WHAT ARE THE EFFECTS OF GENDER AND OBESITY ON FOOT STRUCTURE IN CHILDREN?

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INTRODUCTION
Anecdotal evidence suggests that obese children, particularly boys, often suffer foot discomfort from wearing poorly fitting shoes. Therefore, the foot structure of 10 obese and 10 non-obese children were assessed to determine whether obesity influenced foot shape and if obesity-related changes in foot structure were moderated by gender.

REVIEW AND THEORY
It is generally agreed that shoe shape must be matched to foot shape if correct shoe fit is to be attained [1]. Factors that may affect foot shape should therefore be considered when recommending shoe selection for specific populations. Our previous research has revealed that one factor moderating foot shape in prepubescent children is obesity [2,3]. That is, obese children display significantly smaller Footprint Angles and higher Chippaux-Smirak Index values compared to their non-obese counterparts, parameters that have been associated with a lowered longitudinal internal arch, a flatter cavity and a broader midfoot area of the footprint. However, it is not known whether this effect of obesity on foot structure is common to both girls and boys or whether it is specific to just one gender. Furthermore, our previous studies were restricted to examining how obesity affected external characteristics of the plantar surface of the foot obtained from static weight-bearing footprints. It is therefore unknown whether obesity and/or gender also affect other parameters characterizing foot shape, particularly factors related to shoe fit. Therefore, the purpose of this study was to examine whether the effect of obesity on children’s foot shape is moderated by gender. It was hypothesized that, although obese children would display varying foot shape compared to their non-obese counterparts, gender differences in foot structure would not be evident in prepubescent children.

PROCEDURES
Four female and 6 male obese children (age = 8.8 ±2.0 years; BMI = 25.8 ±3.8 kg/m$^2$) and 10 non-obese children (age = 8.9 ±2.1 years; BMI = 16.8 ±2.0 kg/m$^2$) matched to the obese children for age, height and gender participated as subjects. Twenty-six anthropometric measurements were recorded for each subject’s right and left leg/foot [4] to characterize the external shape of the children’s feet. Static right and left barefoot footprints were then measured for each subject using a Productos Suavepie pedograph while the children stood in the anatomical position. Footprint Angle (FA), Chippaux-Smirak Index (CSI) and Arch Index (AI) were calculated from each footprint to represent the surface area of each child’s foot in contact with the ground and external characteristics of their medial longitudinal arch [5,6]. The anthropometric, FA, CSI, and AI data were then analyzed using a two-way ANOVA design with one between and one within factor to determine whether there were any significant differences in the variables as a consequence of body type or gender. When main effects were demonstrated post hoc comparisons of the means were conducted using a Tukey HSD test ($p \leq 0.05$).
RESULTS & DISCUSSION

Significant main effects of obesity were noted on 16 of the 26 anthropometric variables whereby the parameters measured for the obese subjects’ legs/feet were significantly larger than those calculated for their non-obese counterparts. However, only one parameter, 1st-3rd Toe Breadth, showed a significant interaction between obesity and gender ($F_{(1,39)} = 6.274, p = 0.017$). That is, obese females displayed significantly broader 1st to 3rd toes (62.6 ±5.5 mm) than the non-obese females (51.5 ±5.6 mm). In contrast, there were significant interactions between obesity and gender for all of the parameters characterizing the shape of the plantar surface of the children’s feet (see Figure 1).

![Figure 1. The interactions between obesity and gender.](image)

These figures illustrate that, although the FA, CSI and AI differences between the obese and non-obese girls were not significant, the obese boys displayed a significantly decreased FA, and a significantly increased CSI and AI compared to the non-obese boys. It is recommended that these differences, characteristic of a lowered longitudinal internal arch, a flatter cavity and a broader midfoot area, should be considered when fitting shoes for obese boys to minimise potential for foot discomfort from wearing poorly fitting shoes. As the prevalence of childhood obesity is increasing throughout the world, the possible nexus between obesity, gender and foot shape warrants further investigation, particularly as foot discomfort related to ill-fitting shoes may prevent obese children participating in activity and, in turn, perpetuate their obesity.

REFERENCES