ISSN : 2350-0743

www.ijramr.com

International Journal of Recent Advances in Multidisciplinary Research

Vol. 07, Issue 04, pp. 5684-5686, April, 2020

RESEARCH ARTICLE

ROLE OF FOOT WEAR AS A PREDICTIVE FACTOR FOR FLATFOOT IN CHILDREN OF URBAN AND RURAL COMMUNITIES

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ARTICLE INFO

Article History:
Received 19th January, 2020
Received in revised form
07th February, 2020
Accepted 29th March, 2020
Published online 30th April, 2020

Keywords:

Foot wear - Factor for Flatfoot
Children of Urban and
Rural communities.

ABSTRACT

Background: Flat foot deformity is frequently encountered in pediatric orthopedic and rehabilitation practices**.** The effects of footwear on the development of children's feet has been debated for many years and recent work from the developmental and biomechanical literature has challenged long-held views about footwear and the impact on foot development. This narrative review draws upon existing studies from developmental, biomechanical and clinical literature to explore the effects of footwear on the development of the foot. The emerging findings from this support the need for progress in [children's] footwear science and advance understanding of the interaction between the foot and shoe. Ensuring clear and credible messages inform practice requires a progressive evidence base but this remains big issue in children's footwear research. **Aim of the study**: the present study aimed to investigate and determine the role of footwear as a predictive factor for flatfoot in children of urban and rural communities. **Material and methods**: a cross-sectional study was carried out on 90 Egyptian preschoolers aged 5-7 years to find the role of footwear on flatfeet prediction , at New Cairo Hospital including both sexes data were collected by using foot print analysis using clark's angle. **Results:** The mean ± SD Clarke angle of barefoot, closed shoes and sandals & slippers groups were 34.06 ± 4.47, 12.6 ± 3.79 and 26.03 ± 5.09degrees.Therewas a significant difference in Clarke angle between barefoot, closed shoes and sandals & slippers groups ($p = 0.0001$). The mean difference between barefoot and closed shoes groups was 21.46 degrees. There was a significant increase in Clarke angle of barefoot group compared with closed shoes group ($p=0.0001$). The mean difference between barefoot and sandals & slippers groups was 8.03 degrees. There was a significant increase in Clarke angle of barefoot group compared with sandals &slippers group ($p = 0.0001$). The mean difference between closed shoes and sandals & slippers groups was -13.43 degrees. There was a significant decrease in Clarke angle of closed shoes group compared with sandals & slippers group ($p = 0.0001$). **Conclusion:** It was demonstrated that positive significant correlation between wearing shoes at early age and the risk factor of flatfoot .As there is a positive obvious correlation between flatfoot and ligamentous laxity.

INTRODUCTION

The human foot is a strong and complex mechanical structure containing 26 bones, 33 joints (20 of which are actively articulated), and more than a hundred muscles, tendons, and ligaments [(1)] Flatfoot (FF) , is defined as feet with lowered medial longitudinal arch (MLA).Flatfoot can lead to pain, restricted mobility and compromised quality of life [(2)]**.** Flat feet is a postural deformity in which the arches of the foot coming into complete or near-complete contact with the ground. There is a functional relationship between the structure of the arch of the foot and the biomechanics of the lower leg.

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The arch provides an elastic, springy, connection between the forefoot and the hind foot. This association safeguards so that the majority of the forces incurred during weight bearing of the foot can be dissipated before the force reaches the long bones of the leg and thighs. [(3)] Flat foot (pes planus) is a biomechanical problem consisting of a constellation of physical features that includes excessive eversion of the subtalar complex during weight-bearing, with plantarflexion of the talus, plantar flexion of the calcaneus in relation to the tibia , dorsiflexion and abduction of the navicular, supination of the forefoot, and valgus posture of the heel**.** [(4)] The appearance of flatfoot is normal and common in infants, partly due to baby fat which masks the developing arch and partly because the arch has not yet been fully developed. This fat pad is thought to resolve between ages of 2 and 5 years as the arch of the foot is formed [(5)] The increased

prevalence for flatfoot on modern societies may be the consequence of the inadequate footwear in childhood based on the assumption that barefoot walking represents the best condition for the development of a healthy foot [6]

Patients and methods

Subjects: A total of 90 preschoolers from both sexes aged 5-7 years old who were currently enrolled from New Cairo hospital .in the period of September 2019 to February 2020.Before gathering foot analysis the purpose and the procedures of the study were fully explained to all subjects subsequently voluntarily agreed to enroll in the present study.

General characteristics :the cross-sectional study consisted of equal number of participants in 3 groups, and according to the footwear type they were divided into three groups :sandal ,shoes and not wearing footwearand there was a questionnaire handed out to ask about the routine and simple ink techniques was used to be able to measure clark's angle.

Sampling method: Simple ink technique a thin large piece of sponge (larger than the size of the foot) and a large blank piece of paper for every child. The sponge was placed on a tray and diluted ink was poured.The sponge absorbs all the ink and when the foot is placed, the ink sticks on the bottom of the foot. Then the foot is immediately placed on the paper to obtain the print and hence to measure the angle by Clarke's angle. If the angle is < 31 degree then there is a tendency to pesplanus and or pronation, if the angle is between 31 and 45 degree than it is in the normal range, if the Clarke's angle is larger than 45 degree than there is a tendency to cavus foot (high arched).

RESULTS

The mean ± SD Clarke angle of barefoot, closed shoes and sandals &slippers groups were 34.06 ± 4.47, 12.6 ± 3.79 and 26.03 ± 5.09 degrees. There was a significant difference in Clarke angle between barefoot, closed shoes and sandals & slippers groups (p = 0.0001). (Table 1, figure 3).The mean difference between barefoot and closed shoes groups was21.46 degrees. There was a significant increase in Clarke angle of barefoot group compared with closed shoes group (p = 0.0001). The mean difference between barefoot and sandals & slippers groups was 8.03 degrees. There was a significant increase in Clarke angle of barefoot group compared with sandals & slippers group (p = 0.0001). The mean difference between closed shoes and sandals & slippers groups was -13.43 degrees. There was a significant decrease in Clarke angle of closed shoes group compared with sandals & slippers group (p = 0.0001).

And the score of the questionnaire was demonstrated in table 2. The flatfoot was present in 6 (20%) of barefoot group, 26 (87%) of closed shoes group and in 21 (70%) of sandals & slippers group. There was a statistically significant association between shoes type and development of flatfoot (p = 0.0001)

DISCUSSION

Since the arches are normally developed between the ages of 4 and 6 years, this result might suggest a late development of the arches which could be attributed to the wearing of close-toe shoes especially in the urban children.

Table 3. *Comparison of Clarke angle between barefoot, closed shoes and sandals & slippers groups:*

Clarke angle (degrees) $\bar{X} \pm SD$			F- value	p- value	Sig
Barefoot	Closed shoes	Sandals & slippers			
34.06 ± 4.47	12.6 ± 3.79	26.03 ± 5.09	175.24	0.0001	S
Multiple comparison (Tukey test)					
	MD	p- value	Sig		
Barefoot - Closed shoes	21.46	0.0001	S		
Barefoot - Sandals & slippers	8.03	0.0001	S		
- Closed shoes - Sandals & slippers	-13.43	0.0001	S		

$\bar{X}$: Mean MD : Mean difference S : Significant
SD : Standard deviation p value :Probability value

Table 4. *Comparison of EI score between barefoot, closed shoes and sandals & slippers groups:*

EI score $\bar{X} \pm SD$			F- value	p- value	Sig
Barefoot	Closed shoes	Sandals & slippers			
5.43 ± 0.77	2.33 ± 0.88	3.93 ± 1.25	73.02	0.0001	S
Multiple comparison (Tukey test)					
	MD	p- value	Sig		
Barefoot - Closed shoes	3.1	0.0001	S		
Barefoot - Sandals & slippers	1.5	0.0001	S		
- Closed shoes - Sandals & slippers	-1.6	0.0001	S		

$\bar{X}$: Mean MD : Mean difference S : Significant
SD : Standard deviation p value :Probability value

This agrees with the study by (Sachithanandam and Joseph, 1995) [7] which suggested that the incidence of flat foot was highest in those who, as children, wore footwear for over eight hours a day and reported an association between early shoe wearing and flatfoot. This may be due to the fact that supportive shoes tend to limit the motion exercise of foot muscles which can lead to further flattening of the arch as a result of a weakening of the foot muscles.Shoe wearing in children may thus predispose to flat foot [8] As (J.Epidemiol et al., 2015) [9]stated that, a flatfooted person is 9.7 times more likely to have a Clarke's angle ≤30.5° than a non-flatfooted person. A negative likelihood ratio of 0.11 indicates that a flatfooted person is 0.11 times less likely to have a negative test result than a non-flatfooted person. These findings demonstrate that Clarke's angle is highly accurate in the diagnosis of flatfoot in our sample. We also found that footprint analysis methods are suitable for diagnosing flatfoot, with Clarke's angle being the most accurate.

In previous studies, Brazilian children demonstrated higher dorsal arches than children in the United States and Japan, whereas Australian children showed a lower prevalence of flatfoot compared with German children.(Mauch et al., 2008) [10] postulated that the observed ethnic difference may be associated with footwear, as the Australians preferred barefoot walking or wearing thong-styled and open sandals as a result of a warmer climate. Singaporian children used both open-styled footwear and closed-toe shoes. These findings suggest that the disparity in AI between Singaporean and European children is likely related to the ethnic difference and not footwear usage between the populations. This is similar to the study made by (Arnoldo Jose Hernandez et al.,2007)[11]where the average planter arch index (PAI) values of children aged between 5 and 9 ranged from 0.61 to 0.67. In studies done by(Singrolay et al and Kanatli Ulunav et al.,2016).[12] Simple ink print method can be a cost effective and easier way of diagnosing flat feet compared to radiography. It is simple and easier to apply. This method is non-invasive and does not

involve radiation. Thus it can be used clinically to diagnose flat feet.

This is however in contrast to some prior studies that indicated that only a minority of children will have flat feet by the age of 10 years. The variance could be due to the fact that in these studies, only the rural population of children was studied while this study compared the rural with the urban population. Simple logistic regression analysis of the relationship between types of footwear and prevalence of flatfoot showed that even though the prevalence was significantly higher in subjects shod with closed toe shoes, footwear type was not a predictive factor for flatfoot Nevertheless, the results of this study have shown that closed toe shoes do have a significant impact on the prevalence of flat foot. This is quite pertinent as a child's foot size changes rapidly and foot growth continues to be very rapid in the first 5 years of life [8,14]. A recent study suggested that children who go barefoot have a lower incidence of flat foot and deformity while having greater foot flexibility than children who wear shoes [13] According to Pfeiffer et al. (2006)[15], the natural history of flat foot is spontaneous improvement with increasing age. It is however seen from the result of this study that the incidence of flat foot declined sharply by age 8 years only to gradually increase from age 9 years with a significant increase by the age of 10 years. This agrees with prior studies that the normal findings of flat foot versus children's age estimate 45% of pre-school children, and 15% of older children atan average age 10 years have flat foot [16].

Another study Found poor extensor muscle activity during the heel-contact phase in children with flexible flat feet. The possibility of altered muscle tone could also have resulted in the lifting of the medial longitudinal arch[17]In accordance with bone and ligaments, a long-term altered muscle activation could also result in an adaptation of the bones and ligament of the foot. This theory points to underlying mechanisms that might explain the differences between children who are habituated to barefoot or to shod walking.[18]

Conclusion

It was concuded that the positive relation between flatfoot and shoe type was an important study finding which clearly shows that flatfoot is becoming more evident in urban communities which on the long run might be epidemic if not early controlled.

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