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Artigo Original

QUAL O NÚMERO DE TENTATIVAS NECESSÁRIAS PARA AVALIAR O CONTROLE POSTURAL EM UMA PLATAFORMA DE FORÇA EM CRIANÇAS SAUDÁVEIS?

WHAT IS THE NUMBER ATTEMPTS ARE NECESSARY TO EVALUATE POSTURAL CONTROL ON A FORCE PLATFORM IN HEALTHY CHILDREN?

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RESUMO

A padronização da avaliação do controle postural na plataforma da força facilitará a realização de estudos em crianças. Não há padronização para a população infantil, o que dificulta a comparação dos resultados. O objetivo foi determinar o número de tentativas necessárias para a avaliação do controle postural em crianças. Um total de 344 crianças, 178 (51,7%) meninas, oito anos de idade, participaram deste estudo. O controle postural foi avaliado na posição unipodal durante 30 segundos, foi analisado a área de deslocamento do centro de pressão (COP) e a velocidade ântero-posterior e medial lateral (Vel. AP e Vel. ML). Para a análise comparativa do controle postural com três tentativas, utilizamos o teste de Friedman. Os resultados foram analisados utilizando o coeficiente de correlação intraclasse e o teste de concordância Bland-Altman. Não foram encontradas diferenças significativas (p> 0,05) nas três avaliações. Uma tentativa da criança provou ser suficiente para avaliar a COP, Vel. AP e Vel. ML (p=0,139; p=0,718; p=0,05, respectivamente). Uma excelente reprodutibilidade foi observada na COP e Vel. Variáveis ML (CCI: 090, p<0,0001, Erro: 0,07 cm2, CCI: 0,91, p=0,001, erro: 0,024 cm/s, respectivamente) e replicação média na variável Vel. AP (CCI: 0,68, p=0,0001, erro: 0,10 cm / s). O presente estudo recomenda que uma tentativa seja suficiente para avaliar o controle postural em crianças saudáveis.

Palavras-chave: Equilíbrio postural. Desenvolvimento infantil. Criança.

ABSTRACT

The standardization of the assessment of postural control on the force platform will facilitate the conducting of studies in children. There is no standardization for the child population, making it difficult to compare results.The present study aimed to determine the number of attempts needed for the assessment of postural control on a force platform in healthy children. A total of 344 children, 178 (51.7%) girls, eight years old, participated in this study. Postural control was evaluated with a single leg stance for 30 seconds, the present study analyzed pressure center displacement area (COP) and velocity anteroposterior and medial-lateral (Vel. AP and Vel. ML). For the comparative analysis of postural control with three attempts we used the Friedman test. Results were analyzed using the intraclass correlation coefficient and Bland-Altman concordance test. No significant differences (p >0.05) were found in the three evaluation. One attempt by the child proved to be sufficient to evaluate the COP, Vel. AP and Vel. ML (p =0.139; p =0.718; p =0.05, respectively). Excellent reproducibility was observed in the COP and Vel. ML variables (ICC:090, p <0.0001, Error:0.07 cm^2; ICC:0.91, p =0.001, Error:0.024 cm / s, respectively) and average replicability in variable Vel. AP (ICC:0.68, p =0.0001, Error:0.10 cm / s). The present study recommends one attempt is sufficient to assessment of postural control in healthy children.

Keywords: Postural balance. Child development. Child.

Introduction

Postural control is the capacity to maintain a proper relationship among the body segments and between the body and the environment[1]. This is a fundamental requirement for performing specific tasks and requires complex interactions between the musculoskeletal and neural systems[1]. Human postural control is compared with an inverted pendulum suspended on a base that constantly oscillates to maintain balance and posture[2].

Postural control is a prerequisite for maintaining posture and performing various activities, since it involves control of body position in space, such that stability objectives and guidance are attained[3]. In children, it is especially important since it is the primary requirement for other motor abilities[4]. The appropriate evolution of balance will permit the acquisition of a

larger and more qualified motor repertoire in childhood, since postural control is the basis of typical development in children.

Force platform is the gold standard for the evaluation of postural control[5,6]. The assessment of postural control using the force platform has been applied in studies with different populations, such as adults, older people[7] and children. The studies in children have been carried out with children having typical[8,9] and atypical[10] development, for example, visual deficits[11], hearing deficits[12] and Down syndrome[13].

Different techniques of measurement and assessment have been used by researchers in the health area, which often can lead to differing results. Some protocols for evaluation of postural control differ in the number of attempts, the time maintained in the test position and the posture to be adopted. There is no standardization for the child population, making it difficult to compare results. Most of the child data collection procedures are based on the parameters for the adult population. In adults the recommendations are: two[14] to four[15] attempts with a duration of 30 seconds[16], which has been shown to be sufficient for analysis. Already in children, there are studies with three attempts and a maintenance time in the test position of 30 seconds[8], 20 seconds[17], and 15 seconds[18].

Standardization of the assessment of postural control on the force platform will facilitate the conducting of studies in the pediatric population, since collaboration is one aspect that is difficult to attain. Therefore, the aim of this study was to define the number of attempts needed for the assessment of postural control on the force platform in healthy children with typical development.

Based on our experience of evaluation in children, the performance seems to be similar in the three evaluations. So, it was hypothesized that one attempt is sufficient to evaluate the variables COP, Vel. AP and Vel. ML in the single leg stance, with the participant's choice leg, maintained for 30 second.

Methods

Participants

This was a cross-sectional study, convenience sample, 344 of healthy children with typical development, eight years of age, both sexes, 178 (51.7%) girls from the public schools of the city of Londrina, Parana, Brazil. The age of eight was chosen due to the maturation of postural control[4].

Procedures

A consent form was referred for the signature of the parents or guardians of the children. The research project was approved by the Ethics Committee HU/UEL- Parecer N. 761.965. Exclusion criteria were children with incomplete data, children with the impossibility of maintaining a standing position, the presence of orthopedic changes, neurological and rheumatic changes, having sensory and / or cognitive deficits, history of neuromuscular diseases or previous trauma and orthopedic surgery, acute or chronic illnesses, congenital malformations, complaints of dizziness or vertigo, visual impairment, and continuous medication.

Descriptions of the data collection were adopted from the proposed criteria in the Guideline for Reliability Study (GRRAS)[19].

Data collection included anthropometric measurements (body mass and height) and postural control by a single examiner previously trained. Body mass was obtained by weighing on a Marte brand balance (model LC 200, year 2010), with the children barefoot and orthostatic. The height was measured with a tape measure of 150 centimeters (cm), with 0.1cm markings,

while the children remained upright, feet together, arms along the body and ankles in contact with the wall.

Evaluation of postural control was with a portable force platform (FP) (BIOMEC 410, EMG system). From the ground reaction force, the EMG System used Brasil® software, which performs the calculation of the variables: pressure center displacement area (COP area) (cm^2), anteroposterior and medial-lateral velocity (Vel. AP) (Vel. ML) (cm / s). This is more sensitive and reliable for detecting differences in postural balance in adults and older people[20,21], therefore the present study analyzed the number of attempts on the FP with regard to these parameters.

The children were familiarized with the equipment and the experimental protocol. For the postural control test, the participant was instructed to remain in orthostatic position, barefoot on the FP, with eyes in a fixed stare on the marking ahead, at a distance of two meters, arranged at eye level, with the trunk in an upright position and the arms at the side of the body, in a quiet and reserved room. The position adopted was with one foot support using the leg of preference, the one on which the child felt more stable, sustained for 30 seconds while the other leg remained with the hip in a neutral position and the knee flexed 90º for three attempts, with a one-minute rest interval[8,22,23]. To prevent falls during testing, an investigator stood close to the volunteers during evaluation. A mark on the force platform was used to standardize the position of the feet during the three attempts. The attempt was considered valid when the maintenance in the position occurred without touching the foot in the ground without strategy move and did not touch the evaluator.

The frequency adopted was 100 Hz. The digital data was transferred via universal USB cable to a computer. All force signals by the FP were filtered with a frequency range of 0-35 Hz and second order Butterworth filter to eliminate electrical noise. For the acquisition and treatment of the parameters, we used the software that accompanied the platform: Bioanalysis of the BIOMEC410 platform, compiled from the stabilization analysis routines in MATLAB (The Mathworks, Natick, MA).

Statistical analysis

Data were entered into Microsoft Excel and analyzed using SPSS software (version 20.0) and GraphPad Prism 6. Shapiro-Wilk test was used to verify whether the numerical data presented a normal distribution. For the comparative analysis of postural control with three attempts we used the Friedman test. Results were analyzed using the intraclass correlation coefficient and Bland-Altman concordance test according to the criteria described by Fleiss (1986)[24]. The significance level was set at $p < 0.05$.

Results

The descriptive characteristics of the children participating in the study and variables the control postural was presented in medians and quartiles (25% and 75%) respectively, the children evaluated have body mass (kg) 30.25 (26.92-36.30), height (m) 1.33 (1.30-1.37), COP area (cm^2) 13.38 (9.90-18.40), Vel. AP (cm / s) 4.38 (3.59-5.47), Vel. ML (cm / s) 4.27 (3.62-4.88).

Regarding postural control, the variables COP, velocity AP and velocity ML by means of the Friedman test did not present a difference between the three attempts performed in 8-year-old children ($p = 0.139$, $p = 0.718$, $p = 0.05$, respectively) (Figure 1). That is, one attempt proved sufficient to evaluate the variables COP, velocity AP and velocity ML of postural control.

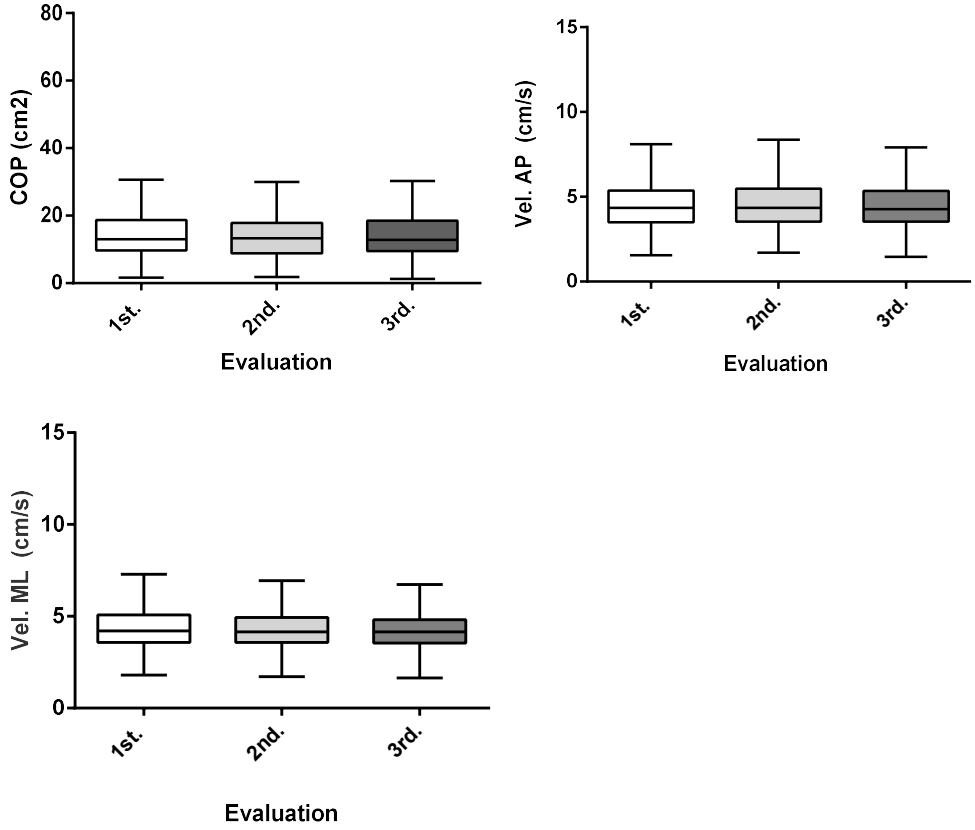

Figure 1. COP, Vel. AP and Vel. ML and number of retries
Source: Authors

In Table 1 are the variables COP, velocity AP and velocity ML for each of the three attempts. The results are presented as medians and quartiles (25% and 75%).

We observed an excellent replicability of the variables COP and velocity ML (ICC:090, p <0.0001, Error:0.07 cm^2, ICC:0.91, p =0.001, Error: 0.024 cm / s, respectively) and moderate replicability of the velocity AP variable (ICC::0.68, p = 0.0001, Error 0.10 cm / s) (Table 2)[24].

Table 1. Static postural control (COP, Vel. AP and Vel. ML) in three attempts, presented as medians and quartiles (25% and 75%)

Attempts	*Percentile*		
	25 %	*Median*	*75%*
COP- 1(cm^2)	9.66	13.00	18.66
COP- 2 (cm^2)	8.80	13.24	17.85
COP- 3 (cm^2)	9.45	12.83	18.52
Vel. AP- 1 (cm/s)	3.50	4.35	5.36
Vel. AP- 2(cm/s)	3.53	4.35	4.27
Vel. AP- 3(cm/s)	5.36	5.48	5.34
Vel. ML- 1(cm/s)	3.57	4.20	5.08
Vel. ML- 2(cm/s)	3.56	4.16	4.92
Vel. ML- 3(cm/s)	3.52	4.15	4.80

Source: Authors

Table 2. Attempts by force platform variables according to Mean, Standard Deviation (SD), Interclass Correlation Coefficient (ICC), and Bland-Altman

Variables PF	1° Measurement		2º Measurement		3º Measurement		ICC		Bland- Altman			
	Mean	SD	Mean	SD	Mean	SD	ICC	P	Error	Bias	Superior Limit	Inferior Limit
COP (cm^2)	14.86	8.32	14.52	8.03	14.52	7.95	0.90	<0.0001	0.07	0.35	15.91	-15.20
Vel. AP (cm/s)	4.51	1.52	4.53	1.77	4.46	1.66	0.68	0.0001	0.10	-1.39	50.20	-52.99
Vel. ML (cm/s)	4.36	1.15	4.31	1.21	4.24	1.18	0.91	0.0001	0.024	0.052	2.01	-1.90

Source: Authors

Discussion

There is discrepancy in the literature as to how many attempts are needed for the different variables measured during the evaluation. The results of our study show that only one attempt is sufficient to obtain reliable measurements of postural stability in healthy children eight years of age with typical development to obtain COP and Velocity AP and Velocity ML variable measurements. The literature shows that in the adult population various repetitions of the same task can provoke a learning effect, which leads to a progressive reduction of body oscillation[25]. Until now, there are no studies with children for standardizing the number of attempts on the force platform.

For children, the smaller number of attempts becomes important, since it is a population for which remaining in a test position is challenging, since they are more agitated compared to adults. The attention of the individual is also a factor that interferes in the evaluation of postural control[25,26]**.** Therefore, an attempt to evaluate postural control in a population of healthy children is relevant.

The variables COP and velocity ML presented excellent replicability, while velocity AP was moderate. That is the performance was similar in the three attempts, therefore does not change in relation to the number of attempts. In higher intensity perturbation the activation of the hip strategy is observed, to control oscillations in the medial-lateral directions[27]. In this study one attempt was sufficient to evaluate velocity ML, probably the single leg stance position was not so challenging for the evaluated sample. The literature shows that in healthy individuals the anteroposterior oscillations are more evident[28], which can explain that performing the test only once to evaluate the AP velocity variable has not produced excellent replicability.

The choice of the duration of the attempts in our study was 30 seconds, since the literature has suggested that this is sufficient to evaluate the body oscillation of both adults[16] and the elderly[29]. For a healthy population of children, it is the period that has also been adopted[8,9].

The standardization of positioning of the foot during the test was one foot support, since this was the most difficult position, therefore, the most effective for evaluation of postural control[30.] We believe that if the selected position for the test in the force platform is not the most effective (single leg stance), a greater number of attempts are required to obtain the values representative.

The standardization of the method of realization posturography in children is important for obtaining more reliable and valid results and in addition will allow a comparison between studies. In our study the gold standard was used, however there are other instruments to evaluate the postural control in children[31].

The limitations of our study were the age group, being restricted to eight years of age, and the sample consisting of only healthy children with typical development. Another limitation of the study was that we did not evaluate a two-foot position, a semi-tandem position, with open and closed eyes. Therefore, the result may not be generalizable to in different age groups and for children with atypical development and/or physical or sensorial deficiencies. In this study we used the variables COP, Vel. AP and Vel. ML, however, Sabchuk, Bento and Rodacki[32] suggests that the other variables can also be used to assess postural control.

Conclusion

The present study recommends one attempt is sufficient to of postural control with the variables COP, Vel. AP and Vel. ML in the single leg stance, with the participant's choice leg, maintained for 30 seconds in eight year old healthy children with typical development. The attempts had excellent applicability for the variables COP and Vel. ML, while the replicability of Vel. AP was classified as good to average.

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