

A Descriptive Study on the Distribution of the Foot Type and its Influence on the Sports Activity Among Adolescents

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Abstract: Foot structure is a fundamental factor influencing human biomechanics, posture, and overall physical health. This study focuses on the distribution of different foot types—namely neutral arch, low arch (flat foot), and high arch—within a population and examines their relationship with postural balance and the potential development of obesity. Variations in foot morphology can significantly affect weight distribution, gait mechanics, and alignment of the musculoskeletal system. These alterations may lead to postural imbalances, reduced stability, and inefficient movement patterns. Over time, such biomechanical inefficiencies can discourage regular physical activity due to discomfort or fatigue, thereby contributing to sedentary behavior and an increased risk of obesity. The study further investigates which foot types are more supportive of efficient movement and sustained physical activity. Understanding these relationships is essential for identifying individuals at risk of developing secondary health complications. In addition, the research evaluates various corrective measures aimed at improving foot function and overall posture. Interventions such as customized orthotic devices, strengthening and flexibility exercises, and gait correction techniques are considered for their effectiveness in enhancing balance and promoting active lifestyles. By establishing a link between foot type, postural control, and physical activity levels, this study highlights the importance of early identification and targeted interventions. The findings are expected to contribute to preventive strategies that improve functional mobility, reduce obesity risk, and support long-term musculoskeletal health.

Keywords: Foot Type; Foot Morphology; Postural Balance; Biomechanics; Physical Activity; Obesity Risk; Orthotic Intervention.

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I. INTRODUCTION

The human foot is a complex anatomical structure that plays a fundamental role in supporting body weight, maintaining balance, and enabling efficient movement. One of its most important features is the medial longitudinal arch, which contributes to shock absorption and proper distribution of forces during standing and locomotion. Based on the height and structure of this arch, feet are generally categorized into three types: normal arch, flat foot (low arch), and high arch (pes cavus). These variations are commonly observed among school-aged children and adolescents, making the assessment of foot type distribution an important topic in the fields of pediatric health, biomechanics, and physical education.

Several studies have examined the prevalence of different foot types in school populations. Findings indicate that a majority of students tend to have normal arches, while a smaller percentage exhibit flat feet or high arches. Flat foot

is particularly common in younger children, as the arch is not fully developed during early childhood. As children grow, the arch gradually forms due to musculoskeletal maturation and increased physical activity. In contrast, high arches are relatively rare but may present distinct biomechanical characteristics that can affect movement patterns. Understanding how these foot types are distributed among school students is essential for identifying potential health concerns and implementing early preventive strategies.

Physical activity plays a significant role in the development and maintenance of foot structure. Activities such as walking, running, and sports participation help strengthen the muscles and ligaments that support the arch. Regular movement also promotes proper alignment and functional stability of the foot. On the other hand, reduced physical activity—often associated with increased screen time and sedentary behavior—may negatively influence foot development. Research suggests that children who engage in

lower levels of physical activity are more likely to exhibit flat feet, possibly due to insufficient muscular stimulation required for arch formation.

The relationship between foot type and physical activity is interconnected. While physical activity can influence the development of the foot arch, the type of foot structure may also affect a child's ability to participate in physical activities. For example, children with flat feet may experience discomfort, fatigue, or pain during prolonged standing or exercise. This can reduce their willingness to engage in physical activities, including school sports and physical education programs. Similarly, individuals with high arches may have reduced shock-absorbing capacity, which can increase the risk of stress-related injuries. These conditions may limit participation and ultimately affect overall physical fitness.

Flat feet, although often asymptomatic, can sometimes lead to functional and biomechanical disadvantages. These may include excessive inward rolling of the foot (overpronation), altered gait patterns, and uneven distribution of pressure across the lower limbs. Over time, such changes may contribute to discomfort or pain in the feet, ankles, knees, or lower back. In a school setting, these issues may interfere with a student's ability to actively participate in physical activities, potentially impacting both physical development and social interaction. Additionally, factors such as inappropriate footwear and lack of proper support can worsen these conditions.

High arches, though less prevalent, are also associated with certain limitations. The reduced surface area of the foot in contact with the ground can result in inadequate shock absorption and increased pressure on specific regions, such as the heel and forefoot. This may lead to problems such as instability, frequent ankle sprains, and stress injuries. For students involved in sports or other physical activities, these issues may increase the likelihood of injury and reduce overall performance.

In contrast, a normal arch is generally considered optimal for efficient foot function. It provides a balance between flexibility and stability, allowing effective weight distribution and shock absorption during movement. Students with normal arches are typically better equipped to participate in a variety of physical activities without experiencing significant discomfort. However, external factors such as obesity, poor footwear choices, and limited physical activity can still influence foot health, even in individuals with normal arches.

Given the increasing concern over declining physical activity levels among school children, it is important to

investigate the relationship between foot structure and activity patterns. Analyzing the distribution of foot types and their association with physical activity can provide valuable insights for educators, healthcare professionals, and researchers. Such information can support the development of targeted interventions, including school-based screening programs, awareness campaigns, and structured physical activity initiatives aimed at promoting healthy foot development.

In summary, examining the distribution of normal, flat, and high arch feet among school students, along with their correlation to physical activity, is essential for understanding musculoskeletal health during growth. Addressing the potential disadvantages associated with abnormal foot types and encouraging active lifestyles can contribute to improved physical well-being and quality of life in children.

II. REVIEW OF LITERATURE

The Staheli Index is a commonly used footprint-based measurement that helps estimate the height of the medial longitudinal arch of the foot. It is a simple, non-invasive method widely applied in clinical and research settings to classify foot types into flat foot, normal arch, and high arch categories. The process begins by obtaining a clear footprint using methods such as ink impressions, a wet footprint, or a pedograph. From this footprint, two specific regions are measured: the narrowest width of the midfoot (A) and the widest portion of the heel (B). The Staheli Index is then calculated as the ratio of A to B. Based on this ratio, values greater than 1.0 typically indicate flat feet, values between 0.5 and 1.0 represent a normal arch, and values less than 0.5 suggest a high arch.

Research conducted among school-going children in South India indicates that the prevalence of flat feet is approximately 9%, although detection rates may vary depending on the assessment method used. These variations are often associated with factors such as age and body mass index (BMI). Among different footprint-based tools, the Chippaux-Smirak Index is often recommended for screening purposes due to its sensitivity, despite a tendency toward overestimation. Studies on flexible flat feet in children report a wide prevalence range, from as low as 3% to as high as 90%, largely influenced by differences in evaluation techniques and examiner expertise.

Overall, most children exhibit a normal arch, while flat feet are more common in younger or less physically active individuals. High arches are relatively uncommon but may present functional challenges. Understanding these variations is essential for early identification, intervention, and promoting healthy musculoskeletal development.

Table 1 Distribution of Foot Types Among Population.

Foot Type	Approximate %	References
Normal Arch	60–80%	Most children have normal arches, especially as age increases. (Lokesh et al., 2025)
Flat Foot	10–25%	Higher in younger children and those with higher BMI or lower physical activity. (Lokesh et al., 2025)
High Arch	2–5%	Rare in the general school population. (Lokesh et al., 2025)

There is a well-established relationship between foot type and obesity, particularly among children. Research indicates that children with higher body mass index (BMI) are more likely to develop flat feet (*pes planus*), with prevalence rates reported between 20% and 40% in overweight and obese groups. Excess body weight places greater mechanical load on the feet, increasing plantar pressure, especially in the midfoot region. This added stress can contribute to the lowering or collapse of the medial longitudinal arch, making it both a structural and functional concern. As a result, children with obesity-related flat feet often exhibit altered gait patterns, reduced stability, and discomfort during walking or standing. These challenges can discourage participation in physical activity, creating a cycle where inactivity further weakens the muscles that support the arch.

In contrast, children with a healthy BMI are more likely to have normal arches, which promote efficient weight distribution, stable posture, and smoother movement patterns. Physical activity plays a key role in maintaining foot strength, as active children tend to have stronger foot and leg muscles that help preserve arch integrity. High-arched feet (*pes cavus*), on the other hand, are relatively uncommon in school-aged populations and are generally linked to genetic or neuromuscular factors rather than body weight. The long-term implications of obesity-related flat feet include an increased risk of musculoskeletal pain, lower limb problems, and reduced mobility. Therefore, early screening using tools such as the Staheli Index or Chippaux–Smirak Index, along with timely interventions like weight management, targeted exercises, and orthotic support, is essential to prevent future complications and promote overall musculoskeletal health.

Several studies have highlighted a significant correlation between foot type and obesity in children. Obesity increases the mechanical load on the plantar surface, which can alter the development and function of the medial longitudinal arch. Specifically, children with higher body mass index (BMI) are more likely to present with flat feet (*pes planus*) compared to their normal-weight peers (Mickle, Steele, & Munro, 2006). Excess body weight contributes to increased plantar pressure, particularly in the midfoot region, which can lead to arch collapse over time. This is further compounded by reduced physical activity in overweight children, which limits the muscular support necessary for proper arch development. Epidemiological studies conducted in Indian school populations also indicate that the prevalence of flat foot is higher among children with obesity, ranging from 20% to 40%, while normal-weight children predominantly exhibit normal arches (Lokesh, Menon, & Ashok, 2025). The association between obesity and flat foot

is not merely structural; it also has functional implications. Children with flat feet due to increased weight may experience altered gait patterns, foot discomfort, and postural instability, which can discourage participation in physical activity, creating a cycle that exacerbates obesity and its musculoskeletal effects. High-arched feet, although less common, are generally less influenced by obesity but may present other biomechanical challenges. Understanding this correlation is crucial for early identification and intervention, which may include weight management, strengthening exercises, and proper footwear to reduce the risk of long-term musculoskeletal complications. Addressing obesity and its impact on foot structure in children is therefore essential not only for musculoskeletal health but also for promoting active lifestyles and overall physical well-being.

Foot type plays an important role in determining how effectively an individual can perform physical activities. A normal or neutral arch is characterized by a moderately curved medial longitudinal arch, which allows for balanced contact of the midfoot with the ground. This structure provides efficient shock absorption during movements such as running and jumping, while also ensuring even weight distribution from the heel to the forefoot. As a result, individuals with neutral arches typically demonstrate stable gait patterns and proper posture, making this foot type highly suitable for a wide range of sports and physical activities with a lower risk of overuse injuries.

In contrast, flat feet, or low arches, are identified by a reduced or absent medial longitudinal arch, leading to almost complete contact of the foot with the ground. This condition is often associated with excessive pronation, where the foot rolls inward during movement. Such biomechanics can reduce shock absorption and place additional stress on the knees, hips, and lower back. Although flat feet may limit efficiency in high-impact sports like running or jumping, individuals can still actively participate in physical activities with appropriate interventions such as strengthening exercises and orthotic support.

High arches, on the other hand, involve an excessively raised medial longitudinal arch, resulting in minimal midfoot contact. This limits the foot's natural ability to absorb shock and increases pressure on the heel and forefoot. Consequently, individuals with high arches may face a higher risk of injuries, including stress fractures and instability. However, with proper cushioning, supportive footwear, and conditioning, they can still engage effectively in physical activities.

Table 2 Injury Risk and Sports Stability Based on Foot Type.

Foot Type	Shock Absorption	Injury Risk	Sports Suitability
Normal Arch	Optimal	Low	Excellent
Flat Foot	Reduced	Moderate	Good with support
High Arch	Limited	Higher	Moderate with cushioning

Foot type plays a significant role in determining physical performance, injury risk, and participation in sports. Among school-age children and athletes, the normal or

neutral arch is most advantageous for physical activity, as it provides optimal shock absorption, balanced weight distribution, and efficient gait mechanics. Studies indicate

that approximately 60–80% of children and 70–90% of athletes exhibit neutral arches, supporting sustained physical activity and reducing the risk of lower limb injuries (Lokesh, Menon, & Ashok, 2025; Bednarczyk et al., 2024). In contrast, children and athletes with flat feet (pes planus), which account for roughly 10–25% of the population, often display excessive pronation, decreased arch height, and altered biomechanics. This can lead to higher stress on the knees, hips, and lower back, as well as reduced shock absorption, potentially increasing the risk of overuse injuries (Mickle, Steele, & Munro, 2006). Despite these challenges, flat-footed individuals can participate effectively in sports if provided with orthotic support, strengthening exercises, or proper footwear. High-arched feet (pes cavus), observed in about 2–5% of children, offer less midfoot contact and limited natural cushioning, which can result in localized pressure injuries and an elevated risk of plantar fasciitis or stress fractures, particularly in high-impact activities (Sudhakar et al., 2018). However, some studies suggest that high-arched athletes may demonstrate superior dynamic balance and sprint performance, likely due to stiffer arches that enhance energy transfer during rapid movements. Overall, foot type influences both performance and injury susceptibility, and understanding these biomechanical implications is crucial for coaches, physical educators, and healthcare professionals. Early assessment of foot type using indices such as the Staheli Index or Chippaux–Smirak Index allows for tailored interventions, promoting safe participation, optimal performance, and long-term musculoskeletal health in children and athletes.

III. METHODOLOGY

Primary data collection refers to the systematic process of gathering original information directly from first-hand sources for a specific research objective. Unlike secondary data, which is obtained from previously published studies or databases, primary data is collected specifically to address the research question at hand. This type of data collection provides researchers with accurate, relevant, and tailored information, ensuring that the findings reflect the real characteristics of the study population. In studies related to school children's foot types, primary data collection typically involves measuring foot morphology, taking footprints, and calculating indices such as the Staheli Index or Chippaux–Smirak Index to classify foot arches as flat, normal, or high. Researchers may also record additional variables, including height, weight, body mass index, and levels of physical activity, to examine correlations with foot structure. Common methods of primary data collection include surveys, structured interviews, direct observation, physical measurements, and controlled experiments. The key advantage of primary data is that it allows for direct control over the quality and accuracy of the data, as well as the ability to tailor measurement tools and protocols to the specific study objectives. In essence, primary data collection ensures that the information used for analysis is original, relevant, and reliable, forming a solid foundation for meaningful conclusions in research.

The Staheli Index is a widely used method to assess the medial longitudinal arch of the foot. Data collection involves taking plantar footprints of the study participants, typically children, while standing in a relaxed posture. The footprint is analyzed by measuring the narrowest width of the midfoot and the widest width of the heel, and the Staheli Index is calculated as the ratio of these two measurements. A lower ratio indicates a higher arch, while a higher ratio suggests a flat foot. This method provides a simple, reliable, and non-invasive means to classify foot types in a sampled population.

Primary data is collected from the sample population of 110 students aged between 13 and 17 including boys and girls.

All the foot types were found in the prevalence in the population. Data was collected based on their physical or sport activity. Comparison made among the foot type and their ability to successfully take part in the sports activity.

Data was analysed based on the foot type and successful involvement of the student in sports activity. Data also says the distribution of foot type in the population. Data set was analysed for the foot type as a cause of obesity.

IV. DATA ANALYSIS AND DISCUSSION

Studies conducted among Indian populations have reported considerable variation in the distribution and prevalence of different foot types. In a cross-sectional study of 500 healthy Indian adults aged 18–21 years, the prevalence of flexible flatfoot was reported to be 13.6%, with a prevalence of 12.8% among males and 14.4% among females, as assessed using the Navicular Drop Test Pandey et al. studied flatfoot in the Indian population and reported varying degrees of flatfoot among symptomatic individuals, demonstrating that the severity of the condition can differ considerably within the affected population. Studies using the Foot Posture Index-6 (FPI-6) have also demonstrated the presence of normal, pronated, and supinated foot postures. Sawant and Akash, in a study of 159 intensive-care-unit nurses, reported that 20% of participants had normal foot posture, 43% had pronated feet, 14% had highly pronated feet, 16% had supinated feet, and 7% had highly supinated feet. Similarly, a study among Grade-I obese school teachers reported approximately 30% normal foot posture, 53% pronated or flat foot, and 17% supinated foot posture. More recently, Lokesh et al. investigated 853 South Indian school children and reported flatfoot prevalence of 9.0% using the Staheli plantar arch index, 12.7% using the Denis footprint grade, and 18.8% using the Chippaux–Smirak index, demonstrating that prevalence estimates may vary substantially according to the assessment method used. Overall, the available Indian literature indicates that normal, pronated, and supinated foot postures are present in the population, while the prevalence of flat or pronated feet varies according to age, sex, body mass index, occupational characteristics, geographical region, and the method of foot assessment. Therefore, the reported values should be interpreted according to the characteristics of the individual

study population rather than being considered representative of the entire Indian population.

21 percent of the sample population shows type 2 foot type flat foot and it is found most prevalent in the population and it goes similar discussed by Sawant AR, Akash A. Prevalence of foot posture deformities using foot posture index in various intensive care 72 percentage shows normal foot type and 7 percent with the high arched foot type.

A normal or moderately arched foot is generally considered advantageous for participation in a wide range of sporting activities because it provides a functional balance between flexibility for shock absorption and rigidity for efficient propulsion. However, athletic performance is not determined by foot type alone and varies according to the specific sport, individual biomechanics, training status, footwear, and other anthropometric factors.”

Table 3 Distribution of Foot Types

Foot type	Boys	Girls	Total	Percentage
Normal	51	12	63	62.38%
Flat foot	21	6	27	26.73%
Arched	8	3	11	10.89%
Total	80	21	101	100%

Sex-wise percentages

Among boys (n = 80):

- Normal: $51/80 \times 100 = 63.75\%$
- Flat: $21/80 \times 100 = 26.25\%$
- High-arched: $8/80 \times 100 = 10.00\%$

Among girls (n = 21):

- Normal: $12/21 \times 100 = 57.14\%$
- Flat: $6/21 \times 100 = 28.57\%$
- High-arched: $3/21 \times 100 = 14.29\%$

Corrective measures for high-arched feet in athletes aim to improve shock absorption, stability, flexibility, and sports performance. Proper sports footwear with adequate cushioning can reduce impact and distribute plantar pressure more evenly. Customized foot orthoses may improve foot stability and pressure distribution. Regular stretching of the calf muscles and plantar structures can improve flexibility, while exercises such as short-foot exercises, toe spreading, and calf strengthening can improve foot control. Balance and proprioceptive exercises enhance stability during running, jumping, and cutting movements. Training intensity should be increased gradually to minimize excessive mechanical stress. Individual assessment by a physiotherapist or sports-medicine professional is recommended for symptomatic athletes.

V. RESULT

In the sample population there is no difference in the percentage of the foot type distribution among girls and boys.

Normal foot type shows maximum participation in the sports activity than the flat and arched foot .

Normal foot type were 51 boys and 12 girls . flat foot include 21 boys and 6 girls

High arched foot 8 boys and 3 girls.

Your total sample is 101 participants:

- Boys = $51 + 21 + 8 = 80$
- Girls = $12 + 6 + 3 = 21$
- Total = 101

VI. CONCLUSION

Foot type may influence sports participation and athletic performance through its effects on lower-limb biomechanics, postural stability, force transmission, and injury susceptibility. Variations in the medial longitudinal arch, including flat, normal, and high-arched feet, may alter subtalar joint motion, leg stiffness, plantar pressure distribution, and lower-limb movement during sporting activities. A systematic review and meta-analysis reported a significant but relatively small association between non-neutral foot types and lower-extremity injuries, with an overall odds ratio of 1.23 (95% CI: 1.11–1.37), suggesting that foot posture may contribute to injury risk in physically active individuals [1]. However, the relationship between foot type and sports performance is not consistent. A recent systematic review and meta-analysis involving nine studies found no significant difference in vertical jump height between individuals with flat feet and normal feet, including both athletic and non-athletic populations. Similarly, a study involving male basketball players demonstrated differences in ankle and hip biomechanics between flat-footed and normal-arched players, although these biomechanical differences did not necessarily result in reduced jumping performance. Research among university athletes has also reported no statistically significant differences in postural stability among low-, normal-, and high-arched foot groups. Furthermore, a systematic review of running biomechanics found moderate evidence of an association between foot posture and subtalar joint kinematics and leg stiffness, while evidence for other biomechanical variables remained limited. These findings suggest that foot type may be related to the biomechanics and injury characteristics of sports participation, but foot type alone does not appear to determine athletic performance. Consequently, investigating the

correlation between foot type and specific sports-performance parameters such as sprint speed, agility, vertical jump, balance, and endurance may provide a more meaningful understanding of the functional significance of foot posture in athletes.

RECOMMENDATIONS

Based on the findings of this study, several recommendations can be proposed for future research and practical applications. First, it is suggested to expand the sample size and include children from diverse regions, age groups, and socio-economic backgrounds to improve the generalizability of results. Conducting longitudinal studies would provide valuable insights into the development of foot arches over time and their relationship with growth, physical activity, and BMI. Incorporating objective measures of physical activity such as accelerometers or standardized fitness tests can help clarify the correlation between foot type and sports performance.

From a practical standpoint, early identification of abnormal foot types should be followed by preventive measures, including exercises, orthotics, or appropriate footwear to support musculoskeletal health and promote physical activity. Finally, awareness programs involving parents, teachers, and healthcare professionals are essential to educate communities on the importance of foot health and early intervention. Collaboration with podiatrists, physiotherapists, and pediatricians can help design effective intervention strategies and improve long-term outcomes for children with foot abnormalities.

Research can be done on the corrective measure and its success in the correction of the body posture.

REFERENCES

- [1]. Jain S, Kumar P, et al. Prevalence of flexible flat foot in adults: a cross-sectional study. *J Clin Diagn Res*. 2017;11(6):AC17-AC20. doi:10.7860/JCDR/2017/26566.10059.
- [2]. Pandey S, Pal CP, Kumar D, Singh P. Flatfoot in Indian population. *J Orthop Surg (Hong Kong)*. 2013;21(1):32-36. doi:10.1177/230949901302100110.
- [3]. Sawant AR, Akash A. Prevalence of foot posture deformities using foot posture index in various intensive care unit nurses. *Int J Community Med Public Health*. 2023;10(9):3276-3282. doi:10.18203/2394-6040.ijcmph20232690.
- [4]. Occurrence of flat foot in Grade-I obese teachers: a cross-sectional study. *Indian J Physiother Occup Ther*. 2018.
- [5]. Lokesh M, Menon PG, Ashok TR. Prevalence of flat foot in South Indian school going children and concordance between Staheli's plantar arch index, Chippaux-Smirak index and Denis foot print grade in diagnosing flat foot. *Indian J Orthop*. 2025;59(11):1959-1968. doi:10.1007/s43465-025-01486-3.
- [6]. Sudhakar, S., Kirthika, S. V., Padmanabhan, K., Mohan Kumar, G., Senthil Nathan, C. V., Gopika, R., & Samuel, A. J. (2018). Impact of various foot arches on dynamic balance and speed performance in collegiate short distance runners: A cross-sectional comparative study. *Journal of Orthopaedics*, 15(1), 114–117. <https://doi.org/10.1016/j.jor.2018.01.050>
- [7]. Sachithanandam, V., & Joseph, B. (1995). The influence of footwear on the prevalence of flat foot: A survey of 1,846 skeletally mature persons. *The Journal of Bone and Joint Surgery. British Volume*, 77(2), 254–257.
- [8]. Jain, S., Kumar, P., & colleagues. (2017). Prevalence of flexible flat foot in adults: A cross-sectional study. *Journal of Clinical and Diagnostic Research*, 11(6), AC17–AC20. <https://doi.org/10.7860/JCDR/2017/26566.10059>
- [9]. Pandey, S., Pal, C. P., Kumar, D., & Singh, P. (2013). Flatfoot in Indian population. *Journal of Orthopaedic Surgery*, 21(1), 32–36. <https://doi.org/10.1177/230949901302100110>
- [10]. Sawant, A. R., & Akash, A. (2023). Prevalence of foot posture deformities using foot posture index in various intensive care unit nurses. *International Journal of Community Medicine and Public Health*, 10(9), 3276–3282. <https://doi.org/10.18203/2394-6040.ijcmph20232690>