INFLUENCE OF GENDER IN POSTURAL BALANCE OF SCHOOL AGE CHILDREN

Influência do gênero no equilíbrio postural de crianças com idade escolar

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ABSTRACT

Purpose: to evaluate the relation between gender and level of development of responsible systems for postural balance in children between six and ten years old. **Method:** it was composed of 282 children, divided into three groups: general (girls and boys), female (146 children) and male 136 male (children aged between six and ten years old). For the evaluation of postural balance it was used the dynamic posturography assesses laser-foam sensory systems through six different tests. Data were submitted to descriptive statistics and tests according to the normality of the data. **Results:** in the Sensory Organization Test, it can be observed that the findings for girls were higher than the values found for boys in the variables Sensory Organization Test I and their average. However, these values for the groups of boys and girls were below the reference values of the Foam-Laser Posturography for adults. When it was done the comparison between genders within each age group it was found statistically significant differences in the Sensory Organization Test I for eight year-old, the Sensory Organization Test V for nine year-old and the Sensory Organization Test and Average VI Sensory Organization Test for eight year-old. **Conclusion:** although postural balance was better for girls than boys, both groups had lower values than those considered normal in adults indicating that the systems responsible for postural balance are not mature.

KEYWORDS: Gender Identity; Postural Balance; Children; Sensation

INTRODUCTION

The body balance evaluation acquires prominence when related to the improvement of the individual's daily life activities. The earlier a balance disorder is detected the shorter the results of therapeutic treatment can be, avoiding problems of learning and socialization among others. The balance is an important evolutionary function that ends up being an indicator of neurological maturity, where children with immaturity of this function have more chances of experiencing learning difficulties, with interference on school issues[1].

In children, the sensory systems are still not in a mature stage and are not selective, failing to capture only the relevant information in order to properly integrate the information from the different sensorial systems[2].

When it comes to children, you should also take into account that the issue of development can have connection with the gender factor, through the relationship between boys and girls and which gender this development may occur earlier. Based

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on this, the scientific curiosity to get the answer on this question becomes increasingly important to understand the whole process of maturation systems.

So both in boys and girls the postural balance is driven by three systems responsible for their organization, the visual, vestibular and proprioceptive, each with their degree of importance to this process[3].

Balance is one of the senses that allow the adjustment of individuals to the environment. Postural control is a basic aspect to understand the ability that humans have to perform their activities and keep the body in balance in situations of rest, as in the case of static equilibrium, and moving when there're stability and guidance[4]. The postural control system is responsible for three basic functions: support, stability and balance. These functions help to prevent the body from falling down due to gravity and this system ensures that the appropriate muscles are contracted to support the body in an upright position[5].

The postural balance is formed by the integration of visual signals, vestibular proprioceptive in different levels in the central nervous system, this will cause the activated muscle synergy to be in the proper completion of specific tasks. Proprioceptors located in the cervical region are extremely important in postural control aiding in the formation of body schema and stabilizing the body[6].

In regards to the development and maturation of body structures and systems connected to gender, girls' bone age had an earlier maturing than boys according to some studies, which shows that the bone maturation can occur up to two years earlier than in boys[7]. This fact may indicate that in other systems may be the same way, postural balance also seems to develop earlier in girls than in boys[8,9].

In this light, the present study aimed to evaluate the influence of gender on the level of development of postural balance in children aged from six to ten years old.

METHOD

Study Group

Initially, the authorization of the school to implement the project was asked and after its approval, a survey with the students was made, and they were handed a Term of Free and Informed Consent Form (ICF) for parents to sign when they agreed with the participation of their child (children). Then, a survey was conducted with the signed ICF forms to determine the students who would be allowed to participate in the evaluations.

Thus, the study group was composed of 282 male and female children, aged from six to ten years and belonging to public schools in Santa Maria. This group was divided into two subgroups: one group composed with 146 girls and other with only boys, five groups again, this time depending on the age and gender as well. The inclusion criteria of the study were to be regularly enrolled in one of the schools participating in the project, to age from 6 to 10 years of age, to be considered as active in physical activity level designated by the IPAQ (International Physical Activity Questionnaire) and to possess the consent term duly signed by the parents. Exclusion criteria were the following: having psychological problems and motor impairment observed in anamneses (medical history).

Procedure

The children's evaluations were held at the school and these consisted of: anthropometric evaluation and postural balance and its relationship with the visual, vestibular and somatosensory systems. For the evaluation of postural balance, it was used the dynamic posturography foam-laser[10]. Dynamic posturography exposes children to six distinct conditions called TOS (*Teste de Organização Sensorial* – Sensory Organization Test), thus performing the tests with reference values (TOS I = 90%, II = 83% TOS, TOS III = 82%, IV = TOS 79%, V = 60% TOS, TOS VI = 54% and Average TOS = 75%)[11] in which the afferent sensory vanish when the individual performs the test with closed eyes (TOS TOS II and IV) the visual information is cancelled and when it is performed on the cushion (TOS TOS III and VI) it cancels the information of somatosensory input, therefore analyzing and comparing a condition to another. In the evaluation by FLP, each child was placed in a 1 m^2 booth, with a 2 m height, made with detachable iron support, wrapped in a cotton fabric which surrounds the child, printed with light and dark horizontal stripes each being 10 cm wide each. The cabin is a simple mechanical system which moves manually at 20° back and forth in the TOS III and VI. A laser pen was attached with the tip being held vertically upward by a belt made of foams whose ends are adaptable to the waist of the individual. The laser was then projected on a graph paper, 50 cm x 50 cm, somatosensory system; it is proposed the use of a 10 cm thick cushion between the feet of the individual and the ground[10]. Thus, the TOS I, II and III are executed without using this cushion and tests IV, V and VI using the cushion. Every condition was performed in the standing position, bare feet, for 20 seconds, in which the displacement of the laser on graph paper was counted by the evaluators

and then placed in the equations to calculate the angular oscillation of the gravity center.

It was also performed an anthropometric evaluation at the school which consisted of body height and body mass evaluations using a tape measure and a Filizola scale, besides the use of a Welmy stadiometer to check stature.

The responsible for the children received and signed a consent form authorizing the participation of the children in the study according to Resolution 196/1996 of the National Board of Health, from the Ministry of Health. This study was approved by the Research Ethics Committee of the Federal University of Santa Maria under the protocol number 0242.0.243.000-08.

Data were subjected to statistical analysis describing the average value and standard deviation. The normality of the data was checked by means of the Kolmogorov-Smirnov test and comparisons were made between males and females for the variables in postural balance. The *Student's t test* was used for the normal distribution of the sample and the *Mann-Whitney's* U test, when the data distribution was considered non-normal. The adopted level of significance for all tests was 5% ($p \leq .05$).

RESULTS

The following tables present the initial descriptive analysis of the variables with the three groups, General (composed of both genders), girls and boys and the reference value of the FLP for adults in (%) and also the value of p in *Mann-Whitney's* U test, or *Student's* t test for comparison between the male and female group.

On table 1, it can be seen the characterization of the groups studied through the description of the average and standard deviation related to the groups' age, body mass and stature as well as the number of children in each group.

Table 1 – Description of the general, male and female groups, by age, body mass and body stature

		Age (years old)	Mass (kg)	Stature (cm)
General (n=282)	X	8,01	34,95	132,17
	S	1,43	7,27	7,58
Female (n=146)	X	8,07	34,04	131,64
	S	1,33	6,49	7,84
Male (n=136)	X	7,96	35,87	132,7
	S	1,54	8,06	7,33

Legend: average (X), standard deviation (S), number of individuals in each group (n)

According to the results shown in Table 2, the results found on the three groups (General, boys and girls) have lower values when compared with the reference values in all TOS and the average of the TOS. Furthermore, the girls' group showed higher values than the boys' in TOS I and in average of the TOS.

Table 2 – Average (X) and standard deviation (S) for sensory organization tests for the three groups, the reference value of the FLP for adults and p-value in Mann-Whitney's U test for comparisons between male and female groups

		TOS I (%)	TOS II (%)	TOS III (%)	TOS IV (%)	TOS V (%)	TOS VI (%)	Average (%)
FLP		90,00	83,00	82,00	79,00	60,00	54,00	75,00
General	X	71,76	65,31	59,44	65,61	51,91	37,64	58,61
	S	11,81	13,95	18,37	14,33	17,16	21,94	11,73
Girls	X	73,12	66,22	60,52	66,46	53,36	38,21	59,65
	S	11,97	14,03	19,29	14,22	16,65	21,87	11,89
Boys	X	70,29	64,34	58,27	64,69	50,35	37,03	57,49
	S	11,50	13,86	17,32	14,44	17,62	22,09	11,50
p- value		0,015*	0,128	0,098	0,258	0,132	0,733	0,123#

* Indicates a statistically significant difference
# *Student's t test*

Table 3 shows average values and standard deviation of the values for gender balance within each age group. It is observed that in relation to the values of average and standard deviation between genders within the age groups, there are no gender differences in the ages of 6, 7 and 10 years old. At the age of eight years old, the groups differ in TOS I, TOS VI and the average of TOS, with higher values for girls. At the age of nine years old, the TOS V variable showed statistically significant differences, with higher values for girls.

Table 3 – Average (X) and standard deviation (S) for the TOS and TOS in Average (%) in the age group from 6 to 10 years old and values of tests comparing genders

	Age group	Female			Male			Student test t	Mann-Whitney
		n	X	S	n	X	S		
TOS I (%)	6	23	67,47	13,87	39	64,64	12,13		0,378
	7	24	68,75	13,05	15	73,14	7,12		0,292
	8	49	72,83	10,52	27	66,66	10,52		0,019 *
	9	20	78,78	6,31	23	75,21	9,35		0,125
	10	30	77,68	11,90	32	75,38	10,83		0,228
TOS II (%)	6	23	57,47	19,95	39	57,75	15,37		0,850
	7	24	63,69	12,48	15	62,88	14,53		0,795
	8	49	66,63	13,27	27	63,69	12,68		0,191
	9	20	71,83	6,45	23	69,53	11,59	0,419	
	10	30	70,54	11,50	32	69,86	10,67		0,805
TOS III (%)	6	23	47,84	19,94	39	52,35	15,69	0,327	
	7	24	62,55	16,79	15	54,60	20,23	0,192	
	8	49	62,30	19,56	27	56,37	20,41		0,178
	9	20	59,37	23,50	23	64,88	12,84		0,961
	10	30	66,49	12,88	32	64,07	15,25		0,741
TOS IV (%)	6	23	58,51	18,37	39	60,01	18,00		0,595
	7	24	65,79	12,22	15	68,28	9,54	0,506	
	8	49	66,44	12,91	27	64,98	11,99		0,572
	9	20	70,36	10,50	23	64,24	12,79		0,141
	10	30	70,54	14,51	32	68,81	13,46	0,628	
TOS V (%)	6	23	44,86	24,77	39	48,29	14,35		0,799
	7	24	51,32	14,21	15	55,88	16,49		0,106
	8	49	52,70	16,13	27	46,15	20,83		0,220
	9	20	59,45	7,89	23	44,95	20,35	0,004 *	
	10	30	58,53	13,20	32	57,68	14,34	0,810	
TOS VI (%)	6	23	33,18	17,89	39	33,58	19,91		0,907
	7	24	35,13	20,46	15	34,14	19,99	0,884	
	8	49	39,46	22,38	27	28,10	20,87		0,030 *
	9	20	37,18	26,80	23	35,96	23,48		0,779
	10	30	43,19	21,43	32	50,88	20,38	0,153	
MÉDIA TOS (%)	6	23	51,55	13,98	39	52,77	10,92		0,994
	7	24	57,87	10,71	15	58,15	10,17		0,544
	8	49	60,06	11,44	27	54,32	10,59		0,023 *
	9	20	62,83	9,45	23	59,13	11,04	0,248	
	10	30	64,50	10,35	32	64,45	10,64		0,978

* Indicates a statistically significant difference

Table 4 shows the results of sensory analysis, analyzing the contribution of each of the systems and comparison between genders. The General group has values from the visual and vestibular systems superior to those from the indicated reference, as well as the girls' group. As for the boys, the somatosensory system showed higher values than the reference, as well as for the visual and vestibular systems.

Table 4 – Analysis and comparison of the average values obtained when comparing the contribution of somatosensory (SOM), visual (VIS), Vestibular (VEST) and preferred (PREF) systems in (%) among the three groups and reference values of the FLP for adults without division by age

		SOM (%)	VIS (%)	VEST (%)	PREF (%)
FLP		92,00	88,00	67,00	95,00
General	X	91,83	92,27	72,75	86,49
	S	19,15	19,74	23,92	56,35
Girls	X	91,16	92,02	73,16	88,62
	S	18,37	19,40	23,09	73,72
Boys	X	92,54	92,55	72,32	84,20
	S	20,00	20,16	24,87	27,61
p- value		0,439	0,696	0,998	0,512

In Table 5, the results of sensory analysis were observed, evaluating the contribution of each of the systems and comparison between genders, within the age groups. The only statistically significant difference was observed in these comparisons in relation to the vestibular system at the age of nine years old, with higher values for the girls' group.

Table 5 – Analysis and comparison of average values (%) for the contribution of somatosensory (SOM), visual (VIS), Vestibular (VEST) and preferred (PREF) systems in the three groups divided by age groups

	Age Group	Female			Male			Student t Test	Mann-Whitney
		n	X	S	n	X	S		
SOM	6	23	82,73	22,56	39	90,98	25,84		0,161
	7	24	94,69	19,53	15	85,78	18,30		0,338
	8	49	92,90	20,83	27	97,21	22,86		0,572
	9	20	91,50	8,88	23	92,67	12,31	0,727	
	10	30	91,73	12,48	32	93,57	13,45	0,579	
VIS	6	23	88,54	26,73	39	92,86	27,99		0,238
	7	24	98,57	23,09	15	94,03	15,78	0,508	
	8	49	92,02	17,46	27	98,62	17,79	0,121	
	9	20	89,53	12,80	23	85,55	14,02	0,339	
	10	30	91,10	15,96	32	91,39	14,89		0,800
VEST	6	23	64,29	35,54	39	76,24	22,20	0,156	
	7	24	77,16	26,36	15	75,61	21,48		0,718
	8	49	72,61	21,65	27	70,11	31,87		0,944
	9	20	75,74	10,47	23	59,23	26,33		0,015 *
	10	30	75,94	14,86	32	77,26	18,84	0,760	
PREF	6	23	82,67	28,44	39	82,61	27,37		0,754
	7	24	84,38	21,37	15	76,76	26,31	0,328	
	8	49	85,29	28,60	27	79,57	33,61		0,131
	9	20	73,46	33,67	23	89,26	25,33	0,087	
	10	30	84,97	19,28	32	89,89	24,21		0,147

* Indicates a statistically significant difference

DISCUSSION

Analyzing the results, it is clear that when these are compared to the reference values of FLP, the values are lower, both when separating the groups by gender and in general. This finding could indicate that the systems responsible for postural balance are not yet matured neurologically in the evaluated children.

When comparing the genders in the General group, girls presented higher values than boys only in the TOS I variable, indicating a slight anticipation of the beginning of maturation in girls. Another study found differences in the stages of motor development and training skills of coordination between boys and girls, girls being more efficient in the static balance task[11].

When the children were divided into groups according to age, differences were noticed at the age of eight years old, for TOS I, TOS VI and the average of TOS, and at the age of nine years old to TOS V, always to the advantage girls. From the age of 10 years old and at 6 and 7 years old it was not found significant differences. These results suggest that differences begin around the age of 8 and cease after the age of 10, the 8-to-9-year-old age group being the critical period for changes in motor development when genders are compared.

Regarding the sensory analysis, the results found in the General group for somatosensory and visual preference were below the reference values of the FLP and the values found for the visual and vestibular systems were above the reference values. Analyzing only the girls' similar results were found; as for boys', only the preferential system was lower. The preferred system refers to the ability to maintain balance with incompatible sensory information, to ignore them in the integration process[12]. In both genders, this information seems not to have being matured neurologically yet. The visual system in both genders had results within the adults' standards of reference.

Comparing the girls' group to the boys' without division by age group, no difference was found. When analyzed by age group, only one difference was found at 9 years old, in regards to the vestibular system, showing advantage for girls. This difference can help in the evaluation of body balance between genders, as for the postural control to act effectively, as mentioned above, it is necessary the action of the three sensory systems (visual, proprioceptive and vestibular). In another study that evaluated 100 children of male and female, the same differences were found in the same age group[8]. This difference is probably due to the different types of activities and motor experiences that they perform. While boys generally perform larger movements such as running, swimming, jumping and playing, the girls perform activities that use more integration of sensory information as ballet and gymnastics, which use more twists and turns, stimulating more the vestibular system.

Other studies have also indicated a similar trend to the present study, in which the girls showed a beginning of the process of development and maturity before boys[8,9]. This result has been attributed to reasons such as the differences between changes in body composition during the age range studied. Another study found in girls aged 9-16 years old a greater increase in body mass (13 years old), coinciding with the period of increased height and two evaluated skin folds (triceps and sub scapular) and then, a tendency not to decrease these characteristics[13]. In the same study, the boys of the same age presented a constant body mass evolution, with a progressive reduction in skin fold measurements, after 13 years old. These findings reveal differences in growth between the genders, showing that girls stabilize the bodily changes earlier than boys. These features, in turn, translate into differences in the motor performance and balance tasks, as found in other studies[8,9].

Thus, these findings should be taken into account in the design of motor activities programs for children, trying to specifically fulfill their needs and limitations, especially on issues related to postural balance, with special focus on the distinction between genders and morphological differences that present during growth in childhood and adolescence. In addition, the biological maturation between them must also be taken into account, as it varies in speed and duration. Therefore, classification of physical growth only by chronological age may be a mistake, because the level of maturation and gender are factors that influence the balance, and should be considered in the preparation of these programs[13].

Another study found gender differences in balance tasks, finding a better development of female children in dynamic tasks which demand high motor coordination and need extero proprioceptive information[14]. Girls also showed fewer differences in the strategies used betweenthe studied age groups than boys, again denoting anticipation on the maturation. In another study, we found a greater number of boys with altered postural balance tests, when compared to the evaluated girls[15].

Specifically relating the findings of this study, for younger children, with the results of other studies, it is clear that these are similar[16]. The values of postural balance in children aged from four and five years old to the seven and eight years old had not in any of the variables statistically significant differences

in gender function[16]. As for older children, from eight and nine years old to nine and ten years old on several variables such as average speed of the center of pressure, with and without open eyes, and the amplitude of displacement of the mediolateral center of pressure presented differences statistically meaningful which was also seen in other studies[16].

The relationship between the difference in neurological maturation between genders in an older age seems to continue later in adulthood, as in other studies with the adult population, women had lower values of oscillation than men[17]. This can happen probably due to differences in body composition and mass distribution, and the location of the center of gravity in women in a lower position than in men, leading to a greater body stability.

In another study no differences were found between genders, which was justified by the small physical differences by gender, with very similar morphological characteristics during this period, showing no significant influence on postural balance[18].

In some studies in adults the differences between genders showed up far greater and with higher significance in both tasks with opened and closed eyes, it starts since the childhood[9]. Despite all these discussed issues, it is not possible to identify a specific age group which could occur the beginning of this gender difference.

CONCLUSIONS

In the results of this study, the found reference values for children were always below the reference values for dynamic posturography of *foam-laser for adults*. When comparing genders without regards to age, only TOS I found a significant difference to the advantage of girls. When the age group was compared, more differences were found with advantage for girls, especially at the age of 8.

There is a tendency and evidence in the literature that girls have better balance than boys, probably due to morphological differences in the growth maturation between genders. However, the chronological age when these differences start to occur varies among the scientific studies, and in this particular study it was found at the age of 8.

RESUMO

Objetivo: avaliar a relação entre o gênero e o nível de desenvolvimento dos sistemas responsáveis pelo equilíbrio postural em crianças de seis a dez anos de idade. **Método:** composto por 282 crianças, divididas em três grupos:geral (meninas e meninos), feminino com 146 crianças, e masculino composto por 136 crianças na faixa etária entre os seis e os dez anos de idade. Para avaliação do equilíbrio postural utilizou-se a posturografia dinâmica foam-laser que avalia os sistemas sensoriais por meio de seis testes distintos. Os dados foram submetidos à estatística descritiva e a testes conforme a normalidade dos dados. **Resultados:** nos Testes de Organização Sensorial, pode-se observar que os valores encontrados para as meninas foram maiores que os valores encontrados para meninos nas variáveis Teste de Organização Sensorial I e na Média destes. Porém, esses valores para os grupos de meninos e meninas foram inferiores aos valores de referência da Foam-Laser Posturography para adultos. Quando foi realizada a comparação entre os gêneros dentro de cada faixa etária, foram observadas diferenças estatisticamente significantes no Teste de Organização Sensorial I aos oito anos de idade, no Teste de Organização Sensorial V aos nove anos e no Teste de Organização Sensorial VI e na Média dos Testes de Organização Sensorial aos oito anos. **Conclusão:** o equilíbrio postural de meninas foi melhor que nos meninos, mas ambos os grupos tiveram valores inferiores aos considerados normais em adultos indicando que a maturação neuronal dos sistemas responsáveis pelo equilíbrio postural ainda não está completa.

DESCRITORES: Identidade de Gênero; Equilíbrio Postural; Crianças; Sensação

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