

OVERWEIGHT AND OBESE PRESCHOOL CHILDREN: ARE THEIR FEET FAT OR FLAT?

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INTRODUCTION

Although obese children typically display flatter feet relative to their leaner counterparts (Riddiford-Harland et al., 2000; Dowling et al., 2001; Gilmour & Burns, 2001) the cause of their flatter feet is unknown. It has been postulated that the flatter feet of obese children may be caused by the existence of a plantar fat pad under the midfoot region. It is known that a fat pad is present underneath the medial longitudinal arch of the infant foot while the arch develops, although this fat pad is thought to resolve by the age of 5-8 years as the arch of the foot is formed (Hefti & Brunner, 1999). Riddiford-Harland et al. (2000) speculated that this midfoot plantar fat pad might remain in the feet of obese children as a protective adaptation to cushion the loads associated with their excess mass, in turn, causing their characteristic flatter feet relative to their leaner counterparts.

Alternatively, it has been suggested that the flatter feet of obese children may be caused by a collapse of the medial longitudinal arch due to excessive loading of the feet as a result of continually bearing additional body mass. Such a structural collapse can develop into a potentially “crippling” problem in later life, as proper functioning of the longitudinal arch is critical to normal foot function. Although this notion of a longitudinal arch collapse is purely speculative, it highlights the need to understand the cause of flat feet in obese children. However, to date, no research has investigated this issue. Therefore the aim of this study was to determine whether flat feet displayed by young obese and overweight children are caused by the presence of a thicker midfoot plantar fat pad or a lowering of the longitudinal arch relative to non-overweight children.

METHODS

Ninety-five children were recruited from 10 randomly selected pre-schools in the Illawarra region of New South Wales, Australia. Of these children, 19 (age = 4.3 ± 0.9 yr; height = 1.07 ± 0.1 m; BMI = 18.6 ± 1.2 kg.m⁻²) were identified as overweight/obese according to BMI cut-off points based on age and gender. A further 19 non-overweight children, matched for age, height and gender to the overweight/obese children, were selected as non-overweight controls (age = 4.3 ± 0.7 yr; height = 1.05 ± 0.1 m; BMI = 15.7 ± 0.7 kg.m⁻²). To determine the thickness of the plantar fat pad in the midfoot region of each child’s foot, the measurement function of a portable SonoSite® 180PLUS ultrasound system (10-5 MHz, maximum depth 7 cm; SonoSite, Washington, USA) was used.

To characterise the external structure of each child’s feet, 10 anthropometric dimensions were directly measured. These dimensions included seven general measurements that characterised the length, width and circumference of the foot and three that characterised the height of the medial longitudinal arch. Plantar pressure variables were also collected as a measure of foot functionality while the children walked over an emed AT-4 pressure platform (25 Hz; Novel_{gmbh}, Munich). Independent *t*-tests were then conducted to compare the foot structure and function data obtained for the overweight/obese children relative to the children of normal BMI to determine whether there were any significant differences ($p \leq 0.05$) between the two subject groups.

RESULTS

There was no significant difference in the thickness of the midfoot plantar fat pad displayed by the overweight/obese children (4.3 ± 0.6 mm) compared to the non-overweight children (4.1 ± 0.6 mm; $t = 0.781$; $p = 0.44$). However, the overweight/obese children were found to have significantly larger

dimensions for all seven general foot anthropometric measurements relative to their non-overweight counterparts (see Figure 1). In contrast, the overweight/obese children displayed a significantly lower plantar arch height (0.9 ± 0.3 cm) than their non-overweight counterparts (1.1 ± 0.2 cm; $t = -2.07$; $p = 0.04$). The overweight/obese children also displayed significantly higher midfoot plantar pressures (6.3 ± 1.2 N.cm⁻²) relative to their leaner counterparts (5.2 ± 1.1 N.cm⁻²; $t = 2.49$; $p = 0.02$).

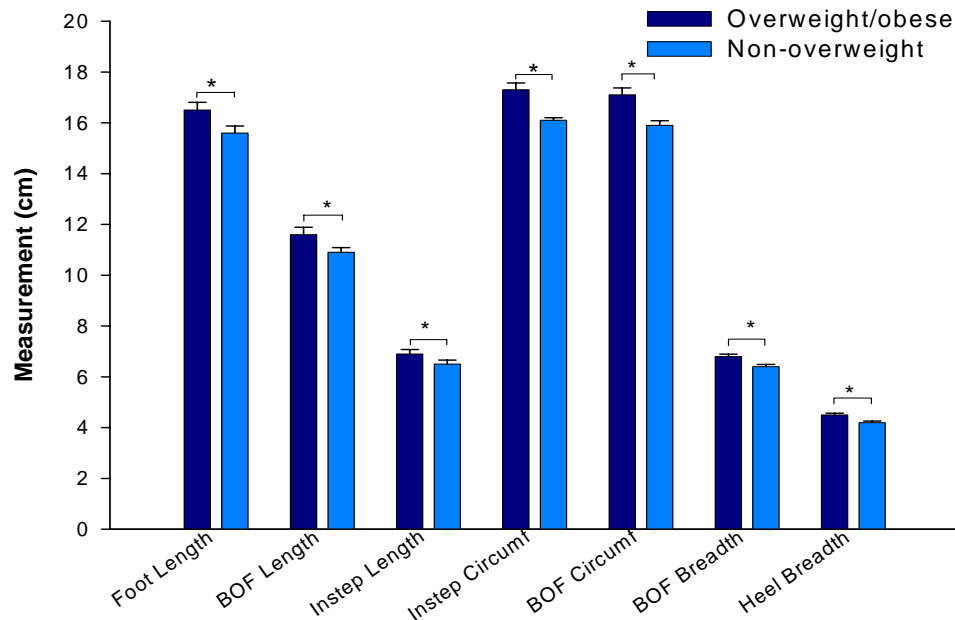


Figure 1: Means (+ SEM) for each of the seven general foot dimensions displayed by the overweight/obese (n = 19) and non-overweight (n = 19) children. * indicates a significant difference between the two subject groups (BOF = ball of foot; Circumf = circumference).

CONCLUSIONS

The lack of difference in fat pad thickness between the two subject groups implies that the flatter foot structure displayed by young overweight/obese children in the present study, relative to their non-overweight peers, was not caused by a thicker midfoot plantar fat pad. Instead, the significantly lower plantar arch height found in the overweight/obese children suggests that the flatter feet characteristic of overweight/obese pre-school children may be caused by structural changes to their foot anatomy, including a lower of the longitudinal arch. It is postulated that these structural and functional changes may be exacerbated if excess weight bearing continues throughout childhood and into adulthood. Therefore, urgent interventions, appropriate to the structural and functional needs of overweight and obese children, are required to prevent further weight gain and structural and functional complications to the feet.

REFERENCES

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