

Systematic review: Straight foot

Dusan Djordjevic A¹, Bojan Bjelica B², Ljubica Milanovic A¹, Mima Stankovic A¹, Milan Zelenović A¹,
Danijel Božić A¹, Radomir Pržulj B²

¹Faculty of sport and physical education, University of Nis A, ²Faculty of physical education and sport, University of East Sarajevo

ABSTRACT

The aim of this study was to identify and summarize the relevant literature on flat feet and to determine its prevalence. Proper posture is a basic prerequisite for normal growth and development. Foot deformities have a decisive influence on the functional state of the locomotor system, and the foot bears the greatest load during the static and dynamic function of the locomotor system. A search of electronic databases (PubMed, SCIndex and Google Scholar) found and analyzed papers published in the period from 2006 to 2020, and a descriptive method was used to analyze the data. The results of the study show a higher frequency of flat feet in male children. Also, the frequency of flat feet varies from 78.9% to 22.4%, and malnutrition significantly affects the prevalence of this deformity, while the frequency of flat feet decreases with age.

KEY WORDS: flat foot, children, pain, pupil

INTRODUCTION

Proper posture is a basic prerequisite for good health, normal growth and development. The number of children with poor posture is increasing. Poor posture and deformities increase in children starting school. Due to school obligations, physical activity decreases, because children spend most of their time in an incorrect sitting position or incorrect standing, to which should be added the time spent at home: watching TV, using computers, video games. Foot deformity is a consequence of this

modern way of life. Deformities of the feet have a decisive influence on the functional state of the locomotor system, and especially the lower extremities. The foot bears the greatest load during the static and dynamic function of the locomotor system. Straight foot is a very common deformity in preschool children [11, 24, 31], and is characterized by the loss of normal, physiological arches of the feet. This deformity can also negatively affect the spine [4], causing pain in the foot, lower legs, pain in the lumbar-sacral part,

faster fatigue when standing and walking. A systematic clinical examination of children is needed to determine the degree of lowering of the foot and to monitor its evaluation through growing up or even better through corrective treatment [35]. This deformity can also negatively affect the spine [4], causing pain in the foot, lower legs, pain in the lumbar-sacral part, faster fatigue when standing and walking. A systematic clinical examination of children is needed to determine the degree of lowering of the foot and to monitor its evaluation through growing up or even better through corrective treatment [35]. This deformity can also negatively affect the spine [4], causing pain in the foot, lower legs, pain in the lumbar-sacral part, faster fatigue when standing and walking. A systematic clinical examination of children is needed to determine the degree of lowering of the foot and to monitor its evaluation through growing up or even better through corrective treatment [35].

By the term flat foot, we usually mean the collective term for all anomalies of the foot, which is characterized by physiological relaxation of the arches, ie disturbance of the stato-dynamic balance until clinically definite pathological changes. A flat foot (*pes planus*) is a relatively common occurrence and represents one of the most common deformities where the loss of normal physiological arches of the foot occurs [36].

The so-called standing occupations such as caterers, traders, dentists, surgeons, foot function is minimized and foot lowering can occur [37]. In most cases, it is a functional disorder, the so-called. insufficient foot. It should be noted that every child is born with a flat foot, it is present in 97% of one-year-olds, and then as the child grows and matures, the foot also develops. In three-year-olds, 54% have a flat foot, while in the sixth year of life it occurs in 24% of children. It is believed that the formation of normal physiological arches ends in the 7th year [20],

so that the prevalence of flat feet in ten-year-olds is about 5% [32].

Causes of flat feet are: rickets, muscle weakness, weakened leg and foot muscles, inappropriate footwear, various injuries and diseases, excessive obesity, premature forcing to walk, static loads on the feet, carrying or holding heavy objects, collapse of the foot structure (trauma, fracture) foot bones) etc. [36]. Therefore, the aim of this study was to identify and summarize the relevant literature on flat feet and to determine its prevalence.

METHODS

Data source and research strategy

Electronic search of papers was performed in the following databases: PubMed, SCIndex and Google Scholar. Papers published on the SCI list in the period from 2006 to 2020 were also searched. In order to find papers related to this topic, the search was limited to the following key words: “flat foot”, “children”, “pain”, “Student” or a combination of the above keywords in English: “*pes planus*”, “flatfoot”, “children”, “pain”, “pupil”.

A descriptive method was applied to the analysis of the obtained data, and all titles and abstracts were reviewed for potential papers that will be included in the systematic review. Also, the lists of references of previous review and original researches were reviewed. Relevant studies were obtained after a detailed review, if they met the inclusion criteria, and the search strategy itself was modified and adapted to each database and search, where possible, in order to increase search sensitivity.

Inclusion criteria

1. Study type: controlled randomized and nonrandomized studies were reviewed and included in further analysis, while uncontrolled studies were excluded. Papers

published in English and Serbian are included in the study;

2. Sample of respondents: male and female children, regardless of lifestyle (active / sedentary), BMI (obese / normally fed), over 3 years of age;

3. Type of results obtained: the primary result obtained for the purposes of the systematic examination was a flatfoot. Studies are included if flat foot correction and treatment options are considered. Secondary results, which are primarily related to the systematic review of papers, were studies where the validity of clinical techniques for the assessment of flat feet was investigated, or if the effects of flat feet on the biomechanics of movement, walking and running were determined.

Exclusion criteria

- Studies written in a language other than English and Serbian;
- Studies focused on the innate flat foot;
- Studies focusing only on the treatment of flat feet in adults;
- Duplicates;
- Studies with respondents over 15 years of age.

RESULTS

After a general search of the database, 83 potential works were identified. After deleting the duplicates and eliminating the

works based on the title, 38 studies remained. The remaining papers were reviewed in detail, so that an additional 19 studies were eliminated on the basis of abstracts and another 8 studies, because they were written in a language other than English. A total of 11 studies met the defined criteria and were included in the systematic review.

All studies examine the deformity of the flat foot, and a detailed presentation of the selection of works and their inclusion can be found in diagram 1.

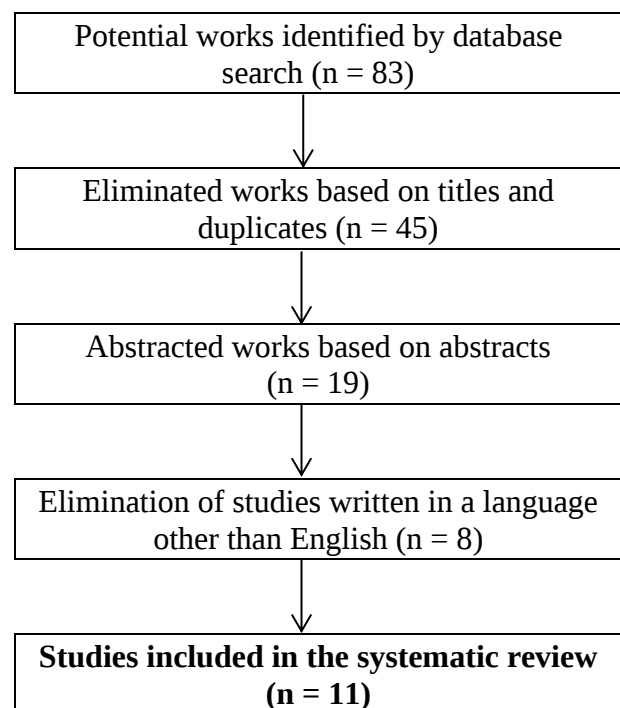


Diagram 1. Overview of the process of collecting adequate works based on pre-defined criteria

Table 1. Research overview

First author and year of publication	Number of respondents	Age of respondents	Grouping of respondents	Measurement technique	Results
Pfeiffer et al. [24]	N = 835 M = 424 F = 411	3-6	The clinical diagnosis of flat feet is based on the valgus position, and on the weak formation of the arch	Surface laser scanner, measuring the angle of the front of the foot	13% of children were overweight and there were significant differences in prevalence between obese, moderate and normal body weight
Evans et al. [9]	N = 140 M = 68 F = 72	7-10	Grouping by flat foot and normal foot	Foot Posture Index-6 Visual Test (FPI-6)	The implication of these results is that the percentage of obese children has less flat feet
Chang et al. [6]	N = 2083	7-12	Grouping by age	"Denis flatfoot staging"	59% of respondents had a flat foot, and boys had almost twice the percentage of a flat foot compared to girls
Puzovic et al. [25]	N = 232 M = 126 F = 106	7-11	Grouping by sex, age and nutrition	The assessment of the status of the feet was performed by the inspection method	Such a high prevalence of flat feet ranks this deformity among the most common postural disorders
Chen et al. [8]	N = 1598 M = 833 F = 765	3-6	3 groups, normal foot, unilateral group and bilateral group	Clinical diagnosis	Age and obesity did not affect the unilateral group of children, but the results must be monitored
Ezema et al. [10]	N = 474 M = 221 F = 253	6-10	Grouping into 4 groups: below normal weight, normal weight, overweight and obese	Flat foot, plantogram	The prevalence of flat feet is high compared to many highly developed countries
Bok et al. [5]	N = 39 M = 18 F = 21	6-14	Clinical diagnosis of flat feet	Measuring the angles of 5 parts of the foot	On the second measurement, significant improvement after using a handmade cartridge
Niksic [23]	N = 1105 M = 563 F = 542	5-12	Grouping into 2 groups: boys and girls	Flat foot, plantogram Thomsen method	The frequency, structure and level of foot deformities vary considerably between boys and girls
Sadeghi-Demneh et al. [27]	N = 667 M = 340 F = 327	7-14	Grouping by year	Standing on one leg, imprint	Boys showed a higher prevalence of rigid flat feet, as in overweight people
Mitrovic et al. [21]	N = 50 M = 25 F = 25	6	Grouping into 2 groups: boys and girls	Digital computer podoscope (SupOrt)	The results cannot be generalized due to the small number of respondents
Stanojkovic et al. [29]	N = 162	7-12	Grouping into 4 groups: no pain, mild, moderate, severe pain	Foot Posture Index-6 visual test (FPI-6)	The risk of falling and injury increases with increasing degree of flat foot deformity

Legend: N- total number of respondents; M- male; F- female.

DISCUSSION

The aim of this study was to identify and summarize the relevant literature on flat feet and to define the prevalence of deformities. The age of the subjects ranged from 3 years, in a study by Pfeiffer et al. (2006), up to 14 years in research by Bok et al. (2014) and Sadeghi-Demneh et al. (2015), while the total number of respondents in this study was 7385.

The flat foot is the most common disorder of the lower extremities, and it is also present in a large percentage in children of preschool and younger school age [4]. The frequency of flat feet varies from 78.9% [25], to at least 22.4% [10]. The prevalence of flat feet decreased significantly with age, 54.5% in three-year-olds, but only 21% of six-year-olds had bilateral flat feet. In the bilateral group, the risk decreased with increasing age, and increased with weight gain outside the normal range, and higher in boys than in girls [8].

Studies also show a higher frequency of flat feet in male children, 51.52% compared to girls 48.48% [3]. The higher frequency of flat feet in male children can be explained by the larger valgus located below the medial longitudinal arch of the foot and that it stays there for a longer period compared to girls, ie that boys' feet develop more slowly than girls [10, 30]. Conducted research examines the association with age, the frequency of flat feet decreases significantly with ascending age. In particular, the prevalence declined rapidly between 6 and 7 years of age, while the change between 7 and 10 years of age was less pronounced [10]. Some studies [12, 14, 26, 28] also showed a decrease in the prevalence of flat feet with advanced age, while the development of longitudinal plantar arch in school and preschool children is influenced by age and weight [27].

Research on the population of school children shows that a large number of students have changes in their feet. The obtained data indicate a high percentage of deviation on the longitudinal arch of the foot [1]. The association

of lower extremity and flat foot injuries as a constitutional variant of the foot is a topic on which the prevailing understanding in the pediatric literature is that altered foot morphology is not often accompanied by dysfunctions and injuries [2]. Studies have shown that when a child with flexible flat feet runs, the feet hyperpronate and the weight distribution moves to the inside of the foot, due to the hyperpronation of the ankle, not only static but also dynamic abnormalities in the linearity of the suprapedal joints of the foot occur [16]. Due to the overload of the medial part of the ankle and knee, with compensatory internal rotation of the upper leg, fatigue occurs faster, children avoid activity and sports, have difficulties in performing certain motor tasks and a tendency to fall and injury [15]. Studies conducted on a population of adolescents with moderate to severe flat-foot deformity have indicated almost twice as common knee and back pain [13, 34]. have difficulty performing certain motor tasks and a tendency to fall and injure [15]. Studies conducted on a population of adolescents with moderate to severe flat-foot deformity have indicated almost twice as common knee and back pain [13, 34] have difficulty performing certain motor tasks and a tendency to fall and injure [15]. Studies conducted on a population of adolescents with moderate to severe flat-foot deformity have indicated almost twice as common knee and back pain [13, 34].

Research conducted in Australia and the results of anthropometry in this study are significant for three things. First, there was a general lack of a significant difference in the basic anthropometric attributes found between flat feet compared to normal feet. Despite significant differences in BMI between groups with flat feet and normal feet, the difference in group sizes and the relatively small sample size of this study must be appreciated. However, this study did not find a previously found result, with heavier children (increased body weight) having flatter legs [6, 7, 18, 19, 22, 24]. Also, a measure of



waist circumference, which is commonly used to assess visceral fat in the body and predict secondary increased health risks (e.g., blood pressure, blood lipids, metabolic syndrome) [17] relates well to weight and height. Of greater interest may have been the finding that the measure of waist circumference was related to foot position, and vice versa, with “thicker” waists being associated with less flat feet. This is in contrast to the work of some previous authors [24], who in a larger study than this, found a correlation between flat feet and obesity in younger children. This finding, however, was supported by previously reported findings in younger children with leg pain, who found that children who had pain were 5% heavier in growth but had less flat feet [9].

It is believed that most children and at least 20% of adults have a flexible, flat foot, which can be corrected [28]. The clinical picture and functional ability of the feet have also not been clarified yet. The clinical assessment of a child with flat feet should consist of a general

examination of the musculoskeletal system, while the general examination aims to assess the angular parameters of the lower extremities. A flat foot causes pain in the legs and lower legs [33], especially after a long walk or intense exercise.

As a flat foot is more present in obese children, it is likely to affect functional abilities and physical activity. However, the recommendation of experts dealing with assessment and treatment is not to treat a flat foot as a potential weight problem. A flat foot leads to a decrease in static and dynamic activity, balance, walking speed, can limit running, dancing, cycling, and can also cause pain in the area of the lower extremities and spine. Clinical practice guidelines for the diagnosis and treatment of flat feet were initiated by the American College of Foot Examination.

The limitations of this study can be reflected in the impossibility of absolute access to all databases, which is reflected in the relatively small number of studies included in this study.

CONCLUSION

A flat foot in children is most often an isolated condition, but in a significant number it is also a consequence of a clinically wider pathological entity. Discovering the causes of lumbar pain in children with flat feet is crucial for the correct choice of further treatment. Mostly, male children and younger ones (less than 9 years old) are at higher risk and therefore may require closer monitoring. Potential research is needed to reveal the interaction between the arch of the foot and relative risk factors. Other unidentified variables may also be advocates of altered foot posture in children.

Therefore, a standardized and ideally valid approach to assessing foot position in children and its association with fundamental anthropometry is needed to clarify whether any concerns regarding children's weight and foot posture are validly justified. Deviation from normal, healthy nutritional levels is also considered a risk factor for foot deformities. It is

generally considered that morphofunctional changes in the feet occur in obese children, while some have not found a significant effect of body mass index on foot deformities.

Given that domestic authors mostly use subjective assessment methods when assessing postural status, it is clear why the prevalence of postural deformities is overestimated, although foreign authors emphasize the problem of overestimating the prevalence, severity and need for flat foot therapy. Most flexible flat feet are physiological, asymptomatic and do not require therapy. According to the results from the country and the region, one third of today's children have some of the deformities. More frequent physical activities would certainly be desirable in this chain of preventive action. Better coordination between pediatricians, kinesiologists and educators is also needed, who should explain to parents how important it is for a child to start exercises for correcting foot deformities in a timely manner, because it is much harder to correct later. On the other side,

the detection of bodily deformities falls within the competence of the physician, who establishes insight into the state of the student's health and physical status only once a year, and now even less frequently. Therefore, it is necessary to include in the control system teachers who will be in constant contact with their students and who can use simple methods to detect changes caused by posture or health disorders. It is considered useful for children to walk barefoot as much as possible, especially on uneven terrain, in order to strengthen the foot muscles that provide dynamic support to the arch of the foot. Doing physical activity, especially after going to school, is also considered useful. Teachers who will be in constant contact with their students and who can use simple methods to notice changes caused by posture or health disorders are also included. It is considered useful for children to walk barefoot as much as possible, especially on uneven terrain, in order to strengthen the foot muscles that provide dynamic support to the arch of the foot. Doing physical activity, especially after going to school, is also considered useful. Teachers who will be in

constant contact with their students and who can use simple methods to notice changes caused by posture or health disorders are also included. It is considered useful for children to walk barefoot as much as possible, especially on uneven terrain, in order to strengthen the foot muscles that provide dynamic support to the arch of the foot. Exercise, especially after going to school, is also considered useful.

Based on the stated facts, it can be concluded that the prevalence of this deformity is high and that it is necessary to pay more attention to this deformity, during medical examinations. It is also necessary for medical examinations of children to be performed several times a year, which would monitor the condition of the deformity in the right way, and better coordination of doctors and experts in this field is needed. Therefore, the results of this research can be used in future research in order to find adequate literature on the topic of flat feet, and this research can have practical application, by creating awareness among people about the existence of this deformity, as well as its treatment and prevention and rehabilitation.

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