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CLASSIFICATION OF CEREBRAL PALSY

Association between gender, age, motor type, topography and Gross Motor Function

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Abstract – The goal of this study was to assess the relation between gender, age, motor type, topography and gross motor function, based on the Gross Motor Function System of children with cerebral palsy. Trunk control, postural changes and gait of one hundred children between 5 months and 12 years old, were evaluated. There were no significant differences between gender and age groups (p=0.887) or between gender and motor type (p=0.731). In relation to body topography most children (88%) were spastic quadriplegic. Most hemiplegics children were rated in motor level I, children with diplegia were rated in motor level III, and quadriplegic children were rated in motor level V. Functional classification is necessary to understand the differences in cerebral palsy and to have the best therapeutic planning since it is a complex disease which depends on several factors.

KEY WORDS: cerebral palsy, disabled children, motor skills, classification system, gross motor function.

Classificação da paralisia cerebral: associação entre gênero, idade, tipo motor, topografia e Função Motora Grossa

Resumo – Este estudo teve como objetivo avaliar a relação entre gênero, idade, tipo motor, topografia e Função Motora Grossa, baseado no Sistema de Função Motora Grossa em crianças com paralisia cerebral. Participaram desta pesquisa 100 crianças com idade entre 5 meses a 12 anos que foram observadas em relação ao controle de tronco, trocas posturais e marcha. Não houve diferenças significativas entre gêneros e grupos etários (p=0,887) e entre gênero e tipo motor (p=0,731). Em relação à topografia corporal, houve predomínio de crianças com quadriplegia, sendo que a maioria (88%) era do tipo espástico. Quanto ao nível motor, as crianças hemiplégicas pertenciam em sua maioria ao nível I, as diplégicas ao nível III e as quadriplégicas ao nível V. Sendo a paralisia cerebral uma condição complexa que depende de diversos fatores, beneficia-se de classificações funcionais para compreensão da diversidade e melhor planejamento terapêutico.

PALAVRAS-CHAVE: paralisia cerebral, criança deficiente, sistema de classificação, habilidade motora, função motora grossa.

Cerebral palsy (CP) is described as a range of disorders of motor and postural development which causes functional limitations attributed to non-progressive disorders that occur in fetal development or child's brain[1]. It has traditionally been described based on the kind of damage (spasticity, dyskinesia and ataxia) and its location, or topography (hemiplegia, diplegia and tetraplegia)[2]. Until recently there were not standardized methods to classify cerebral palsy in relation to subtypes and severity of motor impairments[3-5]. The Gross Motor Function System (GMFCS)[6] was developed to classify functional mobility in children diagnosed with cerebral palsy by levels of functional mobility and consists of five levels ranging from I, which includes children with minimal or no dysfunction relative to community mobility to V, which includes children who are totally dependent and need help to move around[7].

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The goal of this study was to evaluate the relation between gender, age, motor level, topography, and gross motor function of children with cerebral palsy based on the GMFCS.

METHOD

Subjects

One hundred children between 5 months and 12 years and 10 months old participated in this study. They were divided in four groups according to their age in accordance with the GMFCS: 18 children under 2 years old, 21 children between 2 and 4 years old, 24 children between 4 and 6 years old and 37 children between 6 and 12 years old. A sample calculation made for this study indicated that at least 18 children in each age group suggested by the GMFCS would be necessary to evaluate interest ratios with a maximum 20% of error under 90% of probability[8].

Table 1. Number of participants in each age group suggested by the GMFCS according to gender and age.

Gender/age	F	M	Total
< than 2 years old	7	11	18
2 to 4	11	10	21
4 to 6	11	13	24
6 to 12	17	20	37
Motor type			
Spastic	39	49	88
Hypotonic	2	1	3
Ataxic	1	0	1
Dyskinetic	1	2	3
Mixed	3	2	5
Total	46	54	100

Data collection

The children were analyzed during the procedures for referral to the occupational therapy service of a university hospital in a city in São Paulo state with their parents' consent. Their trunk control, postural changes and gait were observed since those items are part of the assessment form used for children with cerebral palsy.

Data analysis

The information collected was organized by groups according to age, and the relation between gender, topography, motor level and age was observed using Fischer's exact test. Cramer's coefficient was used to evaluate how strong the association was[9].

Ethical matters

This study is part of a larger study entitled "The influence of motor levels and social support on daily activities in the life of children with cerebral palsy" which was approved by the Ethics Committee of Hospital das Clínicas at the University of Ribeirão Preto Medical School – São Paulo – USP, through proceeding n° 2565/2008 in 05/25/2008.

RESULTS

Out of 100 children who participated in this study, 54 were male and 46 were female. Distribution of genders (Table 1) in relation to the age groups suggested by the GMSCF was equivalent and there were no significant differences according to Fisher's exact test (p=0.887). The association between gender and motor type did not present significant differences according to Fisher's exact test either (p=0.731).

Relative to topography, fifty-two children were quadriplegic, thirty three diplegic and fifteen hemiplegics. As for motor type, all hemiplegics and diplegics children were spastics and among the fifty two quadriplegics children, three had hypotonia, one presented ataxic, five had spasticity and dyskinesia, three had only dyskinesia, and forty presented only spasticity. There were no significant dif-

Table 2. Distribution of participants according to body topography and motor type in relation to the age in accordance with the age groups suggested by the GMFCS.

Type of CP	Younger than 2 years old	2 to 4 years old	4 to 6 years old	6 to 12 years old	Total
Topography					
Hemiplegic	2 (12.5%)	1 (6.3%)	7 (43.8%)	5 (31.3%)	15
Diplegic	3 (9.4%)	8 (25%)	7 (21.9%)	15 (46.9%)	33
Quadriplegic	13 (25%)	12 (23.1%)	10 (19.3%)	17 (32.7%)	52
Motor Type					
Spastic	14 (15.9%)	20 (22.8%)	23 (26.2%)	31 (35.3%)	88
Hypotonic	3 (100%)	0	0	0	3
Ataxic	0	0	1 (100%)	0	1
Dyskinetic	0	0	0	3 (100%)	3
Mixed	1 (20%)	1 (20%)	0	3 (60%)	5
Total	18	21	24	37	100

Table 3. Division of participants in relation to body topography and motor level.

Kind of CP	Level I	Level II	Level III	Level IV	Level V	Total
Topography						
Hemiplegic	14 (93.3%)	0 (0%)	1 (6.7%)	0 (0%)	0 (0%)	15
Diplegic	9 (27.2%)	6 (18.2%)	11 (33.3%)	7 (21.3%)	0 (0%)	33
Quadriplegic	0 (0%)	1 (1.92%)	0 (0%)	14 (26.9%)	37 (71.1%)	52
Motor type						
Spastic	23 (26.1%)	6 (6.8%)	12 (13.6%)	18 (20.4%)	29 (32.9%)	88
Hypotonic	0	0	0	2 (66.6%)	1 (33.3%)	3
Ataxic	0	1 (100%)	0	0	0	1
Dyskinetic	0	0	0	0	3 (100%)	3
Mixed	0	0	0	1 (20%)	4 (80%)	5
Total	23	7	12	21	37	100

Table 4. Distribution of participants in relation to motor level, in accordance with the age groups suggested by the GMFCS.

Age	Level I	Level II	Level III	Level IV	Level V	Total
< than 2 years old	1 (5.5%)	2 (11.1%)	2 (11.1%)	4 (22.2%)	9 (50%)	18
2 to 4	2 (9.5%)	1 (4.7%)	5 (23.8%)	5 (23.8%)	8 (38%)	21
4 to 6	12 (50%)	1 (4.1%)	1 (4.1%)	2 (8.3%)	8 (33.3%)	24
6 to 12	8 (21.6%)	3 (8.1%)	4 (10.8%)	10 (27%)	12 (32.4%)	37
Total	23	7	12	21	37	100

ferences in relation to topography and distribution of age groups suggested by the GMFCS according to Fisher's exact test (p=0.112), even though most of the children in the hemiplegic group were aged 4 to 6 years and in the diplegic and quadriplegic groups they were between 6 and 12 year.

In relation to motor type, spastic children predominated in all age groups and there was a significant difference between motor type and age group according to Fisher's exact test with p=0.032 (Table 2).

As for motor types, there was a predominance of level I in hemiplegic children, level III in diplegic children, and level V in quadriplegic children. Through statistical analysis it was clear that there was a strong association between body topography and motor level, with Cramer's coefficient=0.744, which is significant according to Fisher's exact test (p<0.000) (Table 3).

As for the distribution of subjects by age and motor level (Table 4), Fisher's exact test was not significant, but it indicated some tendency to association (p=0.075) and that there were more children under 4 years old in level V.

DISCUSSION

The classification in this study was based on clinical changes in muscle tonus and on the kind of movement disorder which could be categorized under the following types of motor dysfunction: spastic, dyskinetic or athetoid, ataxic, hypotonic and mixed[10] and quadriplegia, diplegia and hemiplegia in relation to body topography[10,11], besides the Gross Motor Function Classification System (GMFCS)[6]. Such system has been widely used in clinical practice and in research and it is considered valid, reliable and stable for 2 to 12 year- old children[4,12,13].

Most of the children who participated in the present study were male and that fact has often been reported in the literature[14,15].

As for the distribution of body topography, quadriplegic children were in larger numbers. Quadriplegia is the type of dysfunction most often cited in the international[16] and national literature[17]. This form of CP affecting muscular strength in different levels results from its location associated with the cause (the most frequent is hypoxic-ischemic encephalopathy) followed by defects of cortical cerebral development)[5]. The study was performed in a high complexity health center where only the most complex cases are assisted, which is also consistent with the data found.

Other studies report that diplegic children are the majority[14,18-20]. Diplegia affects principally, or especially the lower limbs because of the serious injury in periventricular areas and subcortical white matter; its main causes are cerebral ischemic and hemorrhagic phenomena and fetal or post-natal hydrocephaly especially in preterm newborn children[5,17].

Spasticity stood out as regards motor type and that is consistent with several studies[14-16, 19, 21].

As long as the relation between topography and age groups are concerned it is important to observe that the hypotonic group is found among children under the age of 2 and the dyskinetic group is identified later in life. There are few studies trying to establish the moment when the child moves from hypotonia to spastic hipertonia or dyskinesia[22-24]. According to those authors spasticity occurs during the three first months and dyskinesia occurs in up to three years in most of the cases. Just few children stay hypotonic and there were no children over 2 classified as hypotonic CP in the present study.

As for the relation between body topography and motor levels, most hemiplegic children were predominantly motor level I, which has also been found in other studies[17-19,25]. In this study there was only one child with hemiplegics CP different from level I and she was classified in Motor level III according to the GMFCS. The child was 8 months old and had late development; it is possible that such condition reaches the lowest lower limbs because of its neurological maturation. Himmelmann et al.[25] found out cases of hemiplegia in all motor levels; Beckung et al.[19] established that the cases varied between levels I and IV; Howard et al.[16] found levels I, II, III and V and Voorman et al.[18] classified the cases under levels I, II and III.

Diplegic children in this study were similar (with no significant difference) in the first four levels and there were no examples of level V; in their study Voorman et al.[18] had the same results and only 3 cases (6.4%) were level V. In their study Himmelmann et al.[25] had diplegic children in all levels, most of them were level II (37.5%) and only 4.9% of the children were classified in level V. Similar results were found in the study of Beckung et al.[19] in which they observed that most children were classified in the first two levels while only 4% were classified in level V. The results in the study of Howard et al.[16] were very similar in the first three levels; only 4 cases (5%) were level IV and no diplegic children were level V.

In this study most quadriplegic children were level V. The quadriplegic child in level II had ataxia which affects all body but does not prevent trunk control or supported gait. Hypotonic, dyskinetic and mixed ones did not influence in the relation between body topography and motor level. In the studies of Beckung et al.[19] the participants were divided according to motor type and the spastic ones were divided according to topography; quadriplegic spastic ones were all level V, dyskinetic children were classified from level I to V, with a predominance of level III and the ataxic ones were classified in levels I and II; there were no cases of mixed cerebral palsy. Himmelmann et al.[25] had similar results, in that quadriplegic spastic children were classified in levels IV and V and most of them were level V; diskinetic children were classified in all levels but the majority was levels IV and V. The study of Howard et al.[16] reported that most of quadriplegic spastic children were level IV and V, diskinetic children were levels II, III and IV and the mixed ones were all levels; the ataxic children were classified in the first three levels and the hypotonic ones were all levels except level II.

Regarding the relation between motor level and age, our study found a certain tendency to association through Fisher's exact test (p=0.075) although it did not present significance. The study of Beckung et al.[19] used the GMFM[26] to evaluate children's motor performance and it showed that age is important in motor prognosis in children with cerebral palsy. Children were evaluated every 6 months up to 4 years old and every year afterwards; development graphs were drawn for 258 spastic children. Level I children (75%) got 90% of maximum score of GMFM up to 5 years old. The best performance was reached at age 7. Level II children got 90% of the score at age 5 on average and 75% of children got it at age 7. Most level III children got 80% of GMFM at age 7 and most level IV children (30%) got it at 5 and did not change anymore.

The goal of a recent study of Gorter et al.[27] was to evaluate the stability (predictive validity) of the GMFCS up to age 2, that is, they evaluated how 77 children, under 2, were reclassified using the classification of children between 2 and 4 years suggested by the GMFCS. The results showed that 42% of the children moved one or two levels and most of them were reclassified in a lower motor level. The results indicate that classifying children younger than 2 years old is less accurate after some time than when it is done with older children. GMFCS[6] development experts had already reported that it is difficult to accurately classify gross motor function of children at 1 or two years of age. It happens because children at this age have a very limited number of gross motor activities, they depend more on the quality of the movement and on how easy it is to sit, crawl, and stand up than on the ability to walk.

It is important to mention that children were divided into age groups because in the development of GMFCS it is recognized that motor function classification depends on age, especially for babies and infants[6].

Cerebral palsy depends on several pre-, peri- and post natal aspects. Besides, different levels of motor damage (topography) and changes in tonus are observed (motor type) according to the kind of cerebral injuries. So, researchers have been trying to elaborate classification standard systems based on the complexity of clinical examples of CP and the difficulties classifying them, as it is proposed by the European Surveillance of Cerebral Palsy[3] which classifies cerebral palsy as ataxic, diskentic and spastic. Spastic cerebral palsy is subdivided in unilateral and bilateral avoiding differences between topographic classifications (diplegia and tetraplegia). The Gross Motor Function System Classification has been widely used to help therapeutic planning and to have stronger clinical and scientific agreement in relation to the classification of cerebral palsy, considering the functional level of the child.

The GMFCS can help health professionals working with children with cerebral palsy make sure they receive appropriate care for their functional level and age. It would not be appropriate, for example, to perform a complex corrective surgery on a six year-old child classified under level V aiming the child's gait because even though the child will take steps, albeit in a limited way, her main means of movement will still be a wheelchair. It is also known that the rate of hip subluxation increases linearly from level I (0% risk) to level V (90% increased risk). This fact highlights how the GMFCS can, in fact, serve as a guide for health professionals to be able to monitor and treat cerebral palsy- related problems[28].

The GMFCS also makes it possible to set functional rehabilitation goals for each motor level in different age groups. Therefore, the treatment of a child in level I aged 0–2 aims to stimulate the child to move to and from a sitting position, use the upper limbs to handle objects, crawl, move to a standing position with support, and walk under supervision. Between ages 2 and 4, the functional goals focus improving sitting position for handling objects, moving to standing position with support, and indoors walking. At ages 4 and 6, the goal are to stimulate moving from the floor and chair to a standing position, climbing up and down stairs, and running and jumping.

On the other hand, a motorly impaired child classified under level V, from age 0 to 2 would be stimulated to keep her head in the median line and turn it 180° in supine position, and roll over with support. Between ages 2 and 4· therapeutic goals would be to facilitate acquisition of basic skills for anti gravitational positions of the head and trunk with support and moving around with support. Because functional prognoses for such children are very limited, such goals also hold for older subjects.

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