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The Occurrence of Congenital Flatfoot in Primary School Children in Dar es Salaam, Tanzania

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Abstract

Background

One of the major reasons for orthopedic consultation during the first decade of life is flatfoot. Flat-footedness may be classified into two main types namely pathological or physiological. The main objective of this study was to assess the occurrence of flatfoot in primary school children in terms of prevalence and anatomical presentation.

Materials and Methods

This study carried out at a primary school in Temeke district in Dar es Salaam. We recruited 159 children between the ages of 6 and 10 years. Any child with a history of foot pathology which may interfere with foot readings e.g. foot ulcers, fractures, sores etc. were excluded from this study. The method proposed to determine flat footedness in this study is the Staheli Plantar Arch Index method.

Results

Only 9.4% (n=15) of the participants examined had flatfoot. Of the 15 participants who had flat foot 46.7% (n=7) had flatfoot bilaterally. The plantar arch index of the right foot of the children examined ranged between 0.39 and 1.65 (mean of 0.87 ± 0.23). The plantar arch index of the left foot of the children examined ranged between 0.26 and 1.91 (mean of 0.88 ± 0.28).

Conclusion

Flatfoot is a relatively common orthopedic condition in childhood with a prevalence of 9.4% in this study.

Keywords: *Flat foot, Plantar arch index.*

Introduction

The arches of the foot are known to be formed in children by the age of five years (1). Studies show that flatfoot is generally common during the first decade of life with greatly variable prevalence (2,3) and may be often ignored by parents and health care givers (4). The condition may present as an isolated condition or with other comorbidities that include ligament laxity, muscular or neurological anomalies, genetic conditions, and collagen disorders (5). Flat-footedness may be classified into two main types namely pathological or physiological. The pathological, or rigid flatfoot, is characterized by a fixed arch that is not modified by the support or lack of support of weight (5). It is known to have multiple etiologies and leads to pain and disability. This often requires treatment given that it is associated to an underlying pathology (6) like congenital vertical talus, tarsalbars, idiopathic short Achilles tendon, and accessory scaphoid bone among others. Theflexible flatfoot is characterized by a normal arch without weight support and flattening ofthe arch during standing (5). It is often prominent during the first decadeof life and can be symptomatic or asymptomatic. Factors such as ligament laxity and overweight contribute to its perseverance (3). The following are risk factors having a very strong association to flat-footedness: male gender, lower age, overweight, and obesity (3).

The prevalence for flat-footedness decreases considerably with age. In three-year old children, the ailment has been reported up to 54% while in the six-year-old group it has been reported to decline to 24% (3). Garcia et al, 1999, found a decreased prevalence of flatfeet in children from low and low-middle class families. He also found amale predilection over females in both social classes. Most children display full development of normal feet by the age of 12 (6). In normal feet, the posterior area bears 61% of the weight, 35% by the anterior area, and only 4% contributes to the mid zone. However, in flatfeet, between 17 and 30% is supported by the mid zone (2). The weight changes from the lateral column to the medial column, which then leads to an abnormal gait in patients with flatfeet. It is thought that plantar fatty pad under the medial longitudinal arch of the foot is responsible for flatfeet in obese children (1). This lessens between two and five years of age when the arch is developed. Another cause proposed for flat-footedness inobese children is the collapse of the medial longitudinal arch because of excessive and continuous load on the foot by the body mass.

Some studies have shown that flat-footedness may be associated childhood overweight and obesity as compared to the children with normal weight due to changes in the structureof the foot, especially of the medial longitudinal arch (1). Studies have found a positive correlation or predication between flat-footedness and increased body weight, age and sex**.** Recent studies in Tanzania have indicated that childhood obesity and overweight are on the rise (7).

Studies involving consequential effect of overweight, nutritional disorders and metabolic diseases have fairly been done and societal awareness thereof has increased recently. However, similar data in regard to musculoskeletal disorders and deformities are scant or fragmented. One available Tanzanian study found a fairly high prevalence of irregular foot arch as a predictor of pes planus in the adult (8). Studies in children have not been done. The main objective of this study therefore, was to assess the occurrence of flatfoot in primary school children in terms of prevalence and anatomical or morphological presentation. This work also aimed at establishing the associated factors which are causal and non-causal in effect suchas age, sex, BMI and inheritance patterns.

Materials and Methods

This was a cross-sectional study. Study samples from a primary school were collected. The school was selected by a convenience sampling technique. Weight, height and BMIof the children were measured to the nearest 0.1cm using a weighing scale, tape measureand the BMI formula respectively. The sample size was 140 students based from the previous study in Nigeria in 2013 (9). This was the most recent research done on flat-footedness in Africa which is near to the country of study i.e. Tanzania. This sample size was determined by the Kish-Leslie method. Children (boy and girls between the ages of 6-10 years) from a public school in Temeke district called Bilal Comprehensive School were the area of study. Every child in a sequence of numbersallocated to them was then chosen for the study. Any child with a history of pathology orconditions in the foot which may cause readings to be altered including foot ulcers, fractures and sores were excluded from this study.

The method proposed to determine flat-footedness in this study was the Staheli Plantar Arch Index method (10). The plantar arch index establishesa relationship between central and posterior regions of the footprint, and it is calculated as follows: a line is drawn tangent to the medial forefoot edge and at heel region. The mean point of this line is calculated. From this point, a perpendicular line is drawn crossingthe footprint. The same procedure is repeated for heel tangency point. We thereby obtained the measurement of the support width of the central region to the foot (A) and of the heelregion (B) in millimeters. The plantar arch index (PI) is obtained by dividing the A value by B value (PI = A/B) (Figure 1)

Figure 3- *Measurement of the width of the central region (A) and heel region (B) of the foot, in millimeters, on a footprint. The plantar arch index is obtained by dividing A value by B value.*

Figure 1. Plantar Arch Index measurement as adopted from Stahel et al, 1987

The children were asked to place the plantar part of both feet onto an ink stamp pad. This was done by ensuring that the children's entire body weight rests on the ink stamp pad. Thereafter, the children were asked to place their feet onto a plain A3 size paper foreach foot so that the print may be copied. The ink stamp pad size was size 8" by 8" so asto make sure that both feet were entirely able to rest on it. Finally, the students were asked to step their feet onto a clean cloth to wipe their feet. Alcohol swabs were presentto remove any ink which does not come off easily. There have been no known effects ofapplying topical ink on children. For this setting it is also one of the most accessible and cheap way for parents to monitor the growth of their children's feet. Trained personnel were present to take the footprints, measurements on weight, height and BMI. Rulers, height boards and weighing scales were used for the above measurements.

Results

Out of 159 participants who were examined, 75 (47.0%) were males and 84 (53.0%) were females. The ages of participants examined ranged between 6 and 10 (mean of 8.3 ± 1.3) years. The weight of the participants ranged between 17 and 71 kg (mean of 25.5 ± 7.2).The height of the participants ranged between 108 and 110 (mean of 124.3 ±8.5) centimeters. The BMI of the participants ranged between 12.1 and 34.7 (mean of 16.3 ± 2.8). The plantar arch index of the right foot of the participants examined ranged between 0.39 and 1.65 (mean of 0.87 ± 0.23). The plantar arch index of the left foot of the participants examined ranged

between 0.26 and 1.91 (mean of 0.88 ± 0.28). Only 9.4% (n=15) of the participants examined had flatfoot. Of the15 participants who had flatfoot 46.7% (n=7) had flatfoot bilaterally. Of the 15 participants who had flatfoot, 66.6% (n=10) were males and 33.4% (n=5) were females (p=0.214, OR=1.944). Of the 15 participants who had flatfoot, 13.3% (n=2) were underweight 53.4% (n=8) were of healthy weight, 20.0% (n=3) were overweight and 13.3% (n=2) wereobese (p=0.074).

Of the 15 participants who had flatfoot, 6.7% (n=1) was aged 6 years, 20.0% (n=3) wereaged 7 years, 26.7% (n=4) were aged 8 years, 26.7% (n=4) were aged 9 years and 20.0%(n=3) were aged 10 years (p=0.974). Of the 15 participants who had flatfoot, only 13.3%(n=2) of them had a parent with flatfoot (p=0.423) (Figure 2).

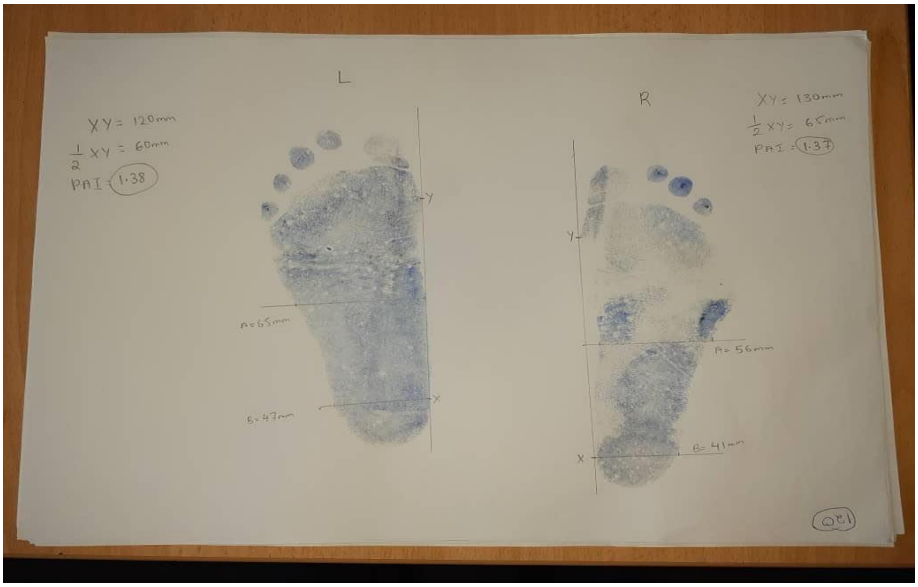

Figure 2A. A print of a child who had flatfeet bilaterally

Figure 2B. A footprint of a child with severe flatfoot bilaterally

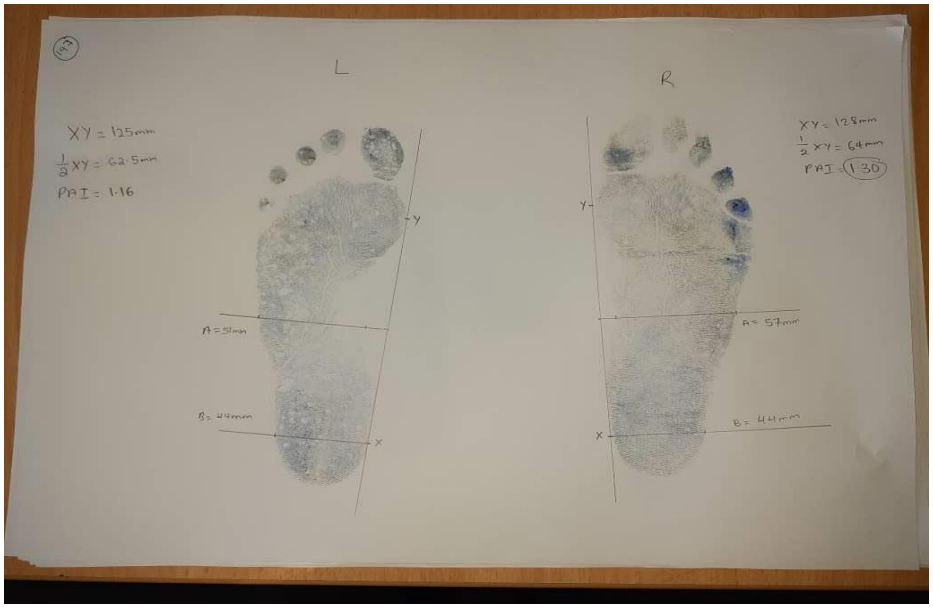

Figure 2C. A footprint of a child with a unilateral right flatfoot

Discussion

This is the first observational study on identifying flatfoot in children in Tanzania. We found a prevalence of 9.4% in the study population. This population is diverse and within the semi-urban population of Dar es Salaam entailing that the data can be generally extrapolated country-wide.

Given this prevalence, we further studied its association with age, gender, BMI and familial patterns with first degree relatives. The prevalence in our population is much similar to other regions in Africa such as Nigeria (10%) (9). Nigerian study among primary school children showed the prevalence tobe as high as 22.4% and the authors attributed this relatively high occurrence to the small sample size or genetic predisposition. The discrepancy between these data and our findings can be explained by the differences in the methods in these studies. Of the 15 children who had flatfoot in our study, there was a higher prevalence in children aged 8 and 9 years. However, this was not statistically significant. (P=0.974). The study in Nigeria which is closest to our study showed that the six-year-old age group had the highest prevalence of flatfoot (9). However, one Australian study also showed a slightly higher prevalence in the age group of 8- and 9-year-olds (11). A study in Sri Lanka showed that flatfoot decreases among children as their age increases (12). In the present research, boys were twice as likely to have flatfoot as the girls. This is in agreement with a similar study in Nigeria which showed that boys weretwice as likely to develop flatfoot compared to girls (13). Several studies have showed a predilection towards the male gender. Chang and coworker found twice as much a likelihood of flatfoot in boys than girls in Taiwanese school-age children (14).

Some studies have reported a higher prevalence in girls than boys (9). The discrepancies need more corroborative studies.

Among the 15 children who had flatfoot only 13.3% were obese. Most of the children, 53.4% were of a normal health and body mass index. This study showed a higher prevalence of flatfoot among children of normal healthy weight which is in stark contrast to other studies (9,12,15). The study is Australia contrasted this finding and showed that children who have a high BMI were less likely to have flatfeet (11). With regards to family patterns only two children out of the fifteen who had flatfoot had a parent with flatfoot. Out of all children examined there were 8 children who didn't have flatfoot but one of the parents had flatfoot entailing that there is no obvious association between flatfoot and familypatterns. However, it is important to note that most associations were not statistically significant. This is partly due to the fact that the sample population was not large enough to make aconclusion.

Conclusion

This study showed an occurrence rate of flatfoot of 9.4% among primary school students.There was a higher prevalence, albeit statistically insignificant, of flatfoot among the 8- and 9-year-olds compared to the other age groups. Boys were twice as much likely to have flatfoot than girls. There was no positive association between flatfoot and childhood obesity.

Study Limitation

The finding in this study may not suffice to draw up conclusion for a wider population. Studies with bigger sample sizes are needed in order to corroborate these findings.

Declarations

Competing Interest

Authors declare that there are no competing interests.

Authors contributions

AMK collected, analyzed data and wrote the first draft of manuscript. DAR conceived the research idea and reviewed and revised the manuscript. All authors approved the final version of the manuscript.

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