The Distribution of Foot Arch Types among Footballers in Bayelsa State, Nigeria

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ABSTRACT

Background: The foot arch plays a vital role in human movement, acting as a shock absorber and stabilizer during physical activities.

Aim: This study examines the distribution of foot arch types among footballers in Bayelsa State, Nigeria.

Method: A total of 56 subjects (22 females and 34 males) between the ages of 18 and 30 years were recruited for the study. The foot arches were measured using a goniometer, and the calcaneal inclination angle (CIA) was determined and documented. Data analysis used the International Business Machines Statistical Package for the Social Sciences (IBM SPSS) version 25. The t-test was used as an inferential statistic to evaluate sexual differences. Chi-square tests were conducted to assess any significant associations between foot arch type. A probability less than 0.05 ($p<0.05$) was considered statistically significant, and 95% was denoted as the confidence level.

Result: The study identified only two foot arch types among participants: 62% had normal arches and 38% had high arches. No flat foot (pes planus) cases were observed. There was no significant difference in age between the normal and high foot arch subjects (t = -0.74; p = 0.46). Also, it showed no significant difference was observed in the weight of normal and high-foot arch subjects (t = -0.87; p = 0.39), while the normal and high-foot arch players showed no significant difference in height (t = -1.22; p = 0.23).

Conclusion: The study evaluated that sex, weight, height, and leg dominance were not significantly associated with foot arch types

Keywords: Normal foot arch; High foot arch; footballers; Bayelsa

INTRODUCTION

The foot is one of the most structurally complex and functionally vital parts of the body. It plays a critical role in athletic performance, especially in sports such as football, where high-impact activities, quick directional changes, and intense footwork are required (Young et al., 2022, and Wilson and Kiely, 2016). Professional footballers rely heavily on the structural and biomechanical integrity of their feet to achieve optimal performance and prevent injury. Among the different aspects of foot anatomy, the foot arch type categorized primarily as high arch (pes cavus), normal arch, or flat foot (pes planus) is of particular interest in sports science because it influences an athlete's balance, stability, and movement efficiency (Mammadova, 2022; Ekanem et al., 2024; Abanoz, 2023). In footballers, these variations in foot arch structure can affect athletic performance.

The normal, or medium, foot arch is a beneficial arch type for athletes due to its balanced biomechanics, efficient shock absorption, and optimal weight distribution (Yunus et al., 2020; Xiong et al., 2010; Moreno-Barriga et al., 2023). It provides a stable foundation for smooth movement, reduces foot-related issues, and enhances agility, balance, and coordination in sports such as football. High foot arch, or pes cavus, is characterized by rigidity, reduced shock absorption, and increased pressure on the heel and forefoot. This can lead to foot fatigue, instability, and injuries (Papaliodis et al., 2014, and Kakwani, 2017). In football, it can affect balance and

endurance. However, some athletes may benefit from increased propulsion during sprinting. Proper footwear and insoles can improve comfort and performance. Flat foot arch, or pes planus, causes excessive foot pronation, reduced shock absorption, and increased stress on lower limbs (Sawant Janhavi and Shinde, 2021; Stricker & LaBella, 2024). It can lead to injuries and challenges in football, but some develop compensatory strength. Proper footwear and strengthening exercises can help manage flat feet, reduce discomfort, and enhance performance.

Moreno-Barriga et al. (2023) researched the effects of foot structure type on core stability in university athletes, which indicated that the presence of high or low foot arches did not significantly impact the activity of the muscles responsible for maintaining the body's centre of gravity or postural stability among university-level athletes. The association between foot type and lower extremity injuries: a systematic literature review and meta-analysis by Tong and Kong (2013), which shows a significant association.

In football, the type of foot arch can impact a player's ability to sprint, change direction, and absorb shock efficiently. Understanding the distribution of foot arch types within this population is essential for tailoring interventions to their biomechanical needs. This study aims to fill this knowledge gap by analyzing the prevalence of different foot arch types among football players in the region.

MATERIALS AND METHODS

The cross-sectional descriptive design was used in this study. Only respondents aged 18 to 30, who comprised the study population (34 males and 22 females), were allowed to participate. The respondents were from Bayelsa Queens Football Club and Bayelsa United Football Club. Bayelsa state was used as the study area, and a multi-stage random sampling technique was adopted to ensure that all respondents had an equal chance of being selected.

Footballers between the ages of 18 and 30 years old were selected for the study.

Footballers above 30 years of age and those who have abnormalities or fractures in their foot arch are excluded.

A descriptive questionnaire was designed and distributed to each respondent to collect information on socio-demographic characteristics. Anthropometric measurements, specifically the height and weight of the participants, were then obtained. The foot arches were measured using a goniometer, and the calcaneal inclination angle (CIA) was determined and documented. This measurement was used to classify each player's foot arch type.

The data obtained were subjected to statistical analysis using IBM SPSS Statistics (version 25). The results obtained were presented in the table as mean ± standard deviation. The t-test was used as an inferential statistic to evaluate sexual differences. Chi-square tests were conducted to assess significant associations between foot arch type and demographic variables; a probability of less than 0.005 ($p<0.05$) was considered statistically significant, and 95% was set as the confidence level.

Consent

Written consent was distributed to all subjects, explaining the nature of the research, and only those who consented were allowed to participate in the study. The consents were retrieved and preserved by the authors.

Ethical Approval

The study was approved by the research and ethics committee of the University of Port Harcourt, Rivers State, Nigeria.

RESULTS

The study comprised 56 footballers (34 males and 22 females) in Bayelsa, Nigeria. The descriptive statistics for the players' demographic factors were presented. The mean age for male players was 22.21±2.53 and

21.77±2.39 for female players (Table 1). Foot arch assessment revealed only two arch types: normal arches in 35 participants (62.5%) and high arches in 21 participants (37.5%). No cases of flat feet (pes planus) were identified among the study population. Table 2 shows no significant association between gender and foot arch type (X^2=0.50, p=0.58). Demographic information for subjects with normal and high arch types shows no significant difference in age between the groups (t = -0.74; p = 0.46). Also, no significant difference was observed in the weight of normal and high-foot arch subjects (t = -0.87; p = 0.39), while normal and high-foot arch players showed no significant difference in height (t = -1.22; p = 0.23) (Table 3). Table 4 shows the distribution of different foot arch types (standard and high) across various playing positions (Goalkeeper, Attack, Defence, Midfielder) in a sports context. The association is tested using a Chi-square test to determine whether there is a statistically significant relationship between a player's position and their foot arch type. The P-value suggests there is no significant association (P > 0.05). Table 5 presents the distribution of foot arch types (normal and high) based on leg dominance (left, right, or both). The Chi-square test is used to examine if there is a significant relationship between a person's dominant leg and their foot arch type. The P-value here indicates no significant association (P > 0.05)

DISCUSSION

The study analyzed data from 56 footballers, with a male predominance of 61% compared to 39% females, reflecting typical gender participations in competitive football. This trend is consistent with global and regional patterns, in which men's football generally receives greater investment, opportunities, and participation rates than women's football. Males had a slightly higher mean age (22.21 years) compared to females (21.77 years), suggesting that male footballers may have a longer playing span or enter competitive football at a slightly older age. Additionally, significant differences in weight and height were observed between genders, with males generally taller and heavier than females, consistent with documented anthropometric differences in sports science, where males typically exhibit greater muscle mass and bone density, which may confer an advantage in strength, speed, and endurance. However, these variations also influence performance dynamics, injury susceptibility, and training requirements. This is consistent with the studies done by Moreno-Barriga et al. (2023), Tudor et al. (2009), and Xiong et al. (2010).

Foot arch types were classified as normal or high, with 62% of participants having a normal arch and 38% having a high arch. The predominance of normal arches aligns with their biomechanical advantages for athletic performance, including better shock absorption, weight distribution, and reduced injury risk (Watkins, 2020; Sarıalioğlu, 2024). This helps reduce the risk of common injuries such as plantar fasciitis, shin splints, and ankle instability. In football, having a normal arch can enhance agility, balance, and coordination, which are essential for quick directional changes, ball control, and overall performance. Due to its biomechanical efficiency, the normal foot arch is often considered the most advantageous of the three foot arch types for athletic activities. The significant proportion with high arches (38%) is noteworthy given their association with increased injury susceptibility due to increased rigidity, reduced shock absorption, and elevated pressure on the heel and forefoot (Ekanem et al., 2024; Malaichamy & Kumbhar, 2023). Due to its elevated structure, the high arch has less surface area in contact with the ground, leading to poor weight distribution and increased stress on specific areas of the foot. This can make individuals with high arches more prone to foot fatigue, instability, and injuries such as stress fractures, ankle sprains, and plantar fasciitis. In football, players with high arches may experience difficulty with balance and shock absorption, which can affect agility and endurance during gameplay (Malaichamy & Kumbhar, 2023). However, some footballers with high arches may benefit from greater propulsion during sprinting because of the rigidity of their feet. Proper footwear and customized insoles can help mitigate the challenges associated with high arches, improving comfort, stability, and overall performance on the field. A notable finding was the complete absence of flat feet (pes planus) among the 56 footballers studied. This contrasts with general population studies where flat feet prevalence typically ranges from 15-30% among adults. Several factors may explain this observation. First, individuals with flat feet may self-select out of competitive football due to biomechanical disadvantages associated with excessive pronation, reduced shock absorption, and increased lower-limb stress (Sawant Janhavi and Shinde, 2021; Stricker & LaBella, 2024). The discomfort and performance limitations linked to pes planus may discourage participation or lead to early dropout from competitive football. Second, natural selection during youth development programs may favor individuals with normal or high arches, as they perform better and are more injury-resistant. No significant

differences in weight and height between participants between arch types, suggesting that other factors, such as biomechanics or genetics, primarily determine foot arch type. This is in line with the findings of Tong and Kong (2013), Woźniacka et al. (2013), and Jankowicz-Szymańska et al. (2018) The study examined the relationship between playing position and foot arch types in football players. Goalkeepers had the highest prevalence of high arches (66.7%), followed by attackers (45.0%), midfielders (50.0%), and defenders (15.8%). However, associations were not statistically significant. Leg dominance may influence foot arch development by altering the distribution of weight and force during physical activities. High arches were more likely to cause foot-related injuries (66.7%) compared to normal arches (33.3%). Participants with 3-5 years of experience were more likely to have a normal arch (73.3%) compared to those with 6 or more years of experience (50.0%). However, this association was not statistically significant. A significant proportion of footballers (38%) had a high arch, a condition often linked to increased susceptibility to injuries like stress fractures and plantar fasciitis. High arches create a rigid foot structure with reduced shock absorption, leading to excessive pressure on the heel and forefoot during high-impact activities like running, jumping, and sudden directional changes in football (Luczak, 2019 and Gyer and Michael, 2023)]. This biomechanical inefficiency can contribute to foot fatigue, instability, and an increased risk of stress-related injuries. Footballers with high arches may also struggle with balance and adaptability on different playing surfaces, further increasing their injury risk (Butler et al., 2013). Given that football is a sport requiring intense physical exertion, proper management strategies, including specialized footwear, custom orthotics, and targeted strength and flexibility training, are crucial to mitigating these risks (Meyer et al., 2015, and Kwakye, 2023). Addressing these factors can help enhance performance and reduce the injury burden among players with high arches.

CONCLUSION

The study provided valuable insights into the relationships between demographic factors and foot arch types among footballers in Bayelsa State, Nigeria. While sex, weight, height, and leg dominance were not significantly associated with foot arch type, foot-related injuries were strongly linked to high arches. These findings underscore the importance of early identification and targeted interventions for athletes with high arches to reduce injury risk and enhance performance. Implementing the recommended strategies, such as custom orthotics, strengthening exercises, and regular foot assessments, can help athletes maintain optimal foot health and minimize injury risk. Further research is needed to explore the long-term effects of different foot arch types on athletic performance and injury prevention

Table 1. Demographic and Anthropometric Characteristics of Footballers by Gender

Demographic Factors	Sex	N	Min	Max	Mean	SD
Age (years)	Male	34	18.00	27.00	22.21	2.53
	Female	22	18.00	25.00	21.77	2.39
	Total	56	18.00	27.00	22.04	2.46
Weight (Kg)	Male	34	50.00	86.00	71.76	8.54
	Female	22	53.00	72.00	60.68	4.52
	Total	56	50.00	86.00	67.41	9.02
Height (cm)	Male	34	156.00	190.00	174.35	9.89
	Female	22	150.00	180.00	163.91	8.56
	Total	56	150.00	190.00	170.25	10.64
Years of experience	Male	34	3.00	10.00	6.24	2.66

	Female	22	3.00	10.00	6.09	2.27
	Total	56	3.00	10.00	6.18	2.49

Table 2. Gender Distribution Across Foot Arch Types

Gender	Foot Arch Type (%)		Chi-square			
	Normal	High	df	X^2	P-value	Inference
Male	20 (58.8)	14 (41.2)	1	0.50	0.58	NS
Female	15 (68.2)	7 (31.8)				

NS= Not Significant

Table 3. Comparison of Demographic Characteristics Between Normal and High Arch Groups

Demographic factors	Foot Arch Type	N	Mean±SD	t-value	P-value	Inference
Age (years)	Normal	35	21.83±2.11	-0.74	0.46	NS
	High	21	22.38±2.99			
Weight (Kg)	Normal	35	66.60±9.66	-0.87	0.39	NS
	High	21	68.76±7.87			
Height (cm)	Normal	35	168.91±10.94	-1.22	0.23	NS
	High	21	172.48±9.98			

NS= Not Significant

Table 4. Distribution of Foot Arch Types Across Playing Positions

Playing position	Foot Arch Type		Chi-square			
	Normal	High	df	X^2	P-value	Inference
Goalkeeper	1 (33.3)	2 (66.7)	3	6.32	0.10	
Attack	11 (55.0)	9 (45.0)				NS
Defence	16 (84.2)	3 (15.8)				
Midfielder	7 (50.0)	7 (50.0)				

NS= Not Significant

Table 5. Distribution of Foot Arch Types by Leg Dominance

Leg dominance	Foot Arch Type		Chi-square			
	Normal	High	df	X^2	P-value	Inference
Left	3 (75.0)	1 (25.0)	2	0.32	0.85	NS

Right	30 (61.2)	19 (38.8)				
Both	2 (66.7)	1 (33.3)				

NS= Not Significant

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