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TO EVALUATE THE FOOT POSTURE INDEX AMONG SCHOOL TEACHERS AND THEIR ASSOCIATION WITH ANTHROPOMETRIC DETERMINANTS AND BALANCE

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ABSTRACT **Background:** The arthrokinematic characteristics of foot misalignment compromise the foot's static and dynamic nature and its capacity to sustain body weight. Teaching needs physical activity such as prolonged standing and effort. Postural changes in the feet cause pain and discomfort. Therefore, the primary aspect of an appropriate clinical response involves evaluation of the foot posture. Significant differences including increased BMI, age, and gender are considered to be causative factors. Therefore, it is important to address this for the benefit of the teachers. **Aim:** To evaluate the Foot Posture Index among School teachers and their association with anthropometric determinants and balance. **Methods:** A cross-sectional study with 60 individuals was included. A self-made demographic questionnaire, Near Tandem Balance test and Foot Posture Index -6 (FPI-6) were administered. **Results:** The balance and foot posture index of the right leg (FPIR) are normally distributed (p-value is less than 0.05). Parameters like age, BMI, and foot posture index of the left leg (FPIL) are statistically insignificant (p-value more than 0.05). Age when correlated with the FPIR and FPIL showed a negative and weak correlation of -0.14 and -0.12 respectively. BMI when correlated with the FPIR and FPIL showed a positive and weak correlation of 0.002 and a negative and weak correlation of -0.078 respectively. **Conclusion:** The common foot posture was maximum neutral and least pronated. There were variations in the left and right foot FPI values in different foot groups. As age increases the foot posture is more likely to be supinated. Balance affection was most common in the pronated foot group.

KEYWORDS : School Teachers, FPI, Balance, Age, BMI

INTRODUCTION

The human foot is an engineering marvel. The design allows the bipedal animal, the human, to walk, run, and jump efficiently over different types of supporting surfaces without pain or injury. It is subjected to impact forces from contact with the ground and must therefore be able to work with the rest of the body to absorb or dissipate the stresses on the structural components of the foot and lower extremity.[7] The foot has a multifaceted efficient role in locomotion because it primarily supports the weight of the body and plays a vital role during movement.[1]The arthrokinematics characteristics of foot misalignment compromise the foot's static and dynamic nature and its capacity to sustain body weight and distribute plantar pressure.[2]

Teaching is one of the jobs that need physical activity such as prolonged standing and effort. However, due to poor foot posture in activities of daily living, such as standing, walking, and jogging, the foot is more susceptible to every day strains.[1]Several factors have been implicated in the high prevalence of pain among school teachers. These included lifting heavy loads, prolonged sitting, improper posture, anxiety level, high job demand/workload, and low peer/colleague support.[3]

Postural changes in the feet can cause pain and discomfort in specific areas of the foot (e.g., forefoot, midfoot, and rear foot) that, over time, can cause injuries due to changes in the force and pressure on the sole, resulting in areas of overload. A lower Medial Longitudinal Arch or pronated foot, features a medial overload of the foot, which can lead to the transfer of large forces to proximal areas, such as the knee, hip, and lumbosacral spine. The increased Medial Longitudinal Arch in the supinated foot leads to larger lateral plantar overloads, which can induce subtalar joint stiffness and therefore place a higher burden on the regions of the forefoot and hind foot. About changes in plantar support and possible susceptibility to the development of lesions (e.g., medial tibial stress syndrome, patellofemoral pain, bone stress reactions), the foot has been the object of many studies.[2] Therefore, the primary aspect of an appropriate clinical response involves early assessment and evaluation of the foot posture.[1]

Various methods are identified in the literature to evaluate standing foot posture. Out of all the measurements, only the Foot Posture Index (FPI) does not require any sophisticated equipment.[1] In addition, the multidimensionality of this approach allows the hindfoot, the midfoot, and the forefoot in all planes of motion to be evaluated.[2]

Some studies have also determined that factors such as age, gender, anthropometric determinants, and balance have an association with the Foot Posture Index (FPI). Significant differences in foot morphology, such as increased BMI were considered to be causative factors that affect the medial longitudinal arch (MLA).[1]

The foot provides a direct source of contact with the ground during standing and walking activities and with pain and/or structural deformity, it is likely in turn to impair balance and consequently increase the risk of falls.[13] To maintain the upright position during balance, both central and peripheral mechanisms of the nervous system regularly interact to control the position of the body and the center of gravity over the base of support.[1] As suggested by Menz et al., the foot contributes to the maintenance of postural stability in two ways: 1) mechanical support for the body via the osteoligamentous arch and the coordinated function of lower limb muscles, and 2) sensory information about body position and proprioception from plantar tactile mechanoreceptors.[14] There is some evidence that excessively flat feet or highly arched feet may impair standing balance in healthy young persons, and a significant association between ankle ROM and balance has been reported in older women.[13]

Need Of The Study:

As there are a lot of articles on the evaluation of the Foot Posture Index in adolescents, school students, and other populations, there is no study done on school teachers who have to stand for prolonged periods and regularly. This being the major literature gap of not having single research done on School teachers is an important issue as there can be various problems that the subjects face and can be brought into the limelight and necessary advice and steps can be taken. Thus, the main purpose of the study is to evaluate the Foot Posture Index among School teachers and their association with anthropometric determinants and balance.

METHODOLOGY:

In this cross-sectional study, the data were collected from 60 individuals for 6 months. Those willing to participate in the study were provided informed consent. A self-made demographic questionnaire was administered using the Direct Interview method. Near Tandem Balance Test and Foot Posture Index – 6 were evaluated. The data were collected and the results were analyzed and graphically presented using SPSS software. MS Office Excel Sheet was used to compile the obtained data. Data was subjected to statistical analysis using Statistical Package for Social Sciences (SPSS v 29.0, IBM). All the parameters were assessed at baseline and the normality test was run using the Kolmogorov-Smirnov test and the data was found to be normally distributed. Pie charts and Graphs were made using Excel for Foot groups, Body Mass Index (BMI), and Balance. Data obtained also had parameters like Age and Body mass index (BMI) which were correlated with the Foot Posture Index using Spearman's Correlational test.

Inclusion Criteria:
- Age group – > 20 years.
- All genders.
- Having a work experience of 1 year.
- Teachers working in teaching but not in administrative positions.
- Full-time teachers (working more than 5 hours).
- No peripheral neuropathy or sensory deficits.

Exclusion Criteria:
- Newly employed teachers.
- Acute or Chronic Orthopaedic conditions.
- No obvious joint deformities or history of orthotic use in lower extremities.
- Vestibular Impairments or any other medical condition that interferes with balance.
- Pregnant women

RESULTS:

This study was performed on School Teachers between the age group 20 to 60 years which included subjects from both genders. We included 60 subjects in the study. The data was compiled on MS Excel and graphs and charts were made and further analysed using SPSS Software. The results of this analysis are discussed below.

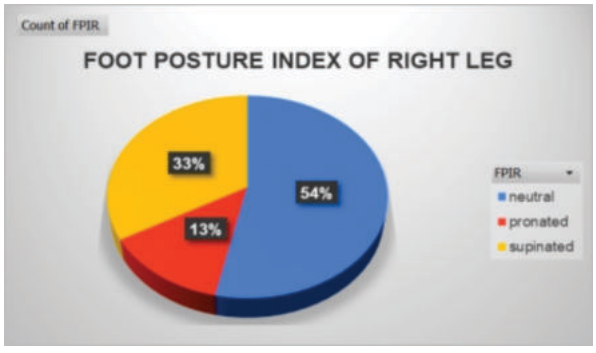
Table 1: Descriptive Statistics (Parameters)

Sr. no	Parameters	Mean	Std. Deviation	P Value	Confidence Interval	
					Lower	Upper
	AGE	42.93	9.20	0.07	40.55	45.31
	BMI	25.74	3.54	0.20	24.82	26.65
	BALANCE	9.31	1.42	0.001	8.94	9.68
	FPIR	0.83	3.65	0.02	-0.11	1.77
	FPIL	1.10	3.78	0.09	0.12	2.07

(BMI - Body Mass Index, FPIR - Foot Posture Index of Right leg, FPIL - Foot Posture Index of Left leg)

Interpretation:

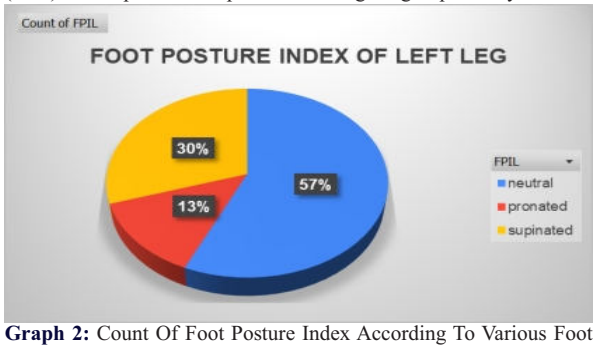
The parameters Balance and FPIR are normally distributed (p-value is less than 0.05). The parameters Age, BMI, and FPIL, when compared, are statistically insignificant (p Value more than 0.05).



Graph 1: Count Of Foot Posture Index According To Various Foot Groups In The Right Leg.

Interpretation:

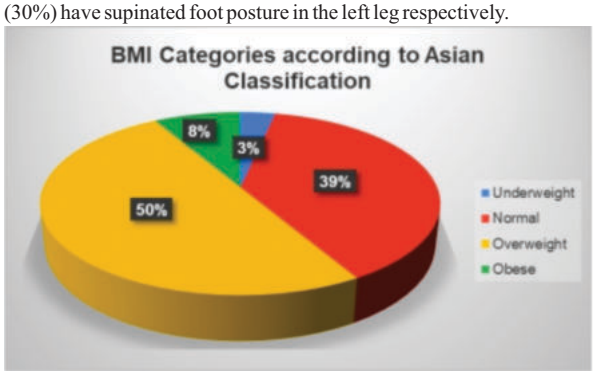
The above graph interprets that out of a total of 60 subjects, 32 (54%) have neutral foot posture, 8 (13%) have pronated foot posture and 20 (33%) have supinated foot posture in the right leg respectively.



Graph 2: Count Of Foot Posture Index According To Various Foot Groups In The Left Leg.

Interpretation:

The above graph interprets that out of a total of 60 subjects, 34 (57%) have neutral foot posture, 8 (13%) have pronated foot posture and 18 (30%) have supinated foot posture in the left leg respectively.



Graph 3: Body Mass Index (BMI) According To Various Categories Of The Asian Classification Of BMI.

Interpretation:

The above graph interprets that out of a total of 60 subjects, 2 (3%) are underweight, 23 (39%) are normal, 30 (50%) are overweight and 5 (8%) are obese according to Asian classification.

Table 2: Correlation Of Age With Foot Posture Index.

Variable 1	Variable 2	r (correlation coefficient)	p Value	Note
AGE	FPIR	-0.14	0.26	Negative and Weak
	FPIL	-0.12	0.35	Negative and Weak

(FPIR - Foot posture index of right leg, FPIL - Foot Posture Index of left leg)

Interpretation:

Age when correlated with the Foot Posture Index of right leg and left leg showed a negative and weak correlation i.e., -0.14 and -0.12 respectively. This indicates that if the subject's age increases their foot posture would be comparatively supinated. According to the p-value, the correlation of age with foot posture index is insignificant as the p-value is greater than 0.05.

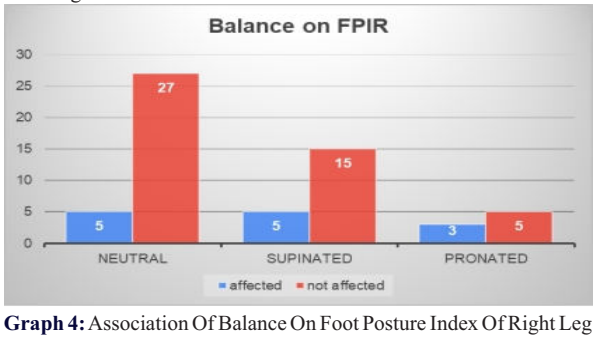
Table 3: Correlation Of Body Mass Index (BMI) With Foot Posture Index.

Variable 1	Variable 2	r (correlation coefficient)	p Value	Note
BMI	FPIR	0.002	0.98	Positive and Weak
	FPIL	-0.078	0.55	Negative and Weak

(FPIR - Foot posture index of right leg, FPIL - Foot Posture Index of left leg, BMI - Body Mass Index)

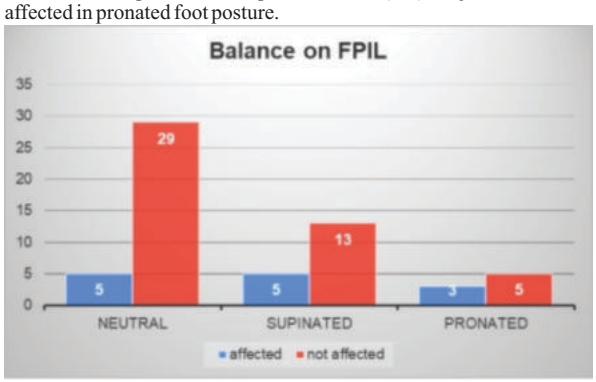
Interpretation:

BMI when correlated with the Foot Posture Index of the right leg showed a positive and weak correlation i.e., 0.002. This indicates that if the subject's BMI increases their foot posture would be comparatively pronated. BMI when correlated with the Foot Posture Index of the left leg showed a negative and weak correlation i.e., -0.078. This indicates that if the subject's BMI increases their foot posture would be comparatively supinated. According to the p-value, the correlation of BMI with foot posture index is insignificant as the p-value is greater than 0.05.



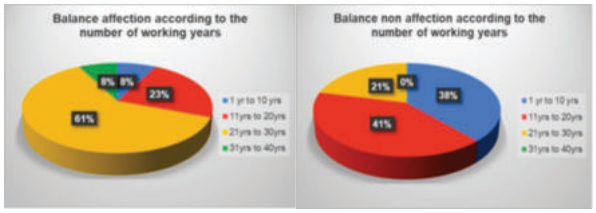
Graph 4: Association Of Balance On Foot Posture Index Of Right Leg In Different Foot Groups.

Interpretation:
The above graph interprets that out of a total of 60 subjects, 27 (45%) subjects' balance is not affected in neutral foot posture, and 5(8%) subject's balance is affected in neutral foot posture 15 (25%) subjects balance is not affected in supinated foot posture and 5 (8%) subjects balance is affected in supinated foot posture.5 (8%) subjects balance is not affected in pronated foot posture and 3 (5%) subjects balance is affected in pronated foot posture.



Graph 5: Association Of Balance On Foot Posture Index Of Left Leg In Different Foot Groups.

Interpretation:
The above graph interprets that out of a total of 60 subjects, 29 (48%) subject's balance is not affected in neutral foot posture, and 5(8%) subject's balance is affected in neutral foot posture .13 (22%) subjects balance is not affected in supinated foot posture and 5 (8%) subjects balance is affected in supinated foot posture. 5 (8%) subject's balance is not affected in pronated foot posture and 3 (5%) subject's balance is affected in pronated foot posture.



Graph 6: Association Of Balance On Foot Posture Index Based On The Number Of Working Years

Interpretation:
The above graph shows that out of a total of 60 subjects, 8% of subjects and 38% of subjects working from 1yr to 10yrs have affection and no affection of balance respectively.23% of subjects and 41% of subjects working from 11yrs to 20yrs have affection and no affection of balance respectively.61% of subjects and 21% subjects working from 21yrs to 30yrs have affection and no affection of balance respectively. 8% of subjects and 0% of subjects working from 31yrs to 40yrs have affection and no affection of balance respectively.

DISCUSSION

This study aims to evaluate the Foot Posture Index among School teachers and their association with anthropometric determinants and balance. 60 school teachers between the age group of 20 to 60 years, who fulfilled the inclusion criteria were selected for the study. This age group was selected as it lies between the period of starting the career and retirement. All the subjects were informed about the nature and course of the study and informed consent was taken from all the subjects before starting the study. The foot posture was evaluated using the Foot posture index - 6 and balance was assessed using the Near Tandem Balance Test. As the foot is a complex multifaceted joint, which plays an efficient role in static and dynamic weight-bearing activities. The foot provides a direct source of contact with the ground during standing and walking activities. Teaching is one of the professions that demand physical activity, such as prolonged standing (for nearly 6 hours at a stretch), walking while teaching inside the classroom, etc. All the above activities make the foot more susceptible to injury and may predispose it to the development of foot pain and deformity. Foot pain and anatomical deformity, can also impair static and dynamic balance and consequently increase the risk of falls. Thus, the primary aspect of appropriate clinical response involves early assessment and evaluation of foot posture. Therefore, the main purpose of the study is to evaluate the foot posture index as it allows the evaluation of the hindfoot, midfoot, and forefoot in all planes of motion among school teachers and their association with anthropometric determinants and balance.

According to the objectives, first, the parameters were assessed which included Age, Body Mass Index (BMI), Balance, Foot Posture Index of the right leg, and Foot Posture Index of the left leg. The statistics of the parameters balance and Foot posture index of the right leg were normally distributed and the others came out to statistically insignificant.

Similarly, through the results of my study, the Foot Posture Index of school teachers was evaluated and we found out that the foot posture of school teachers had a maximum of neutral foot posture, then supinated and least pronated. However, when the foot posture of the right leg and left leg were evaluated, they had certain deviations. To some extent, the supinated foot was recorded more in the right leg than the left leg, and the neutral foot was recorded more in the left leg than the right leg. In this study, a notable discovery was that the left foot FPI values varied compared to the right foot in different foot groups, mirroring findings previously reported by Cain et al. and Redmond et al. The human body shows asymmetry, with the left foot being more linked to weight-bearing function, while the right foot is more involved in the body's forces during locomotion. In this sense, these variations between the right and left feet are significant in the study and support our hypothesis that side differences can be associated with FPI.[1]

In terms of Body mass Index (BMI), the subjects were categorized into different categories according to Asian Classification and our results demonstrated that maximum subjects belonged to the Overweight category. A correlation of BMI with the Foot Posture Index of the right leg and left leg was done separately. BMI when correlated with the Foot posture index of the right leg showed a positive and weak correlation, indicating that as the BMI increases the Foot Posture would be more likely pronated, whereas the BMI when correlated with the Foot Posture Index of the left leg showed a negative and weak correlation, indicating that as the BMI increases the Foot Posture would be more likely supinated.

This result could be associated with excessive overload on the plantar fascia leading to increase in its thickness. Increased thickness, in turn, increases the tensile forces on the Achilles tendon during the stance phase, as does body weight, and may be the causative factor for its association. Although we found a moderate correlation, our study was not able to determine whether this relationship is the result of a higher BMI effect on plantar fascia or the overloading issue that the weight has on plantar fascia thickness.[1]

We also observed the correlation of age with the Foot Posture Index. Both the extremities showed the same results which has a weak and negative correlation, which indicates that as the age increases the Foot Posture would be more likely Supinated. This observation may be because those studies are frequently limited by the unequal sample size, which may not be representative of the general population.

The results of the present study on balance were done on the Right and Left leg and were observed on different foot groups. The right leg and left leg affection with balance showed a maximum in neutral foot and supinated foot and least in pronated foot.

However, this balance can be interrupted by either reduced afferent feedback or any small dynamic change in the structure of the feet. Therefore, we believe that these minor biomechanical alterations, specifically in supinated foot postures, may affect the peripheral input through changes in joint flexibility by influencing postural-control strategies. It seems that the supinated feet may have difficulty reacting and adjusting quickly when the body attempts to maintain balance. Hence, we conclude that the foot type should be carefully considered during clinical evaluations of balance measurement.[1]

The association of balance on foot posture based on the number of working years was also evaluated. The subjects were divided depending on the number of working years from 1yr to 10yrs, 11yrs to 20yrs, 21yrs to 30yrs, and 31yrs to 40yrs. The results showed maximum affection of balance in teachers working from 21 to 40yrs and no affection was seen maximum in teachers working from 11 to 20yrs. The teachers working from 1 to 10yrs showed equal distribution

of balanced affection and non-affection. This indicates that as the number of working years increases there is some affection seen in balance as they have to stand for prolonged periods for a long time. Therefore, there is a major literature gap which is a limitation of this and should be highlighted.

CONCLUSION

Based on the findings, the common foot posture of both legs was maximum neutral then supinated, and least pronated. There were variations noted in the left foot FPI value with the right foot FPI value in different foot groups. Correlations between age and foot posture index were negative and weak indicating that as the age increases the foot posture is more likely to be supinated. The correlation of Body mass Index and foot posture index of the right leg is positive and weak and of the left leg is negative and weak which indicates that as the BMI increases the foot posture is likely to be pronated and supinated respectively. Balance affection was more common in the pronated foot group than in supinated and neutral foot groups in the right and left leg. Balance affection according to the number of working years ranged from 21 years to 40 years.

LIMITATIONS

An equal number of male and female subjects can be recruited to obtain a gender-based correlation of various parameters. It was conducted only on healthy School teachers; thus, it is unclear how such a relationship may be different for subjects with either lower extremity injury or disease. The results only apply to static foot assessment using the FPI because other clinical measures with dynamic foot evaluation during walking were not considered.

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