



ISB 2013  
BRAZIL

XXIV CONGRESS OF THE INTERNATIONAL  
SOCIETY OF BIOMECHANICS

XV BRAZILIAN CONGRESS  
OF BIOMECHANICS

## COMPARISON OF A SINGLE LEG STANCE BALANCE BETWEEN CHILDREN AND ADULTS

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### SUMMARY

Postural balance is important for daily activities in special for children. This balance depends on the integration between the three different sensory systems: vestibular, visual and proprioceptive. Analysis of bipedal balance in children show a maturity of balance at approximately 10-11 years. The aim of this study is to compare the performance of postural balance in single leg stance between typically developing children aged 8 to 11 years old and healthy adults. Participants were divided into 3 groups: 8-9 years, 10-11 years and 18-30 years. Each subject was tested barefoot for three trials collected during 30 seconds in single leg stance with their arms alongside the body. The parameters recorded were: amplitude of the center of pressure (COP) in the anteroposterior (COPap) and mediolateral (COPml) directions, total path length (Path lgth), average velocity (COPvel) and 95% ellipse area (COParea95). The results showed no difference in any of the variables between groups of children (8-9 years and 10-11 years). However, significant differences were found in all variables ( $p < 0.01$ ) when comparing these groups with the adult group. Children have not developed the balance on one leg as adults.

### INTRODUCTION

Postural balance is important for daily activities in special for children, since it is a primary motor skill [1]. Furthermore, during the gait people must be able to control the center of mass during a single leg stance allowing the effectively swing phase of the opposite limb [2]. This balance depends on the integration between the three different sensory systems: vestibular, visual and proprioceptive. Although, bipedal balance analysis in children is relatively well reported in literature showing a maturity of balance at approximately 10-11 years, information about the development of single-leg balance is still difficult to found. The aim of this study is to compare the performance of postural balance in single leg stance between typically developing children aged 8 to 11 years old and healthy adults.

Informations about the development of single leg stance balance in children is important to help to identify impairments or neurological disorders. This evaluation may be more appropriate to assess balance function and determine possible changes of balance in children than

bipedal stance since the individual is more challenged at that position.

### METHODS

Participants were divided into 3 groups: 8-9 years (N=17), 10-11 years (N=21) and 18-30 years (N=20). To measure the balance was used an AccuSway Plus (AMTI, Inc, MA,USA) force platform at a frequency of 100Hz signal acquisition and a 10Hz cutoff filter. Each subject was tested barefoot for three trials collected during 30 seconds in single leg stance with their arms alongside the body while fixating a reference point placed at eye level (one meter in front). The parameters recorded were: amplitude of the center of pressure (COP) in the anteroposterior (COPap) and mediolateral (COPml) directions, total path length (Path lgth), average velocity (COPvel) and 95% ellipse area (COParea95). Statistical analysis was performed using SPSS statistical package version 13.0. The *Shapiro-Wilk* test was used to verify the normality of the data. *Anova One-Way* test was used to compare group means and *Post Hoc Bonferroni* to identify significant differences. The significance level was set at  $p < 0.05$ .

### RESULTS AND DISCUSSION

The results showed no difference in any of the variables between groups of children (8-9 years and 10-11 years). However, significant differences were found in all variables ( $p < 0.01$ ) when comparing these groups with the adult group. It was also observed that the results of the children group aged 10-11 years are closer to the values presented by the adults than the 8-9 years group (Table 1).

The results show that children at the age of 11 years-old do not yet have the full development of balance during the quiet standing position on a single leg. However, the group of 10-11 years showed better results than children of 8-9 years of age. Therefore appears that children aged 8 to 11 years old still lacks the full integration of sensory systems as adults. According to Folio et. al. (2000), motor tests in children have shown increased ability to balance on a single support member with the maturation [3]. Cuisiner et. al.(2011) also found lower values of COP in bipedal stance in children with age evolving gradually to values close to that seen in adults [4].

### CONCLUSIONS

Children have not developed the balance on one leg as adults. Understanding the development of balance in single leg stance may be important to understand how it affects gait and other activities. It can also assist in the diagnosis and treatment planning. These results may also contribute as a reference for evaluating the balance in one-leg support with other populations.

#### ACKNOWLEDGEMENTS

Conselho Nacional de Desenvolvimento Científico e Tecnológico – CNPq

#### REFERENCES

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**Table 1:** Means and standard deviations of the variables of COP (average,  $\pm$  sd)

| Parameters                   | 8-9 years<br>N=17  | 10-11 years<br>N= 21 | Adults<br>N=20                   |
|------------------------------|--------------------|----------------------|----------------------------------|
| COPml (cm)                   | 3.15 $\pm$ 0.42    | 3.13 $\pm$ 0.54      | 2.40 $\pm$ 0.29 <sup>1,2</sup>   |
| COPap (cm)                   | 5.07 $\pm$ 1.12    | 4.56 $\pm$ 1.06      | 3.50 $\pm$ 0.80 <sup>1,2</sup>   |
| Path lgth (cm)               | 155.04 $\pm$ 43.91 | 145.34 $\pm$ 41.44   | 98.00 $\pm$ 20.23 <sup>1,2</sup> |
| COPvel (cm/s)                | 5.17 $\pm$ 1.46    | 4.84 $\pm$ 1.38      | 3.27 $\pm$ 0.67 <sup>1,2</sup>   |
| COParea95 (cm <sup>2</sup> ) | 11.0 $\pm$ 4.31    | 8.27 $\pm$ 2.23      | 5.52 $\pm$ 1.58 <sup>1,2</sup>   |

<sup>1</sup> significant difference 8-9 years group (p< 0.01)

<sup>2</sup> significant difference 10-11 years group (p< 0.01)