The Investigation of Relationship between Stress Urinary Incontinence in Women and Flat Foot by Method of Observing Foot Posture Index 6 (FPI-6) Maede Ansarian, Maghsoud Eivazi Gha...
The Investigation of Relationship between Stress Urinary Incontinence in Women and Flat Foot by Method of Observing Foot Posture Index 6 (FPI-6)

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ABSTRACT
Introduction: There are several reasons named for occurrence of stress urinary incontinence in women, namely postural disorders. This study aims to investigate existence of relationship between flat foot and stress urinary incontinence. Materials and Methods: 85 women participated in this study; 28 stress urinary incontinence female and 57 urinary continence female. It was scored through observation of congruence in foot medial length arch, based on Foot Posture Index 6 (FPI-6) scale laying. Results: There was no significant relationship between right flat foot by method of observing FPI-6 and stress urinary incontinence in women (P = 0.486). Conclusion: Results from the study showed that flat foot could not be a risk factor to stress urinary incontinence. This may be caused by smallness of foot changes effect on pelvic floor mechanism and occurrence of compensatory mechanisms in kinematic chain of distal limbs pelvic girdle.

INTRODUCTION

Pelvic floor disorder namely, urinary incontinence, fecal incontinence and prolapse of pelvic organs, and pain in pelvic muscle are from the numerous problems concerning hygiene in Iran and worldwide [1]. Women suffering from pelvic floor disorder, both physically and affectationally suffer from disorders in their personal and social life. Statistics taken in the level of Iran show that nearly %38.4 to %89 of studied women in different cities suffer from pelvic floor disorders [2,3]. One woman out of each nine ones in America goes under surgery during her lifetime because of pelvic floor disorder among which %30 would need re surgery. It is predicted that in coming 30 years, need for treatments will increase at least %45 [4]. Based on study of Ahmadi et al. factors like internal surgery, presence of osteoarthritis, chronic coughs, rupture during delivery and lack of physical training are considered dangerous factors in the domain of increased incontinence [2]. One of the reasons for urinary incontinence is disability of pelvic floor muscles to proper resisting against increased intra-abdominal pressure. The issue may be caused from damaged neuromuscular, fascia trauma and or change in motor control [5].

First line to treatment of urinary incontinence includes pelvic floor exercises, (muscular contractions of pelvic floor) and changing individuals' behavioral patterns [6]. In the present time, there are some surgical and medicinal treatments for stress urinary incontinence; physiotherapy is considered as primary treatment because of inexpensiveness and having less risks [7]. Fozzatti et al. (2010); concluded that using methods of general postural re-education is another effective method to treatment of women with urinary incontinence. The issue shows a relationship between urinary incontinence in this group of women with pelvic and lumbar disorder and insufficient distribution of inter abdominal pressure in this area and low back pain [8]. Researchers acknowledge that, distal organs' alignment can change pelvic girdle through powers imposed via feet. In fact the reaction between foot and pelvic occurs at reactive behavior kinematically and it is recommended to treatment agents that they should notice alignment too in considering lumbar and pelvis disorder [9]. Different position's impact
of feet on pelvic floor muscles’ activities have been specified by some researchers. Individuals have maximum activity of pelvic floor muscles, in standing position with dorsiflexion. And have minimum rate of activity in position of plantar flexion. This issue is on important factor combined with exercise therapy in stress urinary incontinence [10]. In feet active positions, rate of pelvic floor muscles activity in more than passive positions; and maximum activity pelvic floor muscle was recorded in active plantarflexion by raising hands [11]. Nygaard et al. in their study found a meaningful relationship between decrease in foot flexibility and urinary incontinence. According to Veloshin et al. (1982) and Nigg (1986) whenever feet touch the earth, soft tissue distributes a contact shock to protect pelvis, abdomen, thoracic and cranial content, from undesired effects and walking frequently. Nygaard believes that most of energy should be absorbed by feet that will have more changes in arch's height along middle standing (An stage in gait that midfoot on the ground). Thus a less force is conveyed to pelvic floor and finally, urinary continence substitute with incontinence clinically [12]. Aim of this study is to investigate existence of relationship between flat foot as one of the most important foot disorder and stress urinary incontinence.

**MATERIALS AND METHODS**

This study is of descriptive analytical type. Subjects were 99 women that after getting informed of study's conditions and it is aim participated in this study by filling in content form has been referred to Tabriz city's Alzahra hospital to stress urinary incontinence by diagnose of a gynecologist; were asked; " Whether they have had an experience of leaking urine by coughing, sneezing, laughing or picking a heavy thing during their activities?" [1]; They responded "Yes", They then entered the group of stress urinary incontinence. Method of sampling was in access sampling. Exclude criteria the study were: Having history of delivery by forceps and vacuum, diabetes, hypermobility syndrome, records of any surgery in pelvis and abdominal region, abortion, close of uterus tubule, records of any trauma or surgery in pelvis and distal limbs, congenital bone deformities, consuming urine incontinence drugs, history of lung diseases associated with chronic coughs, record of executing sport with treadmill or jumping sports, existence of any pelvic mass like uterus myoma, more than two time natural delivery, menopause, smoking cigarettes, consuming anti depressive drugs and osteoporosis. Control group consisted of individuals randomly referred to clinic through a summon. They entered the study by completing a content form. They were consistent with our studying group from the view of age and Body Mass Index (BMI). Exclude criteria the study were in addition to mentioned cases was to respond "Yes" to the above question. None of participants were sport women. Fifteen women exited the results analysis because of having fibroma and more than two times delivery. Twenty eight women with stress urinary incontinence and fifty seven ones with urinary continence, with age between 17 to 47 years (average 31.12 years and standard deviation 7.60), average length of 1.58 meter (standard deviation 0.058 m), average weight of 67.74 kg (standard deviation 11.08 kg) and BMI 26.14. Data was gathered through asking and registering the individuals’ information via scoring by observation. Method was based on scoring by observation [13], that height and congruity of foot medial length arch was observed. If arch height was normal and concentrically curved; number "0" was considered; if arch lowered with some flattening in the central portion; number "1" was allocated, if arch very low with severe flattening in the central portion arch making ground contact, number "2" ; if the arch moderately high and slightly acute posteriorly, number "+1"; and if arch high and acutely angled towards the posterior end of medial arch, number "+2" was allocated. Number "0" is normal arch and numbers "1&2" show flat foot.

Exam performance had taken place with written content of the individual. Performing this research was based on giving respect to participants' rights, and contents of Helsinki announcement.

**Statistical analysis:**

Achieved data from the study was investigated and analyzed statistically by using statistical software SPSS18.

In this study p value was considered less than 0.05 which was statistically significant. Normality of data distribution was evaluated by using Kolmogorov – Smirnov exam. The rate of standard error was calculated. Method of sampling was in – access sampling, which were selected among referred individuals to Tabriz Alzahra hospital having the conditions to study. For control group via summon, individuals were selected that had referred to clinic voluntarily and were consistent with our study group from the view of age and BMI. With respect to not finding of any study similar to present study in the results of searching articles and electronic resources; to achieve abundance of flat foot ratio in women group with urinary incontinence, the result from pilot study were used. About 20 women with urinary incontinence were studied. That %70 women with urinary incontinence and %40 of women with urinary continence had flat foot. Next, resultant of flat foot ratio in this group, sample size with power of 80 percent and maximum first type error 0.05 and acceptable difference of final sample size, were calculated by using formula of two ratios resultant.
Results:

Specifications of participant individuals:

In the present study, two groups of women with stress urinary incontinence and urinary continence, having conditions to enter the study were evaluated. Studied subjects were 28 women (%32.9) with stress urinary incontinence and 57 ones (%67.1) with urinary continence. None of the individuals under study, were athletes and they were match the view of the age and BMI. Complete specifications of these people are available in table (1). Individuals ' specifications were compared by using independent- samples T test. Both groups had no significant difference in all case.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Number&amp; percent</th>
<th>Age (year)</th>
<th>Height (meter)</th>
<th>Weight (kilogram)</th>
<th>BMI (kg/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urinary continence</td>
<td>57 (%67.1)</td>
<td>30.31</td>
<td>1.58</td>
<td>64.82</td>
<td>25.93</td>
</tr>
<tr>
<td>Stress urinary incontinence</td>
<td>28 (%32.9)</td>
<td>32.78</td>
<td>1.59</td>
<td>67.60</td>
<td>26.58</td>
</tr>
</tbody>
</table>

| $P$ value               | 0.558           | 0.279      | 0.478          | 0.161             |             |

Marital status of women's two groups is brought in table (2), % 79.4 of individuals that participated were married. By using Fisher's accurate exam, the conditions of marriage were investigated in two groups showing that there was no significant relationship in two groups ($p = 0.377$).

<table>
<thead>
<tr>
<th>Groups</th>
<th>Marital status</th>
<th>Married (number &amp; percent)</th>
<th>number &amp; percent</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urinary continence</td>
<td>7 (%12.3)</td>
<td>50 (%87.7)</td>
<td>27 (%47.4)</td>
<td>57</td>
</tr>
<tr>
<td>Stress urinary incontinence</td>
<td>2 (%7.1)</td>
<td>26 (%92.9)</td>
<td>11 (%19.3)</td>
<td>28</td>
</tr>
<tr>
<td>Total</td>
<td>9 (%10.6)</td>
<td>76 (%79.4)</td>
<td>39 (%45.9)</td>
<td>85</td>
</tr>
</tbody>
</table>

Compare of flat foot via scaling by observation in two groups:

By using FPI-6 scaling on congruency of individuals’ medial longitudinal arch of foot via observing the arch in standing position and equal weight cast on both feet, were scored.

Since data had no significant difference in all case in both right and left foot of individuals using Pearson's consolidation, the analysis of individuals' right side data is mentioned.

Results of both groups using $X^2$ test in table (3) are given.

<table>
<thead>
<tr>
<th>Groups</th>
<th>giving scores to right medial longitudinal arch of foot based on FPI-6 scaling</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urinary continence</td>
<td>1 (%1.8)</td>
<td>27 (%47.4)</td>
</tr>
<tr>
<td>Stress urinary incontinence</td>
<td>0 (%0)</td>
<td>12 (%42.9)</td>
</tr>
<tr>
<td>Total</td>
<td>1 (%1.2)</td>
<td>15 (%17.6)</td>
</tr>
</tbody>
</table>

If individuals having scores 1 and 2 in flat foot group and individuals having 0, -1, -2 in none flat foot group, by using $X^2$ test, results are given at diagram (1).

Thus the zero hypothesis is not refused. Meaning that there is no significant difference for observing flat foot in both groups of women with urinary continence and with stress urinary incontinence ($p = 0.486$).

Results show that 66 people out of 85 ones have flat foot that incudes %77.6.
Diagram 1: flat foot of right foot by scaling with observation in two groups

In next stage, if individuals with score 2 located in individuals with severe flat foot, and rest of samples located in group without severe flat foot; by considering results given at diagram (2) with $X^2$ test, the zero hypothesis would not be rejected. Meaning that there is no significant difference in both groups of incontinence and continence urinary for severe flat foot ($p = 0.297$).

Twenty seven ones had severe flat foot. That it included $31.8\%$ of participants totally.

Diagram 2: severe flat foot of right foot by scaling with observation in two groups

Discussion:

There has not been found a study similar to present one so far. There was no significant difference between number of individuals with flat foot through scaling by observation in both groups of urinary continence and stress urinary incontinence. In this sample of 85 ones, 66 individuals had flat foot, that is $77.6\%$, out of this number, 27 ones had severe flat foot, meaning $31.7\%$ of total participants. This is of importance that outbreak of flat foot in this society of women is more than statistics mentioned. So as in some studies, prevalence of level of flat foot in children and adults is estimated to be $5\%$ [14]. It is likely that high presence of flat foot in two groups of participants may be an effective factor in none significant of difference between two groups.

In some studies, impact of foot position on more proximal parts of body is investigated, that greater intermediations were applied. In some cases these impacts were not significant on pelvis and lumbar. It is possible that results meaningless in present study is also for small changes in medial longitudinal arch's decline, and consequently small effects on pelvic floor's mechanism. From the other side complex changes of foot in kinematic chain of distal limbs till pelvic girdle could be influenced by compensatory mechanisms and it's ill effects may be neutralized to on extent. Khamis et al. have investigated the effect of hyper pronation of foot on pelvic and distal limbs at four positions of standing with neutral ankle on earth, 10, 15 and 20 degree of pronation. Results showed that there is a meaningful difference between foot hyper pronation with leg 's internal rotation, thigh internal rotation and anterior tilt of pelvis bone [9], that in this study, effect of hyper pronation is great. Duval et al. in their study considered effects of eversion and inversion calcaneus on lumbar lordosis and pelvic tilt with 5,10 and 15 degree. Results showed that eversion and inversion calcaneal on pelvic tilt and lumbar lordosis have not a significant effect [15]. Bendix et al. considered the relationship between change in ankle height of lumbar lordosis and pelvic tilt. They put on shoes with $+4.5, 0$ and $-2.5$ heels. By increasing the heel height, lumbar curve increased and pelvic tilt decrease [16]. In another study, excessive foot pronation has been known as the factor to develop deviation in pelvic and chondromalacia [17]. Barwich et al. (2012); in a study reviewed the relationship between foot movements specially excessive foot pronation and it' s effect on distal limbs and lumbar and also sufficient foot functional ostosis. Abnormal foot function specially it's excessive pronation is a risk factor in damage of distal limbs overuse, that includes lumbar, hip, knee, leg and ankle. In theory of increased pronation, it is accompanied with femur and tibia internal rotation and knee valgus and pelvic anterior tilt, that this position increases pressure on concerning musculoskeletal structures and causes overuse damage through micro trauma that occurs frequently in gait cycle. Abnormal pronation results in midfoot destruction and strait on the arch's supportive tissues like plantaris fascia will increase. In static phase, abnormal pronation results in instability of forefoot and as a result, propulsive phase will become idle because
of disorder in first joint of metatarsophalangeal which in turn cause change in gate pattern restriction of hallux. These factor cause change in gait pattern with excessive inversion forefoot, instability of propulsive phase and postural perturbation of changing pattern in putting the weight on feet. Tibia's internal rotation position results in patella's lateral location on femur and patellofemoral pain syndrome. In changing position of pelvis to anterior, strain on pelvic muscles and hip includes iliopsoas, piriformis and gluteus. After that the sciatic great foramen narrows and sciatic nerve may be pressed. Also pelvis anterior rotation causes disc in plane sagittal to become wedge formed. From the other side foot's increased pronation causes strain on lumbosacral. In women because of wider pelvis and femur's more valgus angle and hip's more internal rotation compared to similar men, risk of damage in distal limbs will be more [18]. Mika et al. in their study investigated effect of short heel (4cm.) and long heel (10cm.) and shoeless on time specifications of electromyography of muscles: erector spinae, gluteus medius and biceps femoris. Most of findings concerning the study show that, during of high heel shoes, pattern to activity of hip extensor and lumbar muscles changes. Hip extensor muscles include hamstring and gluteus muscles as lumbopelvic stable during lumbo pelvic rhythm. Putting on high heel shoes, according to the results from this study affects change in coordination of neuromuscular and posture [19].

Pinto et al. by using wedge of 10 degree, investigated the effect of calcaneus increased erosion in three experiments of: without wedge, with one wedge at right foot and wedge on both feet, by using motion analyzer considered the pelvic movement in sagittal and frontal discs. Results showed that one- way and two- way increase of calcaneus erosion cause little but meaningful changes in pelvis. So as the two sided erosion causes anteverision of pelvis and one sided erosion causes lateral tilt of pelvis. According to Botte, hip's inward rotation may cause tension to iliopsoas muscle, and also to capsular ligament of this joint, and finally will cause postural changes in one- side calcaneal erosion, lateral tilt is generated and results in shortness of limbs’ functionality. According to Gurney (2002) and Aebi (2005); calcaneal one sided erosion causes lateral tilt of sacrum base and lumbar scoliosis. Pelvis position also is depended on anatomical factors such as alignment of joints of distal limbs during activities with closed chain (Gurney 2002; Khamis & Yizhar 2007) [20].

Islami in 2006 investigated the effects of 4 wedge in anterior, posterior, medial, lateral of the foot on subtalar joint, ankle, knee, hip, pelvis and trunk; wedges by their change's angle during standing on one foot. it's results showed that in each of four wedges, the mentioned joints' location angle in their movement disc has changed, compared to position without wedge [21]. Betsch et al. (2011); in their study investigated the effects of foot's different position on pelvis and spinal column positions. Foot positions included increased medial and lateral foot, and positive and negative heel height with 5, 10 and 15 mm. changes. More changes up to 40 mm. also was possible but was uncomfortable to individuals. Results showed that there was a significant relationship between heel height change and increased lateral foot and pelvic tilt changes. But there was no significant correlation between foot positions changes and spine posture. An explanation to foot positions changes cannot make a significant change in spine can be because of smallness of foot positions changes. In addition their focus is on fast effects of foot positions changes on spine position. It's long term effects has not cleared yet. Also it is possible that distal limbs and pelvic girdle's kinematic chain compensate a certain amount of changes. Therefore in this study no changes in spine is observed [22]. Nakhaee et al. in their study investigated the correlation between foot's medial longitudinal arch height and rate of damages to ankle and knee in professional runners. Results showed that, there is no relationship between rate of damage to knee and ankle and height of foot's medial longitudinal arch [23]. With regard to the point that, in this study no relationship was found between flat foot and stress urinary incontinence, but a significant association was seen in several studies between low back pain and feet abnormal position. Bird et al. have investigated effect of feet wedges on electromyography activity of erector spinae, gluteus medius muscles during walking. Role of feet's biomechanics influences generation of low back pain in special way. So as sing feet's orthosis is the modality to treat abnormal biomechanical change in distal limbs association with LBP. feet's abnormal pronation leads to generation of internal rotation and a pelvis lateral anterior tilt in a one- sided form that, this may cause increase of strain on some pelvis muscle such as iliopsoas, piriformis and gluteus. And finally causes lumbar rotation towards pelvic anterior and results in change in lumbar dynamic forces during walking. To reduce tension on iliopsoas backward through erector spinae muscles causes muscle fatigueness. It is specified consequently that way feet's abnormal function leads to generate LBP and why it is effective to prescribe orthosis [24]. In some studies the LBP, Lumbar and pelvis position and their effects on activities in pelvic floor muscles are investigate. Sapsford et al. found that sitting different positions are effective on pelvic floor muscles activities [25]. Capson et al. found that, in standing position, level of activities of pelvic floor muscles resting position was higher in hypolordotic posture compared to natural and hyperlordotic posture [26]. In both sexes, sacrum' s posterior rotation leads to increased tension in pelvic floor muscles [27]. Nguyen et al. found that in women with advanced urethra vaginal prolapse, lumbar lordosis is less and their pelvic inlet was less in vertical position compared to women without prolapse [28]. Based on finding of Mattox et al. there is a relationship between spine column curve, means kyphosis of thoracic area and reduced lordosis in lumbar area. This issue causes severity in pelvic organs prolapse. Based on these people' finding, there is an association between abnormal curve increase in spine column and prolapse stages [29]. Of reasons to meaninglessness of correlation between flat foot and stress urinary incontinence in
women, we can name inequality of distribution to number of vaginal deliveries between two groups of women. So as the number of vaginal deliveries is more in stress urinary incontinence group. One of study' limitation was high prevalence of cesarean surgery in women's sample. Because of outbreak of flat foot in woman' sample, perhaps can achieve a significant results by increased sample size.

Conclusion:
There was no significant difference between number of individuals with flat foot among two groups of stress urinary incontinence and urinary continence women. It is suggested that in future studies, individuals with urinary incontinence and foot pronation; the intensity of urinary incontinence is specified, till posed in comparison with control group that similar individuals have conditions to urinary incontinence and normal feet. In under study group, appropriate orthosis must be prescribed and urinary incontinence intensity should be investigated after six months, whether this has had on impact on level of intensity to urinary incontinence or not.

Number of sample size can be increased in future studies. In this study, although number of vaginal deliveries was not more than two, but it's distribution on both groups had a significant difference. Number of deliveries in woman with stress urinary incontinence was more. This note must be under attention in performing other studies.

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