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How body mass affects foot structure and arch development in primary-school aged children

A thesis presented in partial fulfilment of the requirements for the degree of
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Abstract

Introduction: Childhood obesity has long been associated with long term health consequences including musculoskeletal issues. Deviations from the normal foot structure can greatly compromise foot function, causing discomfort and pain. No research has yet examined the feet of primary-school aged children during the critical stage of arch development. The aim of this study was to examine the feet of primary school aged children in terms of foot types and soft tissue structure and how body mass can affect the arch development in young children.

Methods: Thirty-nine primary school aged children (mean age, 5.58 ± 0.67 years) participated in this study. Foot types were determined via footprint analysis with scanned images of the sole of the feet, using the Chippaux-Smirak index. Thickness of the fat pad, plantar fascia as well as cross-sectional areas of the flexor digitorum brevis and flexor hallucis brevis were measured via ultrasound. Soft tissue structures that had the biggest influence on arch flexibility were the flexor hallucis brevis, proximal plantar fascia, and flexor digitorum brevis cross-sectional area when normalised to body mass.

Results: Significant differences of foot types between normal weight, overweight and obese children during sitting and standing were found ($p=0.009$ and $p=0.006$ respectively). The majority of overweight and obese children were classified with having a pes planus foot type. Overweight and obese children also tend to have more flexible feet compared to normal weight children. When normalised to lean body mass and body mass, all soft tissue structures showed significant differences between the different weight classes.

Conclusion: The feet of overweight and obese children tend to be flatter and more flexible compared to normal weight children. As body fat percentage increased the size of the soft tissue structures increased in absolute terms but decreased once normalised to body mass. Therefore, soft tissue structures in overweight and obese children are unable to carry the extra load causing the collapse of the medial longitudinal arch. As these soft tissue structures are vital in forming the medial longitudinal arch, early strengthening programs could prevent symptoms later in life.

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