PREVALENCE OF HIGH ARCH FOOT IN A PEDIATRIC POPULATION IN SOUTHERN NIGERIA

CHIBUZOM CN (FWACS Ortho)
Department Of Surgery,
Nnamdi Azikiwe University Teaching Hospital (NAUTH),
Nnewi, Anambra State, Nigeria.

Correspondence to: Dr. Chibuzom CN
Department Of Surgery,
Nnamdi Azikiwe University Teaching Hospital (NAUTH),
Nnewi, Anambra State, Nigeria.
Email: buzom4christ@yahoo.com

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ABSTRACT

Background: High arch foot is not uncommon among the pediatric age group. It predisposes the foot to further structural abnormalities and painful calluses due to unequal weight distribution over the metatarsal heads. The prevalence of this condition is not documented in our environment.
This study was done to estimate the prevalence of high arch foot among a paediatric population and also to assess its relationship with age, sex, and body mass index.
Patients and Methods: One thousand seven hundred and fifty-eight children aged 5 to 13 years were randomly selected from eight primary schools within the study area. Each child's sex, age, weight and height were documented. The body mass index was calculated using weight (kg)/height (m^2). Each child's foot print was obtained by the ink method for both right and left feet, and graded into normal and high arch using the instep method. All data were entered into SPSS version 21 for sorting and analysis.
Results: Twelve children (8 females, 4 males) representing a prevalence of 0.7% were found to have high arch foot. The mean age of the population was 9.18 ± 2.170 years with 1191 (67.8%) being 10 years and below. The mean BMI was 15.09 ± 2.145 kg/m^2 with 1641 (93.3%) being underweight. All the 12 cases with high arch foot were underweight. There was no significant relationship with age, sex, and BMI.
Conclusion: High arch foot is an uncommon foot abnormality in our environment. Sex, age, and BMI do not affect the prevalence.

Key words: High arch, Foot, Prevalence, Foot deformity.

INTRODUCTION

The foot provides support for the human body during standing and locomotion. It is the part of the body that makes contact with the ground. The normal foot is structurally adapted to perform its natural function during stance and during locomotion.[1,2]
The foot arch provides a springy support for the foot during both stance and walking. The arch of the foot may be normal, flat or high arch when the foot is high and raised from the ground.[3] High arch foot puts undue strain on the metatarsal heads and the heel thereby affecting the biomechanics of locomotion. It predisposes the foot to chronic pain and further structural deformities. Painful

calluses may develop due to unbalanced pressure distribution across the metatarsal heads or the heels, and this may ulcerate resulting in chronic foot ulcers. In addition, it gives rise to much parental concern as to the cosmetic health of their child's foot.[4]

The treatment of high arch when mild or detected early may involve only serial manipulations and use of splints. However, surgery may be indicated in severe cases or when it was not diagnosed and treated early. This may involve soft tissue releases or transfers for early or mild cases, or bony or joint procedures for late or severe types.[5-8] A knowledge of the pattern of the prevalence of high arch foot in an environment will avail the affected patients an earlier detection and treatment which would forestall the development of severely complicated ones.

The foot arch has been studied using clinical, radiographic, and foot print methods.[9-13] The foot print has become versatile as a tool in foot arch assessment because of its ready availability, non-invasiveness, cost advantage, and use in field studies.[12-13]

The prevalence of high arch foot was not known in our population. This study was done to estimate the prevalence of high arch foot in our region among primary school children using the instep method of foot print analyses. We also assessed the relationship between the prevalence of high arch foot and age, sex, and body mass index (BMI).

MATERIALS AND METHODS

We conducted a prospective descriptive epidemiological survey of high arch foot among 5 to 13 years old children within Benin city, Nigeria across of three local council areas: Egor, Oredo, and Ikpoba Okha.

Sample size was estimated using $N=Z^2pq/d^2$ where N is estimated sample size when the population is > 10000, Z is the standard normal deviate 1.96 at 95% confidence interval, p is proportion of target population 50% (0.5), q =1-p ie 1 - 0.5 = 05, d = 0.02 (the degree of precision required). $N=(1.96)^2 \times 0.5 \times 0.5/(0.02)^2 = 2401$

We obtained approval from the ethics committee of the University of Benin Teaching Hospital with certificate number ADM/E22/A/VOL. VII/1193 before we commenced the study. We also received authorization from the Ministry of Basic Education, Edo State Government, Nigeria with approval number MBE/A/144. Consent was further obtained from the parents before the survey was conducted.

Ten schools were randomly selected from the 649 primary schools that were within the study area out of which 8 were sampled during the period of the survey from September 2015 to November 2016. We randomly selected a total of one thousand seven hundred and fifty-eight (1758) children aged between 5 to 13 years from the 8 schools. Two of the selected schools were not audited for the study.

Only subjects who had no obvious musculoskeletal anomaly, injuries, infections or deformities, who were Nigerians were enrolled in the survey. Children from other races were excluded. Those who could not stand erect were also not included.

Each participant's age (provided by the child with corroboration from the class teacher) and sex were obtained and recorded. Their weight was measured using a standard bathroom scale which was standardized daily using a known 1kg weight. The height of each child was recorded using a wall mounted height chart against which the child stood making sure the heels, buttock, and the back of the head all touched the wall with the child looking straight forward and a horizontal ruler placed at the vertex in order to mark off the reading. The body mass index (BMI) was calculated using the formula BMI = weight (kg)/height^2 (m).

FOOT PRINT

Each child's foot prints (left and right) were obtained using the ink method. Each child was made to step unshod on an ink board which had been impregnated with the printers ink on a foam. The child was then guided to step on a plain duplicating paper placed directly in front on a flat surface to obtain the ink print of both feet as shown in figure 1.

GRADING:

A line was drawn as tangent to the medial boarder of the foot print. Perpendicular line bisecting this line was drawn at the mid-foot and labeled A, B, C representing intersections with the tangent, medial, and lateral border of the foot print as shown in figure 1. Lines AB and BC were measured in centimeters using the spreading caliper. This was done for both the right and left foot prints for each child. Where line BC was less

than 1cm, this was interpreted as high arch foot. For line BC greater than 1 cm, the foot was considered normal (figures 1, 2 and 3).

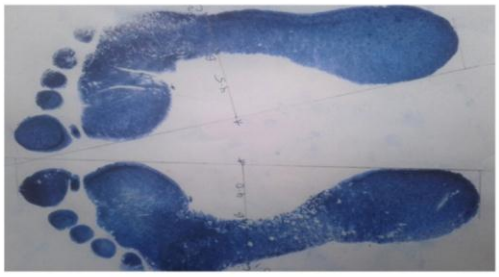

Figure 1: Foot print of a child with normal feet (BC is greater than 1cm)

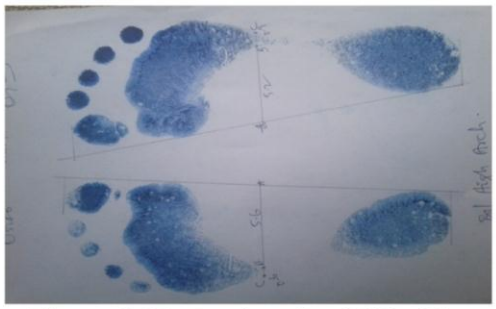

Figure 2: Foot print of a child with high arch feet (BC is less than 1cm)

The enrollees were grouped by their ages into 5-7 years, 8-10 years, and 11-13 years, and sub divided into males and females.

Data was entered into SPSS version 21 and analyzed using descriptive statistics. Mean values were compared using the students t-test, and significance was tested using the chi square test with the confidence interval set at 95%, and p value < 0.05.

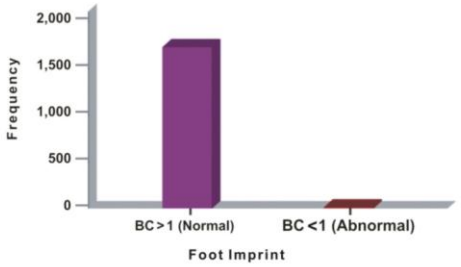

Figure 3: Number of children with normal feet and high arch feet

RESULTS

One thousand, Seven hundred and fifty eight participants aged 5 to 13 years were studied which gave a total of 3516 feet. Eight hundred and fourteen (46.3%) were males while 944 (53.7%) were females, M:F ratio of 1:1.2 Of these, 566 (32.2%) were 5 to 7 years, 625 (35.6%) were aged 8 to 10 years, while 567 (32.3%) were 11 to 13 years. Mean age of the study population was 9.18 ± 2.5 years, while the mean BMI was 15.09 ± 2.145 kg/m2. One thousand six hundred and forty one (93.3%) children were underweight, 114 (6.5%) had normal BMI, 1 (0.1%) was overweight, and 2 (0.2%) others were obese, (table 1).Table 2 shows the relationship between high arch foot and gender, age and BMI.

Variables	Frequency (n=1758)	Percentage (%)
Sex		
Male	814	46.3
Female	944	53.7
Total	1758	100
Age (years)		
5 7-	566	32.2
8 10-	625	35.6
11 13-	567	32.2
Total	1758	100
BMI (kg/m)		
Underweight (<18.5)	1641	93.3
Normal weight (18.5 24.9)	- 114	6.5
Overweight	1	0.1
Obese (>30)	2	0.1
Total	1758	100

Table 1: Sex, Age, and BMI distribution of the studied groups.

Variable	High arch foot (n=) %	X2/p value high arch
Sex		0.822/0.365
Male	4 (33.3)	
Female	8 (66.7)	
Total	12 (100)	
Age (years)		2.852/0.240
5-7	3 (25)	
8 10	7 (58.3)	
11-13	2 (16.7)	
Total	12 (100)	
BMI		0.186/0.878
Underweight (<18.5)	11 (91.7)	
Normal (18.5-24.9)	1 (8.3)	
Overweight (25-29.9)	0 (0)	
Obese (>30)	0 (0)	
Total	12 (100)	

Table 2: Sex, Age and BMI distribution versus high arch foot

DISCUSSION

We found an overall low prevalence of high arch foot of (0.7%) which is in consonance with the observations by Chow et al and Atamtuck et al who reported prevalences of 1.32% and 1.2% respectively. [14-15]

There was a preponderance of this condition among females 8 (66.7%) than males 4 (33.3%) in our series. However, association of high arch foot with gender in this report was not statistically significant (table 2, p=0.365).

High arch foot was more among the 8 to 10 years age group (58%), which incidentally was not statistically significant (p=0.240). This compares with the study by Wozniacka and colleagues who observed a preponderance of high arch foot among the 7 to 8 year olds without any significant association with age. [16]

All our participants with high arch foot were underweight in consonance with reports by Wozniacka et al. However, there was no statistically significant relationship between the body mass index (BMI) of the children studied and the presence of high arch foot (table 2). The prevalence of high arch foot in our series was statistically unrelated to sex, age, and BMI (table 2).

In conclusion, high arch foot is rare (0.7%) in our local population. The prevalence of this condition is not affected by gender, age, and body size.

CONFLICT OF INTEREST:

Author declares no conflict of interest.

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