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Prevalence of Flexible Flatfoot Among School-Age Girls

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Background: Flatfoot in children is one of the most common conditions referred to physiatrists for evaluation and treatment. It is caused by the collapse of the medial longitudinal arch of the foot.
Objectives: The study aimed to determine the prevalence of flatfoot and factors that affect it in a population of children.
Patients and Methods: About 290 elementary school girls with an age range of 6 to 11 years were included in this study. For the assessment of flatfoot, navicular drop test was used. The generalized joint laxity was measured by Beighton score.
Results: Prevalence of flexible flatfoot was 34.9%. Flatfoot prevalence was highest among six-year-old and lowest among 11-year-old children ($P < 0.001$). Children with joint laxity were also at higher risk of flatfoot ($P = 0.01$).
Conclusions: This study indicates that younger school-age children with excessive joint laxity are more predisposed to develop flatfoot.

Keywords: Flatfoot; Prevalence; Joint Laxity

1. Background

A foot with absent or abnormally depressed medial longitudinal arch is referred to as flatfoot or pes planus (1). Flatfoot may be flexible or rigid (2). Rigid flatfoot has multiple etiologies and leads to great pain, often requiring treatment. In the case of flexible flatfoot, the flat contour is pronounced with weight bearing, but the arch can be reconstituted when the child stands on his or her tiptoes (3). Physiologic flatfoot is considered developmental and is often seen in children in the first decade of life. Age is a predictive factor for flatfoot in children, and previous research has shown that flatfoot is likely to resolve with increasing age (4-6). In addition, there is a significant association between ligamentous laxity as well as overweightness with flatfoot (7).The presence of flatfoot has long been described as a foot abnormality that is often associated with pain and poor function. For this reason, many parents are anxious to obtain prophylactic advice and treatment for their children with flatfoot. Clinicians often disagree about the management of flatfeet (8, 9), partly because there is no standard approach to its assessment or classification. Different studies were conducted to determine the prevalence of flatfoot in different countries.

2. Objectives

We aimed to establish the prevalence of flatfoot in a population of school-age children, and evaluate cofactors such as age and joint laxity that might affect its development.

3. Patients and Methods

This cross-sectional study included 290 school girls aged 6 to 11 years. The obtained sample was based on cluster sampling of Shiraz schools for the targeted age group in the 2011-2012 school years. As there were no definite studies on prevalence of flatfoot, we used our pilot study results for estimating the sample size for the flatfoot prevalence study. Considering prevalence of 28.3% in the pilot study, 95% confidence coefficient, and 5.5% precision, sample size was calculated at 258. Children with congenital abnormalities below the level of the ankle, cerebral palsy, history of surgery, and musculoskeletal or neurologic diseases that had affected the structure and movement of the lower extremities (including rigid flatfoot) were excluded. Informed consents were obtained from the parents before enrolment in the study.

3.1. Measures

Flatfoot was determined by navicular drop (ND) test. The ND test was performed by calculating the difference in the height of the navicular from the floor when the subtalar joint was positioned in neutraland in a full-weight bearing position. An ND of 6 to 9 mm was considered being within the normal range and an ND of > 10 mm was considered abnormal result. This test has a high intra-, and inter-examiner reliability (10, 11). The generalized joint laxity was measured by Beighton score. A Beighton score of ≥ 4 was indicative of generalized joint laxity (12).

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3.2. Statistical Analysis

Statistical analyses were performed using the SPSS 16.0 (SPSS Inc, Chicago, Illinois, the United States). Chi square test and independent-samples t test were used for analysis. A P value < 0.05 was considered statistically significant.

4. Results

This study included 290 school-age children, four of which were excluded from the study because of rigid flatfoot. Median age of the children was 8.45 years (range, 6-11 years) including: 52 (18.2%) as 6 years old, 46 (16.1%) 7 years old, 44 (15.4%) 8 years old, 52 (18.1%) 9 years old, 47 (16.4%) 10 years old, and 45 (15.7%) were 11 years old. Flexible Flatfoot was detected in 100 students (prevalence, 34.9%). Mean age of children with flatfoot was significantly lower than that of children without flatfoot (P = 0.00), and they had a higher risk of joint laxity compared to the normal group (P = 0.01) (Table 1).

Table 1. Association of Joint Laxity and Mean Age With Flatfoot

	With Flatfoot	Without Flatfoot	P Value
Mean age, y	7.88	8.77	0.00
Joint Laxity, No.			
With	34	38	0.01
Without	66	148	

5. Discussion

Flatfoot in small children is a physiologic phenomenon that is corrected with age as a result of maturation of the muscles and tissues (1, 7). Researchers have used different methods (e.g. Chippaux-Smirak index, foot X-ray, or children footprint with ink) to diagnose flatfoot (1, 6, 13, 14). In our study, we used ND test that has a high reliability. It must be emphasized that visual assessment of the arch height has been found to be unreliable because the amount of fat mass may mislead the clinician to evaluate the foot as flatfoot. Using easily identifiable bony landmarks such as navicular bone increases the reproducibility and may provide a better indication of typical foot function during walking. There have been many reports concerning the prevalence of flatfoot because of various methods to evaluate it. The mean prevalence of flatfoot was 34.9% among our children. Similar studies evaluating the prevalence of flatfoot among school-age children based on disparate criteria have indicated a prevalence ranging from 17% in 9 years old (15), 35.5% in 6-11 years old (14), and 58.7% in 7-12 years old children (4). In another study, the prevalence of flatfoot in Iranian school-age children was 74% (being mild in 23%, moderate in 34%, and severe in 17%) indicating that flatfoot is a common problem among primary school-age students (16). The high prevalence of flatfoot in our study may be due to a wider range of children' sage and higher prevalence of flatfoot in females (14, 15). Lin et al. (1) determined that flatfoot prevalence declined by increasing age in preschool-age children. Moreover, Cetin et al. reported similar findings in primary school children (14) and Stavlas et al. reported the same in children between six and 17 years of age (17). In our study, the decreases in prevalence of flatfoot were proportional to the increase in age; flatfoot prevalence decreased from 48.1% in the six-year-old group to 15.6% in the 11-year-old group. The general pattern of decreasing flatfoot incidence with age is most likely a reflection of continued development of foot structures, manifested by a decrease in the medial fat pad size and appearance of the longitudinal arch upon footprint analysis (17). Our study found that flatfoot was more common in school-age children with joint laxity (25.2%) (P = 0.01). Previous studies supported our results (14, 18), possibly indicating that the prevalence of flatfoot is also consistent with the noted improvement in the joint laxity. Some limitations of this study were observational nature of ND and uncontrolled variables, such as lack of anthropometric quantification for evaluating flatfoot, body adiposity as a potential confounder in the static structure of the feet, and difficulties in assessing short-term and/or long-term loading effects on the feet.

This study discussed the effects of age and joint laxity on flatfoot in school-age children. Other studies have discussed the influence of race, sex, weight, W-sitting, and shoe wear that were not addressed in the current study (6, 19). Future studies should examine more factors such as heredity and living habits and follow them longer. The results of this study indicated that younger children with excessive joint laxity are more predisposed to flatfoot compared with older children with normal joint laxity. Additional research is needed to examine other factors causing pes planus.

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Authors' Contributions

Study concept and design: Kaynoosh Homayouni and Hajar Karimian; Acquisition of data: Kaynoosh Homayouni, Hajar Karimian, Mahshid Naseri, and Narges Mohasel; Analysis and interpretation of data: Hajar Karimian and Mahshid Naseri; Drafting the manuscript: Hajar Karimian and Narges Mohasel; Statistical analysis: Hajar Karimian, Mahshid Naseri, and Narges Mohasel; Administrative, technical, and material support, study supervision, and critical revision of the manuscript for important intellectual content: Kaynoosh Homayouni.

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