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ANALYSIS OF SYMMETRIES FOR POSTURAL AND LOADING PARAMETERS IN PRESCHOOL CHILDREN

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SUMMARY

During infancy, neuromuscular dysfunction and osseous misalignment may lead to asymmetric features. Monitoring early postural asymmetries becomes important for preventing the scoliosis. The aim of this study was to investigate postural asymmetries in preschool-aged children. The sample consisted of 54 preschool-aged children between four and six years. Baropodometric platform was used to identify the distribution of plantar pressure, whereas foot image in paper was obtained to measure the foot medial arch. Postural parameters were evaluated with photography that was analyzed using the SAPo postural assessment software. Mean, standard deviation and the symmetry ratio (SR) were calculated for each parameter, being considered symmetry values greater than 90%. Baropodometric parameters surface and load, and morphology of the foot did not present significant differences between neither feet nor genders. Only following postural parameters frontal angle of the left lower limb, angle of the right knee and vertical alignment of the body left presented significant differences between genders. As to SR values, surface, load and morphology of the foot and all postural parameters showed values that were less than 90%, indicating asymmetry. Finally, there was a positive and significant correlation between the SR surface and SR foot morphology for girls only and a negative correlation between SR load and SR knee angle for boys only. These results suggest that asymmetries in both posture and foot load distribution occur in infancy, and prospective studies should be conducted with preschool children to monitor these asymmetries in the long term, in order to prevent future disabilities.

INTRODUCTION

During infancy, muscular imbalance, unilateral neuronal dysfunction and asymmetric skeletal disturbances may lead to asymmetric features[1]. Asymmetric posture is not a disease, and others have also reported a high prevalence of asymmetry[2,3]. However, it is unknown whether small asymmetries at an early age are related to physiological variation or whether they are precursors of scoliosis. The early diagnosis of the load feet in childhood is important for their role in the genesis of biomechanical changes that may become in the long term symptomatic, denoting poor posture, joint wear and gait disorders. However, the fact that these studies have rarely focused on preschool-aged children indicates a lack of diagnostic criteria for asymmetries in this particular age group. With a focus on preschool-aged children, this study aimed to evaluate the morphology of the foot, baropodometry and postural parameters and correlating it with postural asymmetry in children from four to six years of age.

METHODS

The sample consisted of 54 preschool-aged children between four and six years. Initially, participants' body stature (cm) and weight (Kg) were measured using a calibrated scale (Welmy, Santa Bárbara d´Oeste / SP, Brazil), we used the correlations between weight for age (W/A), Weight for Height (W/H) and height for age (H/A), as recommended by the World Health Organization (WHO). Later, each individual stood on the platform of the electronic baropodometry in on orthostatic resting position for 5-10 seconds, we invite children to relaxed as possible while they remained on platform, in order to not consciously affect posture during data acquisition. Finally, the children had markers placed on anatomical landmarks with styrofoam balls, that were positioned in standing to obtain the images of posture in the frontal, right and left lateral and sagittal planes. Camera (Sony Cyber-shot DSC-P93) was placed on a tripod (height of 1.63 meters) at 90 degrees and 1.9 meters from participant. A plumb line marked with two styrofoam balls was used for vertical calibration. Photos were analyzed by SAPO (postural analysis software) available in the public domain. The morphology of the foot was evaluated by the photographic image in the plantar region podoscope. The Staheli's Arch Index (SAI) is the method that was selected for assessing the medial longitudinal arch (MLA) from plantar footprints. SAI is the ratio between the arch width in the mid-foot region and the heel width, obtained by footprints. Mean, standard deviation and the symmetry ratio (SR) were calculated for each parameter, being considered symmetry values greater than 90%. The study was approved by the Ethics Committee in Research of Universidade Federal do Ceará (089/11).

RESULTS AND DISCUSSION

Our sample consisted of 46 children. Mean body weight for children (17.1±0.30 kg) is related to a sample of eutrophic children, so these groups truly represent the selected population, for baropodometric parameters are influenced by body weight.

Table 1 shows the means and standard deviations of the variables analyzed. The symmetry ratio results are also shown in Table 1.

Table 1. Baropodometry static parameters of children with 4-6 years of age.

Parameters	Boys	Girls	P value
Surface (cm^2)			
L Foot	39.3±15.9	37.4±17.0	P = 0.7
R Foot	41.4±18.1	36.4±14.3	P = 0.3
P value	P = 0.3	P = 0.7	
Surface SR (%)	82.7±9.2	74.0±22.9	P = 0.2
Load (Kg)			
L Foot	8.7±2.1	8.7±2.9	P = 0.9
R Foot	8.3±2.0	8.4±2.9	P = 1.0
P value	P = 0.5	P = 0.8	
Load SR (%)	74.3±19.3	67.0±25.6	P = 0.4

Data values were expressed as mean ± standard deviation of mean. L= left, R= right. SR= symmetry ratio

No significant differences between surface and load left foot and right foot were observed but the surface and load symmetry ratios in children showed values that were less than 90%, in both groups (Table 1). In relation to the studied baropodometric parameters, no studies were found with reference values for children in preschool age. In eutrophic children, mean age of ten years, Dowling *et al*., 2004[4] found values for foot surface higher than those found by our study in children with mean age of 4.6 years.

Table 2 shows the SR results of the variables analyzed.

Table 2. SR of the postural parameters of children with 4-6 years of age.

SR of the Parameters (%)	Boys	Girls	P value
Head – vertical alignment	45.2±34.2	38.2±26.7	P = 0.4
Pelvis– horizontal alignment	57.3±40.2	64.1±32.5	P = 0.3
Frontal angle	58.1±34.4	60.6±25.6	P = 0.9
Knee angle	50.4±29.1	63.7±19.6	P = 0.1
Body - vertical alignment	50.7±28.0	47.7±34.6	P = 0.6
Angle of the ankle	95.4±3.6	95.1±4.2	P = 0.6

Data were expressed as mean ± standard deviation of mean. SR= symmetry ratio.

Mean and standard deviation of mean value for arch index was 0.77±0.20 for left foot and 0.76±0.29 for right foot in girls, with no significant difference between sides for girls (P=0.83), and 0.88±0.31 for left foot and 0.89±0.35 for right foot in boys, also with no significant differences being observed in them (P=0.69).

Baropodometric parameters surface and load, and morphology of the foot did not present significant differences between neither feet nor genders. Only following postural parameters frontal angle of the left lower limb, angle of the right knee and vertical alignment of the body left presented significant differences between genders. Significant biomechanic and neuromuscular differences seems to occur between genders[5].

As to SR values, surface, load and morphology of the foot and all postural parameters showed values that were less than 90%, indicating asymmetry. Finally, For better understanding of findings, only significant correlations were illustrated. There was a positive and significant correlation between the surface ratio and foot morphology ratio for girls (R=0.526; p=0.021; alpha=0.65), but not for boys (R=0.072; p=0.748; alpha=0.05). There was negative correlation between load ratio and Q angle ratio for boys (R=0.405; p=0.045; alpha=0.522), but not for girls (R=0.249; p=0.319; alpha=0.165).

In childhood, lower limbs present variations in their alignments such as rotations and angular deformities, being these variations the result of normal growth and development and, in part, they resolve themselves without treatment as children continue to develop[5]. In preschool children, several studies identified a high prevalence of postural asymmetries stated as physiologic and not structural, that could be precursors of scoliosis[2,3]. The children assessed in the study are also in this age group, and the observed SR values of less than 90% agree with the high prevalence of asymmetry found in the literature. Thus, postural asymmetry could be a sign for scoliosis predisposion; however, only a small portion of children with asymmetry develop scoliosis, which shows that postural asymmetry is usually an ordinary feature of development[1].

Therefore, the conclusion of this study is that children in the studied age group showed postural and load foot asymmetries correlated with the asymmetry of the lower limb, being the results different between genders. Prospective studies should be conducted with children to monitor these asymmetries, their causes and correlations for the prevention of structural asymmetries as idiopathic scoliosis. Besides these data will provide a basis for more accurately assess postural changes and pediatric foot deformities.

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