Is dynamic plantar pressure really affected by childhood obesity?

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Introduction

Long-term excessive weight bearing forces caused by obesity may negatively affect foot structure and function in prepubescent children, whereby obese children display structural foot characteristics which may develop into problematic symptoms if excessive weight gain continues. Despite negative consequences of obesity on foot structure, only one study was located which examined the effects of childhood obesity on dynamic plantar pressures whereby mean dynamic forefoot plantar pressures experienced by obese children were higher than their non-obese counterparts, irrespective of forefoot contact area [1]. Whether these changes are typical of obese children and, in turn, may hinder obese children from participating in physical activity, warrants immediate investigation. Therefore, the purpose of this study was to re-examine the effects of obesity on plantar pressures generated by children to determine if dynamic plantar pressures are really affected by childhood obesity.

Methods

Right and left barefoot dynamic plantar pressures were measured for four female and six male obese children (age (mean ± SD) = 8.8 ± 2.1 years; BMI = 24.4 ± 3.8 kg·m\(^{-2}\)) and 10 non-obese children (age = 8.8 ± 2.1 years; BMI = 18.2 ± 1.9 kg·m\(^{-2}\)) matched to the obese children for age, height and gender. Plantar pressure data were sampled (25 Hz) using the Novel emed AT-4 system during three dynamic gait trials per limb (two-step method) which were paced by an accompanying walker. Variables of peak force, area and pressure for the forefoot (FF), rearfoot (RF) and total foot (TF) were calculated using emed-SF software. The foot was then divided into 10 anatomical regions of the foot (lateral and medial heel; lateral and medial midfoot; metatarsal heads 1 to 5; hallux and toes 2 to 5) using the Peter Cavanagh mask available in Novel-automask whereby the variables of force, area and pressure were analysed using Novel-multimask software. The data were then analysed using a two-way analysis of variance design with one between factor (subject group) and one within factor (test limb). The purpose of this analysis was to determine if there were any significant \((p < 0.05)\) effects of either obesity or test limb on the plantar pressure variables.

Results and Discussion

The obese children generated significantly \((p < 0.05)\) greater mean \((± SD)\) peak forces during walking under the RF (696 ± 195 N), FF (965 ± 258 N) and TF (1017 ± 256 N) compared to the non-obese children (RF = 443 ± 117 N; FF = 599 ± 142 N; TF = 647 ± 151 N). However, these greater forces were generated over a significantly \((p < 0.05)\) larger peak area of the obese children’s RF (39.3 ± 10.3 cm\(^2\)), FF (58.2 ± 9.9 cm\(^2\)) and TF (90.2 ± 18.2 cm\(^2\)) compared to their non-obese counterparts (RF = 25.9 ± 5.9; FF = 44.7 ± 5.3; TF = 65.1 ± 8.6 cm\(^2\)). Consequently, there were no significant differences in the dynamic plantar pressures generated by the obese children’s RF (39.3 ± 10.3 cm\(^2\)) and TF (90.2 ± 18.2 cm\(^2\)) compared to their non-obese counterparts (RF = 25.9 ± 5.9; FF = 44.7 ± 5.3; TF = 65.1 ± 8.6 cm\(^2\)). Although not statistically significant, differences in pressure readings between the obese and non-obese children were greatest for the FF. Furthermore, mean peak plantar pressures were found to be significantly greater particularly in selected masks of the forefoot in the obese children compared to the non-obese children (see Figure 1). This trend was consistent with previous research in which dynamic FF plantar pressures experienced by the obese children were higher than their non-obese counterparts [1]. It was therefore concluded that dynamic plantar pressures really are affected by obesity in children. Consequently, further research is recommended to determine to what extent the increased dynamic forefoot pressures experienced by obese children influence foot function or predispose them to foot pathologies.
Figure 1  Peak pressures in each of the 10 masked areas (means + standard errors) for the non-obese and obese children. * Denotes significant difference.

References