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Original Research Article

EFFECT OF FOOT POSTURE INDEX ASSOCIATED WITH BODY MASS INDEX AND STANDING BALANCE IN HEALTHY POPULATION: AN OBSERVATIONAL STUDY

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ABSTRACT

Background: The ankle and foot complex play a critical role in maintaining erect posture, as also in adaptation to supporting surfaces, The Foot Posture Index (FPI), which was developed by Redmond AC in 1998. FPI provides quantitative measurements of the typical deviations of foot posture and is sensitive enough to detect any structural dysfunction in the foot. The BMI is defined as the body mass divided by the square of the body height, and is universally expressed in units of kg/m2, resulting from mass in kilograms and height in meters. Commonly accepted BMI ranges are underweight: under 18.5, normal weight: 18.5 to 25, overweight: 25 to30, obese: over 30.

Purpose: To find the effect of foot posture index associated with body mass index and standing balance in healthy population

Materials and Methods: An observational study with 30 participants age between 18 to 30 were recruited in the study, where body mass index, foot posture index and standing balance was noted using the balance master.

Results: The study revealed that no statistically significant difference between the foot posture index, body mass index and standing balance

Conclusion: There is no effect of foot posture index associated with body mass index and standing balance in healthy population .

KEY WORDS: Foot posture index, BMI, Balance.

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INTRODUCTION

The ankle and foot complex play a critical role in maintaining erect posture, as also in adaptation to supporting surfaces, in correcting postural sway in single limb stance, in shock absorption and in transition of ground reaction force (GRF) in order to aid the push off during normal gait [1].

Functional variance and minimal biomechanical alterations in the ankle and foot complex in turn alters the contact with the surface area and the peripheral sensory input in weight

bearing posture [2,3]. Changes in neuromuscular posture [2,3]. Changes in neuromuscular strategies alter the ability to maintain a stable and upright posture, and anticipatory postural control is reduced, increasingly predisposing the individual to falls and associated injuries [4]. Structural deviations in the ankle and foot complex predispose the individual to changes in weight bearing, muscle imbalance static as well as dynamic balance in ambulation resulting in compensatory strategies which often predispose the individual to overuse injuries [5-8].

The Foot Posture Index (FPI), which was developed by Redmond AC [9] in 1998, is arthritis research campaign lecturer in the academic unit of musculoskeletal disease at the university of leeds. He has worked in clinical podiatry and foot-related research for the majority of his career, mostly in multidisciplinary gait and lower limb clinics. The FPI was conceived as a part answer to the recurring clinical problem of assessing gait and posture variables reliably in the clinical setting. Work first started on various iterations of the FPI in 1996, with a more formal approach to the development of the FPI as part of his PhD candidature in the faculty of medicine at the university of Sydney. FPI provides quantitative measurements of the typical deviations of foot posture and is sensitive enough to detect any structural dysfunction in the forefoot, midfoot and rearfoot in the frontal, sagittal and transverse planes. It can be used as a screening tool for different inclusion and exclusion criteria in clinical research. This clinical tool can also be used to monitor the outcome of different rehabilitation strategies [10]. FPI-6, a revised version of FPI, was derived from the original eight - item scale. In the new version, two items were removed due to lack of unidimensionality. FPI-6 is said to have moderate to good inter - rater (0.62 to 0.91) and intra-rater (0.81 to 0.91) reliability as well as instrument validity (64%) in measuring foot posture [11,12].

FPI scoring criteria:

The six clinical criteria employed in the FPI-6 are:

a) Talar head palpation

b) Supra and infra lateral malleolar curvature

c) Calcaneal frontal plane position

d) Prominence in the region of the talonavicular joint

e) Congruence of the medial longitudinal arch

f) Abduction/adduction of the forefoot on the rear foot [13]

The BMI is an attempt to quantify the amount of tissue mass (muscle, fat, and bone) in an individual, and then categorize that person as underweight, normal weight, overweight, or obese based on that value. However, there is some debate about where on the BMI scale the dividing lines between categories should be placed [14]. Commonly accepted BMI ranges are underweight: under 18.5, normal weight: 18.5 to 25, overweight: 25 to 30, obese: over 30. Balance is a generic term describing the dynamics of body posture to prevent falling. It is related to the inertial forces acting on the body and the inertial characteristics of body segments [15].

MATERIALS AND METHODS

Institutional Review Board Approval:

The study was approved by the institutional review board and was conducted in conformity with the ethical and humane principles of research.

Patient Enrolment:

A total 30 subjects were recruited from tertiary care set-up in Belagavi. The inclusion criteria included. 1) Adult age group 18 years and above. 2) Participants willing to participate in the study. 3) Symptomatic ankle and foot problems. The exclusion criteria consisted of subjects with unstable / post operative ankle joint, Congenital deformities of foot, Contracture (ankle joint) and Geriatric population. The subjects who agreed signed an informed consent from and their demographic data, symptoms and medical history was recorded.

Outcome Measures:

Body mass index was calculated by and then categorize that person as underweight, normal weight, overweight, or obese based on that

alue. FPI provides quantitative measurements of the typical deviations of foot posture and is sensitivev enough to detect any structural dysfunction in the forefoot, midfoot and rearfoot.

Balance master (libra easy-tec) was used to measure the static balance performance and also area covered by right foot and left foot was measured.

Procedure:

The purpose of the study will be explained and a written informed consent will be obtained from all the study participants. Subjects will be recruited after meeting the inclusion and exclusion criteria prior to their enrolment into the study. A total sample of 30 will be screened during the study period. Subjects weight and height will be noted and body mass index will be recorded. Subjects with increased body mass index ie obesity 1st grade will be having impact on their balance. Full explanations of each the FPI constituent parts are detailed subsequently, and the derivation of each is referenced and detailed. Each of the components tests or observations are simply graded 0 for neutral, with a minimum score of -2 for clear signs for supination, and +2 for clear signs of pronation. The subjects should stand in their relaxed stance position with double limb support. The subjects should be instructed to stand still, with their arms by the side and looking straight ahead. It may be helpful to ask the subjects to take several steps, marching on the sport, prior to setting into a comfortable stance position. During the assessment, it is important to ensure that the subject does not swivel to try to see what is happening for themself, as this will significantly affect the foot posture. The subjects will need to stand still for approximately two minutes in total, in order for the assessment to be conducted. Balance master scale will be used to assess the standing balance of the subjects. The assessor needs to be able to move around the subject during the assessment and to have uninterrupted access to the posterior aspect of the leg and foot of the subjects.

RESULTS

Table 1: Distribution of male and females in the Study.

Gender	No of respondents	% of respondents
Male	4	13.33
Female	26	86.67
Total	30	100

Graph 1: Showing the Graphical representation of Gender distribution.

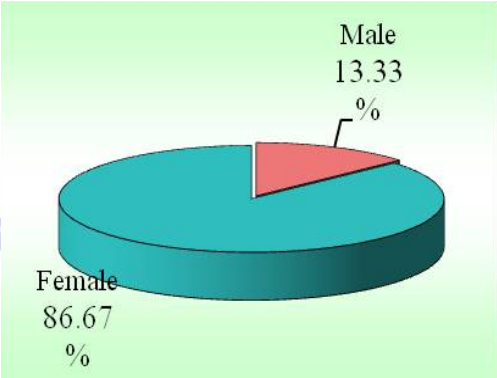

Table 2: Mean and SD age of male and females in the study.

Gender	Mean age	SD age
Male	25.5	8.19
Female	23.65	4.56
Total	23.9	5.03

Table 3: Comparison of male and females with other variables by Mann-Whitney U test.

Variables	Male Mean value	Female Mean value	Z-value	P-value
Age	25.5	23.65	-0.305	0.7603
Height	172	156.92	-3.0199	0.0025*
Weight	85	70.04	-2.5624	0.0104*
BMI	28.74	27.6	-1.3422	0.1795
FPI	8	7.96	-0.5186	0.6041
BMP	17.78	16.6	-0.6101	0.5418
TACBR	9.05	19.79	-0.7016	0.4829
TACBL	83.93	110.92	-1.1592	0.2464

Table 4: Multiple linear regression analysis of BMI

Independent variables	Reg. coeff	SE of Reg. coeff.	t-value	p-value
Constant	27.45	0.786	34.919	0.0001*
BMP	-0.026	0.0527	-0.4943	0.6252
TACBR	0.0009	0.0123	0.0762	0.9399
TACBL	0.0067	0.0081	0.8225	0.4182
R=0.16168, R^2=0.0261, F(3,26)=0.2326, p>0.05, NS, Std.Error of				

*p<0.05

Table 5: Multiple linear regression analysis

Independent variables	Reg. coeff	SE of Reg. coeff.	t-value	p-value
Constant	8.023	1.8593	4.3151	0.0002*
BMP	0.0168	0.1246	0.1344	0.8941
TACBR	0.0071	0.029	0.2439	0.8092
TACBL	-0.0044	0.0193	-0.2259	0.8231
R=0.0693, R^2=0.0048, F(3,26)=0.04184 p>0.05, NS Std.Error of				

*p<0.05

with balance master performance, total area of foot posture index scores with balance covered by right and total area covered by left master performance, total area covered by scores. right and total area covered by left scores

*p<0.05 *p<0.05

DISCUSSION

Understanding foot posture index helps to detect any persistence of deviations beyond a certain stage of development, and also to provide scope for timely intervention to prevent any possible deformities and dysfunctions.

Foot posture has long been considered to influence the mechanical alignment and dynamic function of the lower limb and may therefore be related to the development of lower limb musculoskeletal conditions.

In this study, we investigated foot characteristics of the people with increased body mass index and standing balance with the help of balance master.

A total sample of 30 will be screened during the study period. Subjects weight and height will be noted and body mass index will be recorded. Subjects with increased body mass index i.e obesity 1st grade will be having impact on their balance. Full explanations of each the FPI constituent parts are detailed subsequently, and the derivation of each is referenced and detailed. Each of the components tests or observations are simply graded 0 for neutral, with a minim-um score of -2 for clear signs for supination, and +2 for clear signs of pronation. The subjects should stand in their relaxed stance position with double limb support on the balance master board their performance, total area covered by right foot and total area covered by left foot will be recorded. Comparison of males and females with other variables by Mann-Whitney U test in the age groups of 18-30 years where height in males was 172±4.16 and in females was 156.92±5.71 and weight in males was 85±10.74 and in females was 70.04±14.07 this showed significant difference between height and weight (p=<0.0025) .

Present study correlated with Staheli LT, Chew DE, M. Corbett study in which authors have suggested that some external factors like anthropometry and BMI, which varies across children of different ethnic groups are said to affect foot postures in typically developing children . There is also a significant difference in height (12%) and weight (30%) between children in developing countries and those of western countries, and further research on foot posture development is suggested for more comprehensive information [16].

Similar study was done with the Normative values for the Foot Posture Index (FPI-6) by Redmond et al in 619 adult subjects were obtained and compared to those of 388 subjects aged 3 to 17 years. This study stated that the age and presence of pathology influences foot posture while gender and BMI (body mass index) does not have any effect

Similar study was done by using FPI-6 was conducted by Target et al on 225 children aged 3 to 11 years in the UK and normative values were established. The results of this study suggested that there is an increased occurrence of flat foot in 3 year-old children and a gradual decrease of flat foot with increasing age. The pronated foot in younger children is said to get corrected itself with increasing age development is suggested for more comprehensive information [17].

Present study correlated with Anthony C Redmond, Yvonne Z Crane et al on normative values for the foot posture index the total sample comprised 1648 participants. There were 717 males, 825 females and 116 participants for whom gender was not specified. The mean age was 42.3 years (SD=25.1) with a range of 3 to 96 years. BMI data were available for 1101 participants were normal's from the control arms of studies, with the remaining 641 having

defined pathologies. Only data from normal adults were included in the main analysis, and the data from the pathological groups is reported separately. The normal adult sample comprised 619 observations of a single limb from each participant. Data were first tested for normality and this was confirmed both graphically and by the calculation of skewness and kurtosis statistics (skewness =0.118, kurtosis = -0.096). Left and right side data were compared using Student's t-test to identify any side – related systematic difference between observations (left side mean = 1.9 SD =2.1, right side mean = 1.9 SD = 2.0) This difference was not significant (p=0.983). The mean of the logit scores for the normal sample was 2.4 (SD=2.3). Logit scores were back transformed into FPI raw scores and normal, potentially abnormal and truly pathological ranges defined [18].

In the present study the correlation between body mass index scores with balance master performance, total area covered by right and total area covered by left scores by Karl Pearson's correlation coefficient method did not show any significant difference.

Similar study was done by Al Abdulwahab SS, Kachanathu et al. on various degree of foot posture on standing balance in a healthy adult population with a convenience sample of 41 healthy adult subjects with a mean age of 24.3±6.4 years had participated in the study and found significant correlation between the standing balance and FPI [19].

In the present study the correlation between foot posture index scores with balance master performance, total area covered by right and total area covered by left scores by Karl Person's correlation coefficient method showed no significant difference.

In the present study the multiple linear regression analysis of body mass index with balance master performance, total area covered by right and total area covered by left scores showed statistically significant (p=>0.0001).

In the present study the multiple linear regression analysis of foot posture scores with balance master performance, total area covered by right and total area covered by left scores showed statistically significant (p=>0.0002)

CONCLUSION

There is no effect of foot posture index associated with body mass index and standing balance in healthy population.

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Conflicts of interest: **None**

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