensory and vestibular systems.

There are mainly two types of balance. Static balance is the ability to maintain stable antigravity position while it is at rest such as while sitting or standing. This occurs when the centre of gravity of the individual is on the axis of rotation. [3]
Dynamic balance is the ability to stabilize the body when the support surface is moving. While transitioning from one position to the other, two main forces act on the body, gravity and momentum.[4]

Agility can be defined as the ability to change direction rapidly or the ability to change direction rapidly and accurately. It can also be described as the ability to maintain or control body position while quickly changing direction during a series of movement[5] . Agility requires a change of direction and is different from straight line speed performance.[6] Other components of agility are acceleration and deceleration that are involved in change of direction movements and help improving the performance, so those are specific skills that should be trained separately. Agility involves moving upper body segments to change the running direction rapidly without losing balance.[7]

Coordination and movement control are important in agility skills, but apart from this other component affects the level of agility such as dynamic balance, mobility of joints, power and flexibility, resources of energy, strength, speed and biomechanical structure of movement.[8]

Body mass index is a measure of body composition. It is derived by taking a person's weight and dividing it by their height square. BMI is often used to determine the level of health risk associated with obesity. The higher figure in this calculation can be an indicator of obesity. [9]
Measuring body mass can be valuable for monitoring body fat or mass muscle changes.
The Standing Stork Test is used to monitor an individual's ability to maintain a state of equilibrium and balance in a static position. Materials required are stopwatch, a warm dry location to perform the test, a pencil and paper to record the time taken. [10]

The star excursion balance test is a dynamic balance test which examines strength, flexibility and proprioception. It is used to assess physical performance and as a screening tool to find deficits in dynamic balance and postural control. It can also be used as a post- rehabilitation test to ensure dynamic functional symmetry. [11]

METHODOLOGY

Study design: Survey study

Ethical clearance was taken from Institutional Ethical Committee for Research, for this survey study.

Inclusion Criteria: Age group: 15 to 60 years. The participant should not have undergone surgery recently[12]. The participants should not be on any kind of medication. Both male and female were included in this study.
Exclusion Criteria: Age group: < 15 or > 60 years. Pain prevailing due to any accident, injury, surgery or cardiovascular condition in the past[12]. Any neurological or muscular condition present that affects balance. Any psychological condition present.

Outcome measure/ evaluation tools: 1. Standing Stork Test - To assess the static balance 2. Star Excursion Test- To assess the dynamic balance. 3. Quadrant Jump Test- To assess agility.

PROCEDURE:

Total 120 subjects were taken who were fulfilling the inclusion and exclusion criteria. All the participants were informed about the objectives of the study and consent was taken from each participant in the form of signature on the consent form. The participants were then divided into 3 groups on basis of the age. The Group1 was of 15-30 year old (n=40), Group2 consisted of participants of age 31-45 (n=40) and Group3 was comprised of participants of age 46-60 (n=40). Participants were explained about the research. Personal information such as name, age, gender, address, height, weight, contact number etc. was taken. The participants were asked to sign the consent form. BMI was calculated using the height and weight of the participant.

RESULT

Descriptive analysis of age, BMI and scores of Standing Stork Test and Quadrant Jump Test were interpreted by using Pearson's correlation, whereas Star Excursion Test in correlated using Chi square test in IBM SPSS version 20[13].

Total 120 subjects were divided into age group 15-30, 31-45 and 46-60. Each group consisted of 40 subjects. Total 10 subjects were included in the underweight category, 51 subjects were included in the normal category and 59 subjects were included in the overweight category respectively.

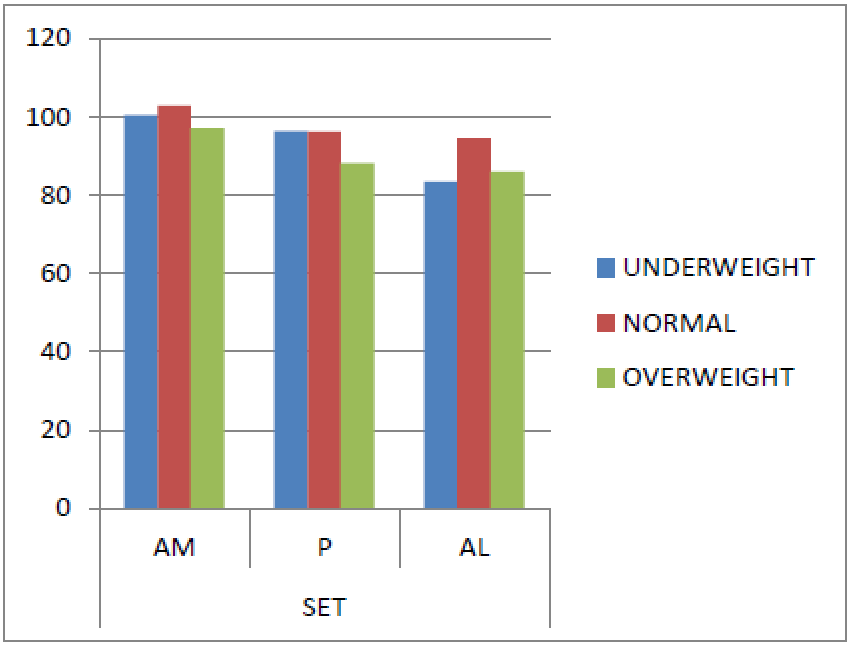
AGE	BMI			Total
	UNDERWEIGHT	NORMAL	OVERWEIGHT	
15-30	7(17.47)	24(21.72)	9(33.51)	40
31-45	1(15.9)	14(22.29)	25(31.08)	40
46-60	2(18.2)	13(23.45)	25(30.76)	40
Total	10	51	59	120

When compared body mass index with standing stork test in various age groups, the mean values of standing stork test where r value was found to be -0.165, -0.441 and -0.398 for the age groups which is statistically not significant at <0.05 level of significant except for the age group 31-45 at p value 0.04 which shows statistical significance.

When compared body mass index with star excursion test in various age groups, the mean values of star excursion test anteromedial r value was found to be -0.1, -0.06 and -0.23 for the age groups which is statistically not significant.

When compared body mass index with quadrant jump test in various age groups, the mean values of quadrant jump test where r value was found to be -0.337, -0.23 and -0.3 for the age groups which is statistically not significant except the age group 15-30 which shows significance at p value 0.03 and 46-60 group which shows significance at p value 0.05.

When compared body mass index with star excursion test in various body mass index groups, the mean values of star excursion test anteromedial are 100.25±9.64, 102.78±22.31 and 97.02±14.83, for posterior values are 96.25±15.09, 96.05±15.71 and 88.15±20.01 and for anterolateral values are 83.37±37.31, 94.50±16.98 and 85.84±15.95 for underweight, normal and overweight groups respectively whereas r value was found to be 0.042, 0.069 and 0.46 for anteromedial direction,0.12, -0.035 and 0.49 for posterior direction and -0.72, -0.046 and 0.05 for anterolateral direction for the groups. Anteromedial direction, posterior direction and anterolateral direction in overweight group show statistical significance at p values <0.05 respectively.



DISCUSSION

This study was intended to provide new information on the correlation of BMI with static balance, dynamic balance and agility in various age groups. The study was carried out as a survey which included subjects from varying age groups. The subjects were divided into 3 groups according to the age as 15-30 years, 31-45 years and 46-60 years accordingly. They were further divided into 3 categories according to the BMI obtained as underweight, normal and overweight in each age group. To test the static balance of the subjects, Standing Stork Test, Star Excursion Test was carried out to measure the dynamic balance while to measure agility, Quadrant Jump Test was used. The findings of the present study show that there is a non-significant correlation of BMI with static balance, dynamic balance and agility[13,14]. Though it is noted that with the increase of age there is a loss in ability to maintain the static balance, dynamic balance and agility[15].

Previous authors have found that in older adults, both static and dynamic balance become poorer as BMI increases. This fact can also be justified on a biomechanical basis. Relating to this, studies show that in obese subjects, predominantly those with a high accumulation of adipose tissue in abdominal area, the center of mass is displaced forward with reference to ankle joint, which then affects the postural control leading to impairment in balance and agility. It has also been seen that obese older adults show a lower planter sensitivity, which results from continuous pressure of supporting a large mass, can also lead to diminished postural control thus resulting in impaired balance[16].

The correlation between BMI and static balance is found to non-significant, the pearson correlation ($r = -0.165$ at $p = 0.31$) for 15- 30 age group, ($r = -0.398$ at $p = 0.11$) for 46-60 age group respectively but shows significance at ($r = -0.0441$ at $p = 0.04$) for 31-45 age group. The correlation between BMI and dynamic balance is found to non-significant, the pearson correlation ($r = -0.1$ at $p = 0.527$) for 15- 30 age group, ($r = -0.06$ at $p = 0.702$) for 31-45 age group and ($r = -0.23$ at $p = 0.14$) for 46-60 age group respectively. The anterolateral direction was found to be the most affected. The correlation between BMI and agility is found to non-significant, the Pearson correlation ($r = -0.337$ at $p = 0.03$) for 15- 30 age group and ($r = -0.23$ at $p = 0.14$) for 31-45 age group but shows significance at ($r = -0.3$ at $p = 0.05$) for 46-60 age group respectively.

Several methodological limitations must be acknowledged which may affect the interpretation of the result present here. First, the sample of subjects included a considerable less amount of underweight individuals therefore the analysis of BMI with relation to balance and agility in terms of underweight individual holds less significance.

CONCLUSION

The results of this study suggest that there is significant level of correlation of BMI with static balance in 31-45 age group, no significant correlation with dynamic balance and significant level of correlation of agility at 15-30 and 46-60 age groups of healthy individuals. Significant correlation was found for underweight BMI group for static balance and overweight BMI group for dynamic balance in anteromedial, posterior and anteromedial directions when all the age groups are combined and divided into BMI categories.

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CONFLICT OF INTEREST :None

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