DO OVERWEIGHT AND OBESITY AFFECT DYNAMIC PLANTAR PRESSURE DISTRIBUTIONS IN PRE-SCHOOL CHILDREN?

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INTRODUCTION

It has been speculated that foot pain caused by high plantar pressures generated during walking may decrease a child's desire to participate in physical activity and, in turn, perpetuate the cycle of obesity. Although obese primary school children have been found to generate higher plantar pressures when walking compared to their leaner counterparts [1], it is not known whether younger overweight and obese children also generate these potentially negative higher pressures. Therefore, the purpose of this study was to determine the effects of overweight and obesity on plantar pressures generated by pre-school children during gait.

METHODS

The height and mass of 86 consenting children (mean age = 4.2 ± 0.6 years) from 10 randomly selected pre-schools in the Illawarra region of New South Wales, Australia, were measured following standard procedures. Each child walked across an emed AT-4 pressure platform (25 Hz; Novel$_{gmbh}$, Munich) using the first-step method, with up to 6 successful trials being collected on each child's left and right foot. A subset of 17 overweight/obese children (BMI = 18.5 ± 1.2 kg.m^{-2}) were then identified from the sample and matched for height, age and gender with 17 non-overweight children (BMI = 15.7± 0.6 kg.m^{-2}).

Peak plantar pressures (N.cm^{-2}), maximum force (N), contact area (cm^{-2}), force-time integrals (N.s) and pressure-time integrals (N.s.cm^{-2}) were then derived for five regions of each child's feet, averaged across all trials. Independent *t*-tests were then applied to the data to determine whether there were any significant differences ($p < 0.05$) in the plantar pressure variables between the two subject groups.

RESULTS AND DISCUSSION

The overweight/obese children had significantly larger contact areas between the total foot (TO), heel (M01), midfoot (M02) and forefoot (M03) and the ground when walking, compared to the non-overweight children. The overweight/obese children also generated significantly larger forces in the total foot, heel, midfoot and forefoot regions of the foot when walking. This was to be expected, as heavier children should generate greater forces than their leaner counterparts. Despite generating the higher forces over larger contact areas, the overweight/obese children displayed significantly higher peak pressures (Figure 1), force-time integrals and pressure-time integrals in the midfoot region of the foot (M02), compared to the non-overweight children.

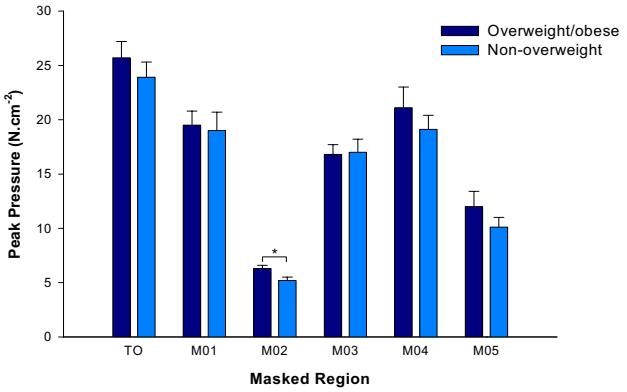

Figure 1: Means (+ SEM) of the peak pressures generated in each masked region of the foot, displayed by the overweight/obese and non-overweight children. * indicates a significant difference between the two subject groups.

CONCLUSIONS

These results imply that the additional contact area displayed by these overweight/obese pre-school children in the midfoot area of the foot was not able to compensate for the high forces generated in that area of the foot during walking, resulting in higher pressures under the midfoot. As force-time and pressure-time integrals provide an indication of the load imparted on particular bony and soft tissue structures in the foot, these results suggest that the midfoot area of these overweight/obese young pre-school children may be exposed to increased stress and, in turn, vulnerable to bony fatigue and soft tissue damage. It is postulated that these 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 very young overweight and obese children, are required to prevent further weight gain and structural and functional complications to the feet.

REFERENCES

1. Dowling AM, et al. *International Journal of Obesity and Related Metabolic Disorders* 2001; **25**:845-852.

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