

CORRELATION BETWEEN FOOT POSTURE INDEX WITH STATIC AND DYNAMIC BALANCES IN SOCCER PLAYERS

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ABSTRACT

Background: Static and dynamic balance is essential for optimal performance in sport activity. In the case of soccer players, the static dynamic balance are important factors. By the deficiency of the static and dynamic balance they may get more injured. The feet are the only body segments that come into direct contact with the ground surface, especially during weight bearing and gait. When their anatomical and sensorial structure is intact, with no joint or soft tissue changes, they contribute to the maintenance of postural stability. Variations in foot posture also one of the factors that will affect the balance. Some studies shows that postural stability is affected by foot type under both static and dynamic conditions. Screening of the athletes by using FPI to identify risk of injury related to balance problems is important to prevent future serious injuries.

Materials and Methods: Recreational soccer players with BMI between 18–24 were selected from football academies. After obtaining informed consent, each participant underwent the following assessments: Foot Posture Index (FPI) to classify foot posture. Static balance assessed by the Stork Balance Test (both limbs). Dynamic balance assessed by the Y-Balance Test (both limbs). Data were analyzed using correlation statistics.

Results: Right Foot: FPI vs Static Balance: Significant negative correlation ($r = -0.364$) FPI vs Dynamic Balance: Non-significant negative correlation ($r = -0.006$). Left Foot: FPI vs Static Balance: Significant negative correlation ($r = -0.404$), FPI vs Dynamic Balance: Non-significant negative correlation ($r = -0.047$)

Discussion: The results suggest that an abnormal foot posture, as indicated by FPI, negatively impacts both static and dynamic balance. Significant findings with static balance highlight the potential role of foot alignment in postural control. Although the dynamic balance did not show significant results, the trend still suggests an inverse relationship.

Conclusion: This study concludes that FPI is negatively correlated with both static and dynamic balance in recreational soccer players, with a significant correlation noted in static balance on both sides.

Keywords: Foot Posture Index, Static Balance, Dynamic Balance, Soccer Players, Y-Balance Test, Stork Balance Test

INTRODUCTION

Balance, also known as postural control, is described as the ability to maintain a stable base of support with minimal movement and to accomplish tasks

while keeping a stable position. Internal and external pressures, as well as environmental elements, are dynamically integrated to maintain balance [1–

3]. Visual, vestibular, and proprioceptive stimuli are all important in balance regulation. [1, 4]. Balance is the capacity to maintain an upright posture while keeping the center of gravity (COG) within the base of support and with minimal movement. It is described as the ability to complete tasks while maintaining a steady body position and without changing the base of support in a dynamic manner [5–6].

In general, Majority of nervous and musculoskeletal system diseases can change the balance control. Maintaining postural balance requires sensorial detection of movements of our body parts, integration of sensory-motor information into the central nervous system and an appropriate motor response. The position of the body in relation to space is determined by visual, vestibular and somatic-sensitive functions. Muscular control and dynamic maintenance of balance involve the activity of coordinated muscular kinetic chains [7-9].

In all kind athletic events and sports especially soccer like group sports, coordinative abilities depend on the movement control and regulation processes, and they are fundamental in sports, as they allow athletes to easily control their own motor actions. One of the main components of coordinative abilities is balance. Especially in soccer play the static and dynamic balance are very important. So the assessment and training of balance is the important preparatory parts of sports. [10]

Static balance may be assessed by having the individual maintain a motionless position while standing on one or both legs. Whereas, dynamic balance can be assessed by controlling the center of mass with one leg while the leg is reaching for maximum distance. The dynamic balance test has a greater demand on balance and neuromuscular-control system. [1, 11-13]

Static and dynamic balance is essential for optimal performance in sport activity, in the case of soccer players, the static dynamic balance are important factors. By the deficiency of the static and dynamic balance they may get more injured. [1, 14]

The feet are the only body segments that come into direct contact with the ground surface, especially during weight bearing and gait. When their anatomical and sensorial structure is intact, with no joint or soft tissue changes, they contribute to the maintenance of postural stability. [14-16]

Variations in foot posture also one of the factors that will affect the balance. Variation in foot posture can affect the function of the foot and this lead to injuries. Foot posture has long been considered to influence the dynamic function of the lower limb and alignment also, therefore surely the foot posture related to the development of lower limb musculoskeletal conditions. [15]

Factors that may influence balance ability should be considered in examining balance as an outcome measurement as a risk factor for injury in sports. [15, 16]

There are different methods for identifying foot posture. The FPI-6 is an observational scoring system (The foot posture index). It consists of a series of criterion – based on observations of the six constituent measures of (talar head palpation, curves above and below the lateral malleoli, inversion and eversion of calcaneus, bulge in the region of the talonavicular joint, congruence of medial longitudinal arch, and adduction of the forefoot on the rear foot) back foot and fore foot when standing in a relaxed position. [17-21]

For checking the dynamic balance. Y -balance test relatively recent, so its method has been constantly improved and standardized. However, its application has been an important tool in clinical practice, especially in sports. [22, 23]

For checking the static balance Stork balance test. The purpose of this test to measure static balance by evaluating the ability to balance the body in a stationary, upright position using a small base of support. [24-26]

Some studies shows that postural stability is affected by foot type under both static and dynamic conditions. [15, 16]

The playing of football requires a unipedal balance to perform different technical movements such as shooting, dribbling, and passing the ball. The balance in the supporting foot is essential to shoot as accurately as possible. [1, 27]

Static and dynamic balance is an important factor in the soccer play. Soccer play will lead to a substantial number of musculoskeletal injuries. To prevent such injuries rehabilitation specialist, propose balance training programs. [1, 14, 27]

Screening of the athletes by using FPI to identify risk of injury by related to balance problems is important to prevent future serious injuries. [28]

Therefore, this study going to assess how FPI of recreational soccer players is related to static and dynamic balance.

NEED OF THE STUDY

Static and dynamic balance is an important factor in soccer play. Many other factors related directly or indirectly to these static and dynamic balance.

The foot is the most distal segment in the lower extremity chain and represents a relatively small base of support on which the body maintains balance (particularly in single leg stance). Although it seems reasonable that even minor biomechanical alterations in the support surface may influence postural-control and balances strategies, the implication of foot posture index on balance have received little attention to date.

But there is lack of studies is done by the relation between foot posture index to the static and dynamic balances in soccer players.

There for, this study will focus on the correlation between FPI with static and dynamic balances in soccer players.

AIM AND OBJECTIVE OF THE STUDY

AIM OF THE STUDY:

To find out the correlation between FPI with static and dynamic balance in recreational soccer players.

OBJECTIVE OF THE STUDY:

To identify the correlation between static and dynamic balance in soccer players by the following,

1. To evaluate the foot posture. Foot posture index scale (FPI-6)
2. To assess the static balance: Stork test
3. To assess the dynamic balance: Y-balance test.

Then, To find the correlation between FPI and static balance in soccer players.

To find the correlation between FPI and dynamic balance in soccer players.

METHODOLOGY

Source of Data: Recreational soccer players in, Dakshina Karnataka

Recruitment: Subjects were included using convenient sampling.

Method of Data Collection

Research Design: Correlational Study

Type: Observational

Target Population: Recreational soccer players

Duration: 12 months

Study Enrolment: May 2020 – May 2021

Sampling Design: Non-Probability Sampling

Sampling Method: Convenient Sampling

Sample size: 100, based on G power 3 software.

SELECTION CRITERIA

INCLUSION CRITERIA

- Male
- Soccer players
- Age-15-25
- BMI=18-24

EXCLUSION CRITERIA

- Repeated lower extremity injury.
- Recent injuries to ankle , foot, and knee
- History of surgery to the lower extremity
- History of cerebral concussion or visual or vestibular disorder ,Inner ear infection and upper respiratory infection

PROCEDURE

In this study the participants were recruited from football academies in Dakshina Kannada.The sampling was done by judgmental sampling .100 soccer players selected and screened.

Selected recreational soccer players from football academies according to the inclusion and exclusion criteria.

Measured their weight and height to confirm their BMI in-between 18-24.

A signed concern letter collected from all the selected participants.

Then as the first part of the study, assessment of foot posture index done.

Then assessment of static balance done by the stork balance test, and recorded the values on both limbs.

Then assessment of the dynamic balance of the players done by Y-balance test, recorded the values on both limbs.

After collecting all data, the data all are analyzed by statistical method to find out the correlation of the FPI data with static and dynamic balance.

OUTCOME MEASURES

FOOT POSTURE INDEX

FOOT POSTURE INDEX-6

It is an observational study.

It is the most reliable and validated index scale to measure the posture of foot. For measuring the FPI-6 scale, the participant should stand in their relaxed position with double stance position with double limb support. The participant should be instructed to stand still, with their arms by the side and looking straight ahead. It may be helpful to ask the patient to take several steps, marching on the spot prior to setting into a comfortable stance position. During the assessment, it is important to ensure that the participant does not swivel to try to see what is happening for themselves, as this will significantly affect the foot posture.

In this scale we assessed the six components of foot posture. And gave the score according to the guideline from -2 to +2.

Reference value

Normal = 0 to +5

Pronated = +6 to +9, highly pronated 10+

Supinated = -1 to -4, highly supinated -5 to -12

Six components that we measured

1. Talar head palpation
2. Curves above and below the lateral malleoli
3. Inversion or eversion of the calcaneus
4. Prominence in the region of talonavicular joint
5. Congruence of the medial longitudinal arch
6. Abduction or adduction of forefoot on rear foot

STORK TEST

Stork Stand Balance Test (SSBT), SSBT is used for assessing static balance. Before testing participants were given instructions to familiarize with SSBT scoring rules. Then the subjects were asked to put their hands on their hips and unininvolved foot against the medial side of the knee of the stance leg. Each subject maintained this position until the unininvolved limb touched the ground or the hands came off the hips. Each subject maintained the position for the maximum possible time. The best of three trials was recorded for the analysis.

Objectives used

A stop watch.

Y –BALANCE TEST

It is the dynamic balance test.

It is the most recent and easily assessable and highly reliable and validated test. It is the modified form of star excursion test.

A functional movement screening device commonly used to predict the risks of injury in athletes

Simplified version of the Star Excursion Balance Test (SEBT)

Also used widely for the measurement of pre- and post-rehabilitation performance, improvement after performance enhancement programs, dynamic

balance for fitness programs, and return-to-sport-readiness.

The Y-balance test assessing the participants balance on one leg while simultaneously reaching as far as possible with the other leg in three separate directions: anterior, postero-lateral and posteromedial.

Objectives used

Reliable and consistent testing facility (minimum 2*2 meters)

Test administrator.

Y-balance test kit or sticky tap and a measuring tape.

Performance recording sheet.

Scoring System

With the test complete and all performances recorded, the test administrator can then calculate the athletes YBT performance scores using any of, or all of, the following three equations:

$$\text{Absolute reach distance (cm)} = (\text{Reach 1} + \text{Reach 2} + \text{Reach 3}) / 3$$

$$\text{Relative (normalized) reach distance (\%)} = \text{Absolute reach distance} / \text{limb length} * 100$$

Composite reach distance (%) = Sum of the 3 reach directions / 3 times the limb length * 100
In this study we took composite score to assess participants balance.

MATERIALS USED

1. Measuring tapes
2. Weighing machine.
3. Stature meter.
4. Warm and dry location.
5. Stop watch
6. Pen and papers.

	Number of participants	Mean	Standard deviation
FPI ®	100	2.44	3.625
FPI (L)	100	2.44	3.625
S.T ®	100	17.25	8.39
S.T (L)	100	16.77	8.28
Y.B.T ®	100	123.77	12.06
Y.B.T (L)	100	121.21	13.87

DATA ANALYSIS

Table 1: Descriptive statistics of demographic data

Table 1: shows the demographic data of participants that included in inclusion criteria. That are 100 participants' age with mean 20.42 and standard deviation ± 20.42 , height with mean 166.65 and standard deviation ± 4.702 , weight with mean 64.41 and standard deviation ± 4.716 and BMI with mean 23.16 and standard deviation ± 0.758 .

Outcome measures

Table 2: Descriptive data of outcome measures

	Number of participants	Mean	Standard deviation
Age	100	20.42	1.505
Height	100	166.65	4.702
Weight	100	64.41	4.716
BMI	100	23.16	0.758

Table 2: shows that data of outcome measures of all participants left and right foot. That FPI of left and right foot with mean 2.44 and standard deviation ± 3.625 , static balance of right foot that is stork test value with mean 17.25 and standard deviation ± 8.39 , static balance of left foot with mean 16.77 and standard deviation ± 8.28 , dynamic balance of right foot that is Y balance test score with mean 123.77 and standard deviation ± 12.06 and dynamic balance of left foot with mean 121.21 and standard deviation ± 13.87 .

Correlation –FPI with static balance (right side)

Correlations -FPI RIGHT WITH RIGHT STATIC BALANCE				
		F.P.I S ®	S.T ®	
Spearman's rho	F.P.I S ®	Correlation Coefficient	1.000	-.364* *
		Sig. (2-tailed)	.	.000
		N	100	100
	S.T ®	Correlation Coefficient	-.364* *	1.000
		Sig. (2-tailed)	.000	.
		N	100	100

**. Correlation is significant at the 0.01 level (2-tailed).

Table 3: correlation statistics of FPI with static balance (right side)

Table 3 shows that correlation statistics of FPI with static balance (stork test score) of right foot of all 100 participants. It clearly show they both having a negative correlation with significance.

Correlation-FPI with dynamic balance (Right side)

CORRELATION-FPI WITH DYNAMIC BALANCE (RIGHT SIDE)		F.P. I S ®	Y.B. T ®
Spearman's rho	F.P.I S ®	Correlation Coefficient	1.00 00
		Sig. (2-tailed)	.
		N	100
	Y.B.T ®	Correlation Coefficient	-.00 6
		Sig. (2-tailed)	.952
		N	100

Table 4: correlation between FPI with dynamic balance (right side)

Table 4: shows that the correlation between FPI with dynamic balance (Y balance test) on right side. And it shows that negative correlation between them with no significance.

Correlations-FPI LEFT WITH LEFT STATIC BALANCE				
			F.P.I S(L)	S.T (L)
Spearman's rho	F.P.I S(L)	Correlation Coefficient	1.000	-.404**
		Sig. (2-tailed)	.	.000
		N	100	100
	S.T (L)	Correlation Coefficient	-.404**	1.000
		Sig. (2-tailed)	.000	.
		N	100	100

**. Correlation is significant at the 0.01 level (2-tailed).

Table 5: correlation of FPI with static balance (left side).

Table 5: shows that statistics of correlation of FPI with static balance (left side). It shows a clear negative correlation between them with significance.

Correlation- FPI with dynamic balance (left side)

Correlations-FPI LEFT WITH LEFT DYNAMIC BALANCE				
	F.P.I S(L)	Y.B.T (L)		
Spearman's rho	F.P.I S(L)	Correlation Coefficient	1.00	-.047
		Sig. (2-tailed)		.644
		N	100	100
	Y.B.T (L)	Correlation Coefficient	-.047	1.00
		Sig. (2-tailed)	.644	
		N	100	100

Table 6: correlation of FPI with dynamic balance (left side).

Table 6: shows statistics of correlation of FPI with dynamic balance of left foot. It shows a negative correlation in-between them without significance.

RESULTS

This study is correlated the foot posture index (FPI-6) with static balance (stork test) and foot posture index with dynamic balance (Y-balance test). That is this study is focused on both right and left side of 100 recreational soccer players. After collecting the data from the selected participants according to study's inclusion and exclusion criteria, went through the statistical processes in SPSS version 21. Spearman correlation study used for the analysis. Then result found that,

The correlation statistics of FPI with static balance (stork test score) of right foot of all 100 participants

having a negative correlation with significance ($r=-.364$).

The correlation between FPI with dynamic balance (Y balance test) on right side shows a negative correlation between them with no significance ($r=-.006$).

The correlation between FPI with static balance (left side) shows a clear negative correlation between them with significance ($r=-.404$).

The correlation between FPI with dynamic balance of left foot shows a negative correlation in-between them without significance ($r=-.047$).

DISCUSSION

The goal of this research was to see if there was any correlation between FPI with static and dynamic balance in recreational soccer players. We chose recreational soccer players from football academies based on inclusion and exclusion criteria for our project. They had their weight and height measured to ensure that their BMI was between 18 and 24. All of the selected participants signed a letter of concern. Then, as the first phase of the investigation, the foot posture index was assessed. The players' static balance was assessed using the stork balance test, with values recorded on both limbs, and their dynamic balance was assessed using the Y-balance test, with values recorded on both limbs. Following the collection of all data, the data is evaluated using statistical methods to determine the correlation.

Balance, both static and dynamic, is critical in soccer. Many other factors are linked to these static and dynamic balances, either directly or indirectly. The foot is the farthest section of the lower extremity chain, and it provides a minimal basis of support for the body to maintain balance (particularly in single leg stance). Despite the fact that it seems reasonable that even minor biomechanical changes in the support surface could influence postural control and balance strategies, the impact of foot posture index on balance has received little attention to date, and there are few studies on the relationship between foot posture index and static and dynamic balances in soccer players. As a result, the focus of this research will be on the relationship between FPI and soccer players' static and dynamic balances.

Present study compared with one related study conducted by AnandHeggannavar et al on the topic

of- Effect of foot posture index associated with body mass index and standing balance in healthy population: an observational study. This is a 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. In this study they found that no statistically significant difference between the foot posture indexes, body mass index and standing balance. And they concluded that there is no effect of foot posture index associated with body mass index and standing balance in healthy population. In this study they considered the participants with increased BMI with mean in male participants 28.74 ± 0.1795 and in female participants 27.6 ± 0.1795 . [16]

The current study, however, found a link between FPI and static and dynamic balance in soccer players. FPI has a significant negative link with static balance and a non -significant negative correlation with dynamic balance, according to the findings. In contrast to the previous study, we used recreational soccer players with BMIs ranging from 18 to 24. For the balance measurement, we employed a static stork and the Y-balance test. All of these factors could have contributed to a different FPI and balance correlation.

Present study compared with one another study, that study done by Staheli LT, Chew DE, M. Corbett, in which they 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 difference in height (12%) with significance 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. [29]

Similar study was done on the subject of 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 suggested 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 stated 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. [30]

In this present study considered participants as recreational soccer players with BMI in between 18-24 with mean 23.16 ± 0.758 . why considered BMI in this study means BMI does not have role with FPI but of course BMI will affect the balance. One study conducted by Jae Joan Lee et al on relationship between obesity and balance in the community-dwelling elderly population. They concluded that the elderly population with obesity exhibits poor balance performance, and it is associated overall strength and power but logically showed that it is related to the BMI.

Al Abdulwahab SS, Kachanathu et al. conducted a similar study on the effects of different degrees of foot posture on standing balance in a healthy adult population, using a convenience sample of 41 healthy adult subjects with a mean age of 24.36.4 years, and found a significant correlation between standing balance and FPI. They enlisted healthy adults aged 24.3 ± 6.4 and with a BMI of 29 kg/m^2 for this study. They divided the individuals into two groups based on their FPI scores (A=FPI-6-11, B=FPI-0-5), and the standing balance components were examined using computerized dynamic posturography in this study (CDP). By applying the limit of stability (LOS) and the modified clinical test of sensory interaction on balance (mCTSIB).

Because the current study used the static stork test for static balance and the Y-balance test for dynamic balance, these two tests will not provide as accurate results as computerized dynamic posturography. The current study's participants are recreational soccer players. As a result, these could be the reasons for the negative connection found in the current study.

As for the study's flaws, such include the inability to effectively apply the test, which means that for dynamic balance test, a Y-balance test tool is available, which may provide more accurate results than the measuring tape approach. And the participants' attire during the balance tests may affect the results; that is, participants may arrive for the tests wearing a variety of outfits with varying textures, which we believe may affect the dynamic balance values because they must stretch one lower limb while keeping the other stable. Another

constraint is the full participation of participants, which means that differences in mental and physical interests may affect the values of all outcome measures. Suggestions for future studies,

Suggestions for future studies include recruiting appropriate, trustworthy people based on your inclusion and exclusion criteria, and using outcome measures as effectively as possible to increase the accuracy of the values. All measurements should be taken by a single assessor to ensure that all participant's values are correct and accurate. The presence of numerous assessors may result in diverse approaches to the test, resulting in a range of results.

CONCLUSION

This study is concluding that there is a negative correlation between FPI with both static and dynamic balances of both lower limbs in recreational soccer players. And also concluding that there is a significance in negative correlation of FPI and static balances in both lower limb.

SUMMARY

This study focused that to find out the correlation between FPI with static and dynamic balance in recreational soccer players. Statistical analysis of collected data about the foot posture index, static balance and dynamic balance of recreational football players. This study is concluding that there is a negative correlation between FPI with both static and dynamic balances of both lower limbs in recreational soccer players. And also concluding that there is a significance in negative correlation of FPI and static balances in both lower limb.

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