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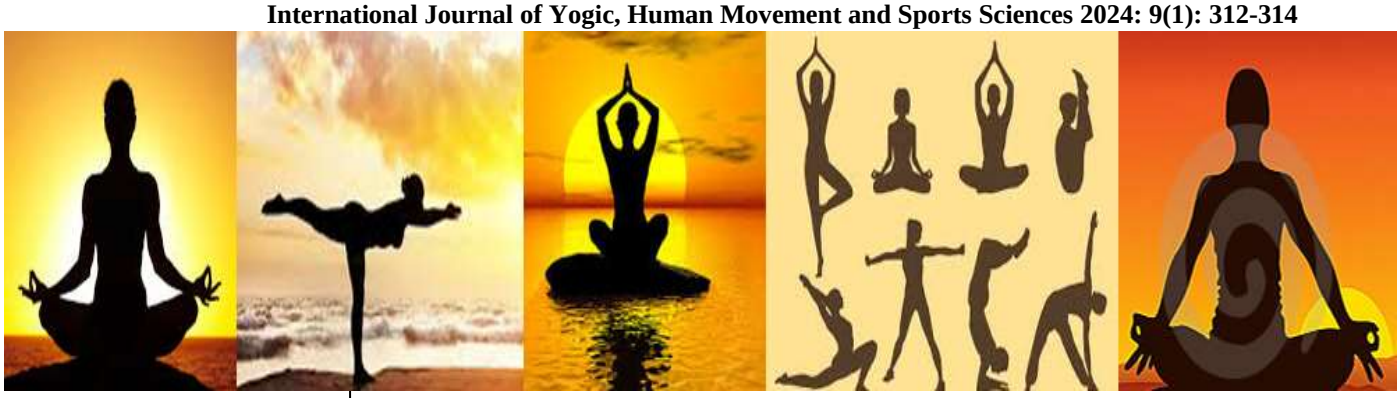

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Correlation of dynamic balance and static balance with body mass index

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Abstract
The study aimed at understanding correlation between individuals of different BMI categories and their dynamic and static balance. Total of 80 subjects participated in the present study. All the subjects who participated in the study were below 25 years of age. Subjects selected for the study was at random. After collecting the consent forms, the height and weight of the subjects were measured using stadio-meter and digital weighing machine. The subjects were categorized as Underweight, Ideal weight, Over weight and Obese based on their body mass index. Pearsons Correlation method was used to evaluate the data collected. The study was purely a quantitative assessment. The results showed statistically significant correlations between body mass index and balance: underweight and ideal body mass index (p<0.005). On the other hand, there was a slightly negative correlation of body mass index of overweight and obese with balance (static and dynamic). It was found that the individuals of overweight and obese body mass index had difficulty in maintaining balance while compared to underweight and ideal weight body mass index. The study concluded that the postural balance (dynamic and static) correlates with body mass index.

Keywords: Dynamic balance, static balance, BMI, posture, overweight

Introduction
The process that maintains the center of gravity within the base support of body is balance. Balance requires constant adjustments provided by muscles and joint positioning (Greve J *et al*., 2017) [1]. Human locomotion maintained by stable posture and good balanced body. Balance or body postural control is so vital for all our daily activities. The sensory, musculoskeletal and the central nervous system plays a major role in postural control and all these systems contributes to keeping the balance or postural control of the body (Swarnalatha S, 2018) [2]. Postural control and balance categorised as static balance and dynamic balance. Static balance is balanced when the body is at rest and the dynamic balance is balanced when the body in motion (Melina Handayani, 2022) [3]. The static balance is the ability to stabilize the center of gravity within a supporting base during static standing, and the dynamic balance is the ability to maintain stable posture within a supporting base during body movement. The objective of this study was to understand relationship of body mass index with static and dynamic balance among postgraduate students. The study hypothesized that body mass index and balance (static and dynamic) correlated.

Methods
Body mass index and balance were measured on subjects. The subjects were randomly selected and consent was collected priorly from the participants who were interested to participate in this study. The height and weight of the subjects were measured by using stadiometer and digital weighing scale. Body mass index were calculated by dividing the weight in kilograms and height in meters. For better understanding the subjects were divided as underweight, ideal weight, over weight and obese according to their BMI.
Balance divided into dynamic balance and static balance. Dynamic balance was assessed by administering Y-balance test. For the test, three Lines drawn on floor in Anterior, posteromedial and posterolateral directions. The lines were over lapped by three measuring tapes. Prior to the test the procedure was clearly explained to all the subjects.

Subject was made to stand on one leg where the ball of touching foot was placed in intersecting point of the three lines. The subject has to reach as far as possible with the opposite leg in each direction (Anterior, Posteromedial and Posterolateral) without losing balance. The point to contact on the measuring tape was taken for reading. The test was followed for both legs. Length of both Limbs was measured before the test administered. Calculation involved taking average of three reach distances. Data was then normalized by dividing it by limb length of the same leg and multiplied by 100. In this study, Flamingo test was performed to measure static balance of the subjects.

Results and Discussion

The objective of this study is to understand the correlation between balance and body mass index. In this study Pearson correlation method was used to assess the relation between BMI and balance.

Table 1: Correlation between balance and Body Mass Index (Underweight and Ideal weight)

Balance	BMI (Under weight)	BMI (Ideal weight)
Dynamic balance (R)	0.4075	0.0414
Dynamic balance (L)	0.3079	0.1298
Static balance	0.4437	0.1333

The table no. 1 shows the correlation between balance and body mass index categories. In Underweight category the dynamic balance of right limb was found significantly correlated with Body mass index as obtained correlation of 0.4075 at the level of 0.05 level of significance. The dynamic balance of left limb also significantly correlated with body mass index as obtained correlation of 0.3079. The above table also revealed that, in ideal weight category the dynamic balance of right limb was found significantly correlated with Body mass index as obtained correlation of 0.0414 at the level of 0.05 level of significance. The dynamic balance of left limb significantly correlated with body mass index as obtained correlation of 0.1298. The static balance also correlates with the body mass index in underweight and ideal categories as obtained correlation of 0.4437 & 0.1333 respectively. It is clearly indicating that there are moderate positive linear relationships between dynamic balance (right), dynamic balance (left), and static balance, and BMI in the underweight category. This means that as BMI increases, all three measures of balance also tend to increase.

Table 2: Correlation between balance and BMI categories (Over weight and Obese)

Balance	BMI (Overweight)	BMI (Obese)
Dynamic balance (R)	-0.1456	-0.0985
Dynamic balance (L)	-0.2221	-0.0691
Static balance	-0.3857	-0.0388

The table no. 2 represents that the correlation between balance and body mass index overweight and obese categories. In Overweight category the dynamic balance of right limb found significantly correlates with Body mass index as obtained correlation of -0.1456 at the level of 0.05 level of significance. The dynamic balance of left limb significant correlate with body mass index as obtained correlation of -0.2221. The static balance of individual also correlates with the body mass index in overweight categories as obtained correlation of -0.3857.

The correlation coefficient between dynamic balance (right), dynamic balance (left) and BMI, as well as static balance and BMI, are all negative. This means that there is a negative linear relationship between these variables. In other words, as BMI increase, dynamic balance and static balance tend to decrease. The above table also revealed that, in obese category, the dynamic balance of right limb found significant correlates with Body mass index as obtained correlation of -0.0985 at the level of 0.05 level of significance. The dynamic balance of left limb significant correlate with body mass index as obtained correlation of -0.0691. The static balance of individual also correlates with the body mass index in obese categories as obtained correlation of -0.0388.

The Pearson correlation coefficient between BMI and dynamic balance (right), dynamic balance (left), and static balance are all negative and very small. This means that there is a very weak negative correlation between BMI and these measures of balance. In other words, as BMI increases, balance tends to decrease.

Earlier similar researches supported the present study results. Body mass index is a major performance determinant of both static and dynamic balance. Obesity and level of muscular fitness are playing major role in balance deficiencies (Hassinen *et al*. 2005) [6]. Obesity has a strong association with decreased balance and potential relationship of balance impairment and BMI. Individuals with high body mass index have impaired dynamic balance control. Earlier studies (Sung Min Son, 2016) [12] opinioned that, over weight and obese individuals have less ability to maintain postural stability compared to ideal weight individuals and suggested obese individuals are have greater risk of fall. Alice *et al*. (2022) [13] revealed that the Obesity negatively impact on balance and observed substantial correlation between obesity and balance. Body weight is a powerful predictor of postural equilibrium and postural sway linked to higher body mass index.

Present study observed that being overweight and underweight affects a person's level of balance. Changes in body mass decreases the ability of muscle tone and decreased muscle strength cause balance problems. Muscle strength is one of the major factor that affect postural balance. Ideal body mass index category person has better muscle strength than non-ideal body mass index category. (Tomlinson D et. al. 2015) [8] Non ideal body mass index associated with decreased muscle performance which affects balance ability of the person.

Conclusion

As a conclusion, the results showed relationship between postural balance and body mass index. Study observed that increased body mass tends to increase balance in lower body mass index categories. And in overweight and obese categories, increased body weight tends to decrease balance.

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