The relationship with balance, foot posture, and foot size in school of Physical Education and Sports Students

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The aim of this study is to investigate the relationship of foot posture and foot size with balance. A hundred and thirteen healthy volunteers were recruited from undergraduate students (Male = 74, Female = 37, age range 18–22). The Foot Posture Index (FPI-6), anthropometric measurements, dynamic balance and static balance measurements were done to investigate the relationships between all the variables. Pearson product’s moment correlation coefficient test was used for statistical analyses. As a result, it was found that there was a weak, negative correlation between the static balance and foot posture variables, $r = -.22$, $n = 113$, $P < .005$. Moreover, there was a weak positive correlation between static balance and heel breadth, $r = -.19$, $n = 113$, $P < .005$; and it was found that there was another small negative correlation between dynamic balance and foot length, $r = -.13$, $n = 113$, $P < .005$. Deficiency in foot posture may lead to some injuries by affecting on balance. This can be very important to both athletes and elderly people.

Key words: Foot posture, foot size, university students, balance.

INTRODUCTION

Variations in foot posture can affect the function of the foot and this may lead to injuries (Redmond et al., 2008; Nigg et al., 1993). There are different methods for identifying foot posture. The FPI is an observational scoring system (the Foot Posture Index); it consists of six validated, criterion-based observations of the back foot and the forefoot when standing in a relaxed position (Redmond et al., 2001; Redmond et al., 2008). Screening of athletes by using the FPI to identify risk of injury is important to prevent future serious injuries (Cain, 2007). Both pronated and supinated foot is a risk factor for sports injuries (Cain, 2007). Balance is defined as the process of maintaining the center of gravity within the body's base of support and it has been used as a measure of lower extremity function (Cote et al., 2005). Factors that may influence balance ability should be considered in examining balance as an outcome measurement as a risk factor for injury in sports (Rosychuk et al., 2005; Emery, 2003). In some research, supinated or pronated foot types are addressed for reason of balance deficiency (Cote et al., 2005; Hertel et al., 2002; Olmsted and Hertel, 2004).

In literature, the relationship of foot posture and injury risk was studied by some researchers (Cain, 2007;...
Table 1. Descriptive Statistics of Participants.

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (year)</td>
<td>21.3</td>
<td>1.63</td>
<td>113</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>1.74</td>
<td>8.02</td>
<td>113</td>
</tr>
<tr>
<td>Weight(kg)</td>
<td>66.6</td>
<td>9.52</td>
<td>113</td>
</tr>
<tr>
<td>Static Balance (time)</td>
<td>1.69</td>
<td>1.86</td>
<td>113</td>
</tr>
<tr>
<td>Dynamic balance (sec)</td>
<td>10.68</td>
<td>4.17</td>
<td>113</td>
</tr>
</tbody>
</table>

MacManus et al., 2004) with very limited research (Cote et al., 2005) to identify if there was any relationship between dynamic or static balance, foot posture and foot size. The aim of this study was to investigate the relationship of foot posture, foot size and balance. Poor foot posture may be controlled by well-designed appropriate footwear or orthoses. After identifying and solving foot posture problem, balance deficiency may be decrease in sports school students for success in their sports performance. Moreover, if the problems are identified early, and with suitable treatment it may minimize elderly from the risk of falling.

**METHOD**

**Participants**

One hundred and thirteen healthy volunteers were recruited from the undergraduate students of the Mugla Sitki Kocman University, School of Physical Education (Male = 74, Female = 37, age range 18–22). Subjects were included in the study who had not sustained any injury in their both lower leg/foot over the past 12 months, had no pain, symptoms or previous surgery in their feet. Health report document signed by a medical doctor was demanded from all participants and informed consent was signed by participants after giving them short information about the study. Each subject’s age, height, weights, foot size (foot length, foot width and heel breadth) were documented (Table 1).

**Measurements**

*The Foot Posture Index (FPI-6):* This item consists of a series of criterion-based observations of the six constituent measures required to assess overall foot posture (*Talar head palpation, Curves above and below the lateral malleoli, Inversion/eversion of the calcaneus, Bulge in the region of the talonavicular joint, Congruence of the medial longitudinal arch, Abduction/adduction of the forefoot on the Rear foot*). For the measurements, participants stood in their comfortable angles with their arms by their sides and looking straight ahead to assess the FPI-6. A 5-point Likert-type scale where lower scores represent a more supinated foot position and higher scores a more pronated position scoring system was used. Ordinal FPI data were converted to Rasch transformed scores allowing the data to be analyzed as interval data (Keenan et al., 2007).

**Anthropometric measurements of foot (foot size)**

Foot size (mm) was measured by using anthropometric set including heel breadth, foot breadth, and length of foot measurements.

**Dynamic and Static Balance**

*Dynamic Balance* was assessed using a Lafayette Instruments Stabilometer (model number 16030-Lafayette, IN). Each subject was given one trial to understand how the apparatus worked and to experiment with foot and body position. From that point, each subject was given a 30 s trial with rest periods between each trial. The best score of the three trials was recorded (Wolkodoff et al., 2008). *Static Balance* was assessed by using flamingo balance test. The participants were asked to stand on their dominant leg. The free leg was flexed at the knee and foot of this leg hold close to the buttocks. After one trial was given the stopwatch was started and counted the number of falls in 60 s (Oja and Tuxworth, 1995).

**Statistical analyses**

SPSS 17.0 Statistical package was used for analyzing data. Pearson product's moment correlation coefficient test was used to analyze correlation between variables (p<0.05). Demographic data were summarized by arithmetic mean and standard deviation values. The difference assumed significance when the ‘p’ value was lower than 0.05.

**RESULTS**

The relationship between Balance, Foot Posture, and Foot Size was investigated using Pearson product’s moment correlation coefficient.

Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity and homoscedasticity. There was a weak, negative correlation between the static balance and foot posture variables, \( r = -.22, n = 113, P < .005 \). Moreover, there was a weak positive correlation between static balance and heel breadth, \( r = -.19, n = 113, P < .005 \) and it was found that there was another small negative correlation between dynamic balance and foot length, \( r = -.13, n = 113, P < .005 \) (Table 2).
DISCUSSION AND CONCLUSION

Our primary findings revealed that foot posture and foot size types were affected in static and dynamic measures. The ability to sense motion in the foot and make postural alterations in response is essential in preventing injury. Our findings suggest that some aspects of postural stability are affected by foot type and posture.

Cote et al. (2005) determine if supinated and pronated foot types influence measures of static and dynamic balance. They found no difference in center of balance or postural sway as a function of foot type. Moreover, their results suggested that postural stability is affected by foot type under both static and dynamic conditions. In our study, we found that dynamic balance and foot posture were associated with each other although static balance was minimally affected by foot type.

Habib and Westcott (1999) found that increased foot length was associated with greater balance ability in children. The age of their subjects differed considerably from that of the subjects in our study; in this study it was found that there was a weak relationship with static balance and heel breadth.

Menz et al. (2005) found that foot and ankle characteristics are significant independent predictors of balance and functional ability in older people. One hundred seventy-six people recruited to their study; they measured foot posture and effects of on balance and it explained up to 59% of the variance in these test scores. In this present study, it was found that there was a relationship between balance and foot posture; it may have similar findings, but their subjects’ age group was older.

Cowley and Marsden (2013) studied the changes in foot posture after a half marathon. They found that foot posture towards a more pronated position may have implications for foot function, and therefore risk of injury. This study group included school of physical education students and it was assumed that they were active in different sports; so it is important result to find relationship with foot posture. This may lead to sports injuries, because foot posture problems can cause balance deficit whether they are in sports activity or not. Some researchers (Dong-chul et al., 2014) suggested some foot exercises for people having foot posture problems to increase their balance ability. This study results show the importance of identifying foot posture problems which is to balance deficiency.

As a conclusion, problems in foot posture may lead to some injuries by affecting balance or result in falls. This can be very important both to athletes and in the future for elderly people. This study suggest that if foot posture problems are diagnosed earlier, it may decrease falls which can cause injuries in both daily and sports activities.

Conflict of Interests

The author have not declared any conflict of interests.

REFERENCES


