



IMPACT OF BODY WEIGHT ON FOOT ARCH STABILITY

Anatomy

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ABSTRACT

The foot arch plays a crucial role in human locomotion by providing shock absorption, distributing body weight, and maintaining stability. This study explores the relationship between body weight and foot arch integrity, with a focus on how excess weight impacts foot function, arch deformation. This study investigates the correlation between body weight categories (normal weight, overweight, and obese) and foot arch structure, as measured by the Foot Arch Index (FAI), as well as foot function and pain, assessed by the Foot Function Index (FFI)

KEYWORDS

Body Weight, Foot Arches, Flatfoot, Plantar Fasciitis, Medial Longitudinal Arch.

INTRODUCTION

The human foot arch acts as a critical structural component that helps in weight distribution, balance, and movement. The medial longitudinal, lateral longitudinal, and transverse arches of the foot function collectively in weight transmission, shock absorption, and maintenance of posture¹.

With increasing body weight, these arches undergo varying degrees of stress, which may result in changes to their structure and function. Obesity and weight gain are often associated with foot deformities, discomfort, and a higher risk of musculoskeletal disorders health².

These arches are supported by ligaments, tendons, and muscles, with the plantar fascia playing a pivotal role in maintaining the integrity of the medial arch. Proper functioning of these structures is essential for absorbing and redistributing the forces exerted during walking and running. When standing or moving, body weight is transmitted through the lower extremities to the feet. The arches absorb the initial impact and help distribute the weight evenly across the foot. Height of the medial longitudinal arch of the foot is commonly thought to be a predisposing factor to injuries hence medial longitudinal arch is the most important arch of the foot from a clinical point of view³.

However, as body weight increases, the foot arches are subjected to greater compressive forces, leading to potential changes in their structural integrity. The medial longitudinal arch collapses under added pressure, which can result in conditions like flatfoot. Furthermore, the plantar fascia may become overstretched, leading to conditions such as plantar fasciitis.

The foot arch plays a crucial role in human locomotion. Increased body weight places greater compressive forces on foot arches, risking structural changes. This research explores how body weight affects foot arch function to mitigate foot-related issues

Objectives

1. To Explore the Impact of Body Weight on Foot Arch Types
2. To Assess the Relationship Between BMI and Foot Function
3. To Investigate Footwear Choices and Orthotic use across different weight Groups

Material and methods:

This study was a descriptive observational study. A total of 50 participants aged 18–50 years, were included for this study. Participants were divided into three groups based on their Body Mass Index (BMI)

Inclusion criteria:

No history of foot-related surgeries or deformities.

Exclusion criteria: Participants with pre-existing musculoskeletal conditions affecting lower limbs Pregnant women, due to potential changes in weight and foot structure during pregnancy

Data collection

1. Foot Arch Index (FAI): The Foot Arch Index was calculated. High arch: Arch index < 0.21. Normal arch: Arch index between 0.21 and 0.26. Low arch (flatfoot): Arch index > 0.26

2. BMI Calculation: Body weight and height were measured using a digital scale and measuring tape, respectively. BMI was calculated as weight (kg) divided by the square of height (m²)^{4,5}.

3. Self-Reported Foot Pain and Function: Participants completed the Foot Function Index (FFI) questionnaire, which assesses foot pain, disability, and activity limitations. This index helped quantify the subjective impact of body weight on foot function, particularly in individuals with excess body weight.

4. Footwear Analysis: Information on participant's regular footwear was collected, including types of shoes worn (e.g., flat shoes, athletic shoes, heels) and the presence of any orthotic insoles. The data helped assess the role of footwear in exacerbating foot arch issues related to body weight.

RESULTS

The study revealed a strong correlation between body weight and foot arch types, specifically flatfoot.

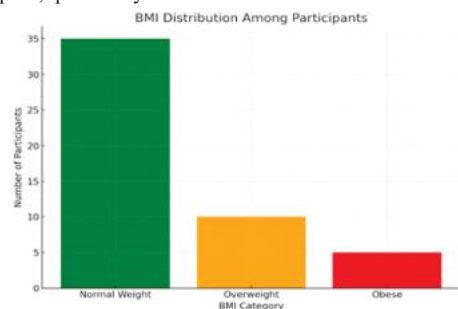


Fig-1 Higher body weight strongly correlates with lower arches (flatfoot)

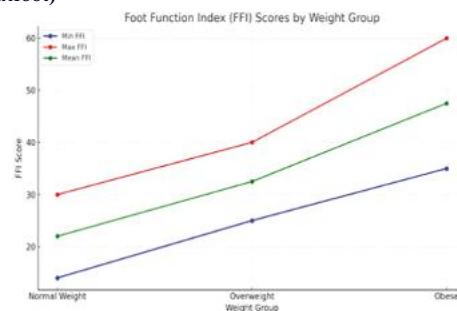


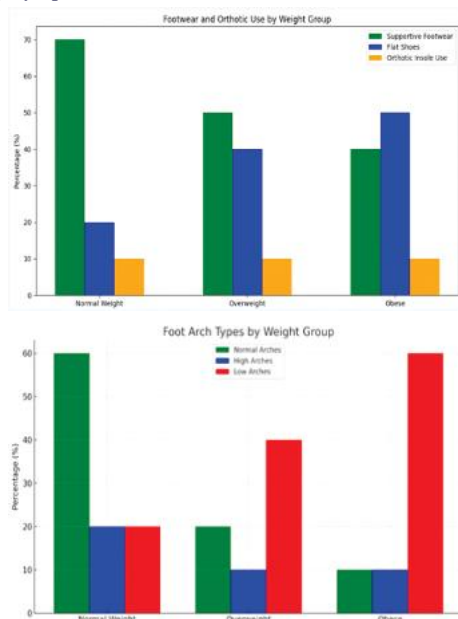
Fig-2 FFI Scores: Pain and disability increase with body weight

Statistical analyses:

Correlation: The Pearson correlation coefficient between BMI and Mean FFI is 0.99, indicating a very strong positive correlation. The p-value is 0.082, which suggests that the correlation is not statistically significant at a 0.05 significance level, but it's quite close. **ANOVA:** The F-statistic is 5.35, with a p-value of 0.046. This indicates that there is a

statistically significant difference in FFI scores across the different weight groups, as the p-value is just below the 0.05 threshold.

Fig-3 Supportive footwear mitigates some issues, orthotics help manage symptoms



DISCUSSION

Out of the 50 participants, 35 were classified as normal weight, 10 as overweight, and 5 as obese.

The BMI values for normal-weight participants ranged between 18.5 and 24.9, while overweight individuals had BMIs between 25 and 29.9, and obese individuals had BMIs above 30. This distribution is consistent with the defined categories and allowed for a comparative analysis of how different body weights affect foot arches and foot function.

For the normal weight group:

A higher percentage had normal arches (around 60%), followed by some with high arches (20%) and low arches (20%).

This indicates that normal weight individuals typically have a healthier foot arch structure.

In the overweight group:

There was a notable shift towards low arches (40%), with fewer individuals having high or normal arches.

This suggests that increased weight begins to impact the integrity of the foot arch, making the foot flatter.

For the obese group:

A significant portion (60%) had low arches, while only 10% had high arches.

This indicates a strong correlation between obesity and the likelihood of having flat feet, where excess body weight puts additional strain on the foot's arch.

Normal weight individuals had the lowest FFI scores (around 14–30), reflecting lower levels of foot pain and disability.

Overweight individuals had moderate FFI scores (25–40), indicating a noticeable increase in foot pain and discomfort, likely due to the additional weight.

Obese individuals had the highest FFI scores (35–60), showing significant pain, disability, and activity limitations. The strain on the foot from excess body weight is likely the cause of the increased discomfort and functional issues.

Normal weight participants were more likely to wear supportive footwear like athletic shoes and reported less need for orthotic insoles.

Overweight and obese participants often wore flat shoes, which may exacerbate foot problems, especially for those with low arches. A portion of these participants reported using orthotic insoles, which could indicate a need for additional foot support due to arch problems. Heels were worn less frequently across all categories.

The study confirmed that higher body weight is significantly correlated with a greater incidence of low arches (flatfoot). Obese individuals were more prone to flatfoot, leading to increased foot pain and disability, as measured by the FFI. The study correlates with previous studies stahelis plantar arch⁷.

Footwear plays a critical role in managing foot health, as participants with supportive footwear (e.g., athletic shoes and orthotic insoles) reported lower pain levels despite having low arches.

The findings suggest that weight management and proper footwear can mitigate the negative impact of excess body weight on foot arch integrity and function.

CONCLUSION:

This study highlights the importance of maintaining a healthy weight and wearing supportive footwear to prevent foot arch degradation and associated pain. Future interventions should focus on educating individuals about the impact of body weight on foot health and the role of appropriate footwear in reducing foot-related discomfort.

REFERENCES

1. Gray's Anatomy Standing S, ed. *Gray's Anatomy: The Anatomical Basis of Clinical Practice*. 42nd ed. Elsevier; 2020
2. Wearing SC, Hennig EM, Byrne NM, Steele JR, Hills AP. Musculoskeletal disorders associated with obesity: a biomechanical perspective. *Obes Rev*. 2006;7(3):239-250
3. Koirala S, Khanal GP, Shah S, Khanal L, Yadav P and Baral P. Calculation of Staheli's Planter Arch Index, Chippaux-Smirak Index, Clarke's Angle Prevalence and Predictors of Flat Foot: a Cross Sectional Study. *Austin J Anat*. 2021; 8(1): 1095.
4. Nagraraj Mallashetty, Veeresh Itagi, Vikas N M. EFFECT OF BODY WEIGHT ON ARCHES OF FOOT-A CORRELATIVE STUDY BETWEEN BMI AND ARCH INDEX. *Int J Anat Res* 2019;7(3.2):6877-6881. DOI: 10.16965/ijar.2019.248.
5. Giladi M, Milgrom, C., Stain, M, Kashtan, H, Margulia, J, Cisin, R., Steinberg, R, and Aharonson, Z; The low arch, a protective factor in stress fractures a prospective study of 295 military recruits. *Orthop, Rev*. 1985;14:709-712.
6. Kulkarni, Shrihari & Kulkarni, Shweta & Dsouza, Regina & Kour, Harpreet. (2023). Relationship between Body Mass Index (BMI) and Foot Posture Index (FPI) Among Healthy Adults Aged 20-30 Years - An Observational Cross-Sectional Study. *RGUHS Journal of Physiotherapy*. 3. 10.26463/rjpt.3_3_5.
7. Dr.Singrolay R and Dr. Kushwah R ; Staheli's planter arch index measured by simple footprint method is an effective diagnostic tool for flat foot as radiological methods – A comparative study *Journal of Scientific Research*, Sept 2015;4(9).