SINGLE LIMB STANCE BALANCE IN OBESE AND NON-OBESE CHILDREN

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SUMMARY

There is a progressive improvement in balance with age and the processes underlying to maintain an optimal postural stability are mature at least as soon as 6 years of age. When compared to normal-weight children, obese children have showed poor motor competence. However, it is not clear how overweight and obesity affect the postural balance during childhood and early adolescence. The aim of this study was to verify the differences between postural balance in obese and non-obese children. The postural balance of 71 children (38 normal weight and 33 obese), divided into two age groups (8-9 and 10-11 years-old), was assessed by testing the standing dominant single leg stance and eyes open. The differences between groups were verified using one-way analysis of variance test. Pairwise comparisons were performed using Bonferroni post-hoc test ($p<0.05$). A force plate was used to measure the anterior-posterior amplitude, medio-lateral amplitude, mean velocity and 95% area of the ellipse. Significant differences were found only between 8-9 obese and 10-11 obese groups ($p=0.04$) for velocity of COP and between 8-9 obese group and 10-11 non-obese group for area of COP ($p=0.02$). There is no other significant difference between groups. The results of our study are not clear about the effect of children obesity in postural balance, moreover the less age groups presented poor performance than others showing age could be more important factor in balance than weight status.

INTRODUCTION

Balance control is prerequisite in posture and locomotion. There is a progressive improvement in balance with age and the processes underlying to maintain an optimal postural stability are mature at least as soon as 6 years of age [1]. However, children until 10-12 years old seem less efficient than adults in the control of static or dynamic balance [1,2]. It has been suggested that a decrease in balance stability is correlated to an increase in body weight [3,4]. When compared to normal-weight children, obese children have showed poor motor competence [5,6]. However, it is not clear how overweight and obesity affect the postural balance during childhood and early adolescence. Increased instability and major dependency on vision system have been reported [4]. On the other hand, some investigations have found no differences between normal-weight and obese children balance during the bipedal quiet standing posture [7,8]. For subject without neurological conditions, bipedal quiet standing may not test the ability of the musculoskeletal system to provide functional balance in single limb support during gait [9]. No study could be located that had tested single limb stance in obese children using force plate measures. Therefore, the purpose of this study was to verify the differences between postural balance in obese and non-obese children from 8 to 11 years-old.

It is believed that a better understanding of development of balance in obese children can be useful to separate effects of obesity from balance impairments or neurological disorders.

METHODS

The postural balance of 71 children from 8 to 11 years-old (38 normal weight and 33 obese) was assessed. They were divided into two age groups (8-9 and 10-11 years-old). Cole et al [10] was used to classify the weight status groups. An AMTI AccuSway Plus force plate at a frequency of 100Hz and filter cut-off at 10Hz was used to measure the anterior-posterior amplitude (COPap), medio-lateral amplitude (COPml), mean velocity (COPvel) and 95% area of the ellipse (COParea). The subjects were tested for three trials (30s) standing in dominant single leg stance and eyes open. However, some children were unable to remain in the position for the 30s and their results were not included. The dominant lower limb was classified as the limb the participants chose to "stand on one leg". The non-dominant limb was held flexed at the knee. The normal data distribution was verified by Shapiro-Wilk test while differences between groups were verified using one-way analysis of variance test. Pairwise comparisons were performed using Bonferroni post-hoc test ($p<0.05$).

RESULTS AND DISCUSSION

Significant differences were found only between 8-9 obese and 10-11 obese groups ($p=0.04$) for velocity of COP and between 8-9 obese group and 10-11 non-obese group for area of COP ($p=0.02$). There is no other significant difference between groups. In general, older groups (10-11 years-old) had better results than youngest groups (8-9 years-old) for all variables (Table 1). The 8-9 years-old obese group showed worst results for all variables compared to another groups, including higher variability.

An increase in body weight has been correlated to a decrease in balance stability [3,4]. The results of our study are not clear about the effect of obesity in children from 8 to

11 years-old. Besides the 8-9 years-old obese group presented poor performance than others groups it seems age is a more important factor in balance than weight status. Our findings are similar with Mickle et al. (2011) that found the 8 years-old healthy children displayed greater sway than the 10 years-old during single limb stance condition during 30s. In a different protocol with 3s of stance single limb conducted by Zumbrunn et al. (2011) results also indicated balance improves with age from 4 to 18 years-old. There is a lack of information concerned single leg stance balance in obese children. These data could contribute to determining balance impairments or neurological disorders in this population. A limitation of the study was that because some children could not stay in the determined position and their results were not included, may be that the differences were minimized between those with the ability to complete the assessment.

CONCLUSIONS
The results of our study are not clear about the effect of obesity in children from 8 to 11 years-old. Besides the 8-9 years-old obese group presented poor performance than others groups. It seems age is a more important factor in balance than weight status during 30 seconds of balance recording.

REFERENCES
- 1. Rival et al. Neur Sci Letters.376. 133-136. 2005.
- 2. Nolan et al. Dev Med Child Neur. 47.449-454. 2005
- 3.Hue O. et al. Gait Posture. 26. 32-38. 2007.
- 4.Menegoni F. et al. Epidemiology. 17. 1951-1956. 2009.
- 5.D´Hont E. et al. Gait Posture. 33. 179-184. 2011.
- 6. Lopes VP. et al. J Sci Med Sport. 15. 38-43. 2012.
- 7. D´Hont E. et al. Clin Biom. 26. 84-89. 2011.
- 8. Pau M. et al. Gait Posture. 35. 378-382. 2012.
- 9. Zumbrunn, T. et al. Gait Posture, 34. 174-177. 2011
- 10. Cole TJ et al. British Med J. 335. 194-202. 2007.
- 11. Mickle et al. J Sci Med Sport. 14. 243-248. 2011

Table 1: COP parameters for obese and non-obese groups (mean±SD).

Age (yrs)	Groups	N	COPml	COPap	Area95	COPvel
8-9	non-obese	17	3,15 ± 0,42	5,07 ± 1,13	11,0 ± 4,31	5,17 ± 1,46
8-9	obese	13	3,49 ± 0,81	5,85 ± 1,55	12,18 ± 5,42	5,69 ± 1,81
10-11	non-obese	21	3,13 ± 0,54	5,01 ± 2,31	8,27* ± 2,24	4,84 ± 1,38
10-11	obese	20	3,10 ± 0,44	4,58 ± 0,90	9,11 ± 2,93	4,34** ± 0,81

 * Significant difference between 8-9 obese group and 10-11 non-obese group.
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