Environmental settings and families' socioeconomic status influence mobility and the use of mobility devices by children with cerebral palsy

Contextos ambientais e nível socioeconômico das famílias influenciam a mobilidade e a utilização de dispositivos de suporte por crianças com paralisia cerebral

Valéria C. R. Cury[1], Priscilla R. P. Figueiredo[2], Marisa C. Mancini[3]

ABSTRACT

Functional mobility of children with cerebral palsy (CP) is influenced by personal and environmental factors, serving as barriers and/or facilitators and impacting on children's strategies and functional outcome. Objectives: To describe typical mobility methods used by children with CP at home, school and community and to compare them across family's socioeconomic levels (SES). Methods: The Functional Mobility Scale was used to assess mobility of 113 children with CP of high and low SES at home, school, and community. Results: Differences in mobility methods of participants classified as Gross Motor Function Classification System levels II, III and IV were found between home and community. For levels III and IV, differences were also found between home and school. At home, participants from higher SES used wheelchairs more frequently while those from lower SES used floor mobility (crawling). Conclusions: Environmental settings and families' socioeconomic status influence mobility and use of mobility devices by children with CP.

Key words: cerebral palsy, environment, self-help devices, mobility limitation, socioeconomic factors.

RESUMO

A mobilidade funcional de crianças com paralisia cerebral (PC) é influenciada por fatores pessoais e ambientais, que servem como barreiras e/ou facilitadores e têm impacto nas estratégias e nos desfechos funcionais dessas crianças. Objetivos: Descrever os métodos usuais de mobilidade usados por crianças com PC em ambiente domiciliar, escolar e comunitário, e compará-los entre famílias de diferentes níveis socioeconômicos (NSE). Métodos: Foi usada a Escala de Mobilidade Funcional para avaliar a mobilidade de 113 crianças com PC de NSE alto e baixo, em casa, escola e comunidade. Resultados: Foram encontradas diferenças nos métodos de mobilidade nos participantes classificados nos níveis II, III e IV do Gross Motor Function Classification System entre casa e comunidade; nos níveis III e IV, adicionalmente, foram encontradas diferenças entre casa e escola. Participantes de NSE alto relataram uso frequente da cadeira de rodas no ambiente domiciliar, enquanto os de NSE baixo usavam o engatinhar. Conclusões: Contexto ambiental e NSE das famílias podem influenciar a mobilidade e a utilização de dispositivos de suporte por crianças com PC.

Palavras-Chave: paralisia cerebral, ambiente, equipamentos de autoajuda, limitação da mobilidade, fatores socioeconômicos.

Functional mobility encompasses the individual's capacity to transfer from one's own position, to move indoors and outdoors, and to walk independently or with a walking aid. It constitutes an important patient-centered rehabilitation outcome[1]. Children and adolescents with cerebral palsy (CP) often need assistive devices to enable functional mobility[2]. The use of assistive devices and mobility methods has been shown to vary across the environmental settings of home, school, and community[3]. This variation is more pronounced in those classified as Gross Motor Function Classification System[4,5] (GMFCS) levels II, III, and IV[6]. For example, a child that walks holding onto the furniture at home may use a walker at school and a wheelchair in the community.

The selection and use of a specific mobility method or device constitutes finding an effective solution to overcome a particular environmental challenge, leading to independent

[1]Master of Science, Physical Therapist, Universidade Federal de Minas Gerais (UFMG), Belo Horizonte MG, Brazil;
[2]Physical Therapist, Advanced Master Student, Graduate Program in Rehabilitation Sciences, UFMG, Belo Horizonte MG, Brazil;
[3]Doctor of Science, Department of Occupational Therapy, Graduate Program in Rehabilitation Sciences, UFMG, Belo Horizonte MG, Brazil.
Correspondence: Valéria C. R. Cury; Rua da Groelância 395/201; 30320-060 Belo Horizonte MG - Brasil; E-mail: valeriacury@hotmail.com
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functional mobility for individuals with CP[3]. This assertion might be true for cultural contexts, in which mobility devices are available to individuals with mobility restrictions. Most of the available literature describes the functional mobility of children with CP from developed countries[3,6]. However, in developing countries, resources are often more limited and availability of mobility devices may be more restricted. In such environmental context, a family's socioeconomic status may likely have an impact on these children's functional mobility opportunities, as families from a higher socioeconomic status may have resources that allow them to obtain various mobility devices, thus supporting functional mobility in different environments.

Specific scales, such as the Functional Mobility Scale (FMS), were developed to describe performance in mobility in children who use mobility aids in their daily lives[2,7]. This scale takes into account the fact that mobility of a child with CP is not exclusively related to the severity of motor impairment, but it is also dependent on the distance required within a specific setting. Furthermore, socioeconomic status of families may be an environmental factor related to functional mobility[8]; however, to date, its influence has not been directly investigated yet.

Given these considerations, the aim of the present study was to describe the typical mobility methods and devices used by Brazilian children with CP in their home, school, and community, and to compare these methods across family's socioeconomic levels. This information might help guiding recommendations of effective mobility devices for children and adolescents with CP in order to enhance their functional mobility across settings.

METHODS

Design

This cross-sectional observational study included children and adolescents recruited from rehabilitation centers and private clinics. During selection of the participants, the researchers sought to include children across a wide range of ages and socioeconomic status levels. An interview was conducted between the participant's parents or caregivers, the participant and a physical therapist trained in the administration of the FMS. All face-to-face interviews were carried out in the related rehabilitation center. The free written informed consent was obtained from all participants in the study. The Ethics Review Committee approved the present study (ETIC 641/08).

Participants

Individuals with CP were included if they were between 4 and 18 years of age and classified as levels II, III, or IV in the GMFCS. This classification level range was selected because it demonstrates more variability in mobility methods compared to children from levels I and V[3,6]. The children's GMFCS level was collected from charts and confirmed during the interview by a physical therapist who was trained and familiarized with the GMFCS classification system. Any disagreements between the classification performed by the physical therapist and provided by the chart were taken as a misclassification from the last source. Children were excluded if they had received orthopedic surgery in the lower limbs within one year before the study, as this intervention could potentially alter the use of mobility devices. Demographic characteristics (age or gender) as well as the type of mobility aid utilized were recorded.

Procedures

Mobility was measured with the FMS, which was administered in the format of an interview conducted with children's parents or caregivers, who were asked to report about the mobility devices typically used by their children, at home, school, and in his/her community. The authors of this scale used three distances (5, 50 and 500 meters) as a reference of the typical distances ambulated by children with CP at home, school and in the wider community, respectively. The administration of the FMS consists on asking the parent to report what the child 'does' in each of these environments, in terms of using mobility devices, and therefore this scale was not administered by direct observation. A rating of 1 to 6 is given for each distance with the scores indicating the type of mobility aid used by the child (1, wheelchair; 2, walker; 3, crutches; 4, sticks/canes, or holds on walls, furniture, fences, shopping fronts for support; 5, no assistive devices needed on level surfaces; and 6, no assistive devices on all surfaces). In addition to these ratings, "C" was assigned if the child crawled and a rating of "N" was assigned if the distance was not covered, or if an adult carried the child. A Portuguese version of the FMS[9], developed by the present authors, was used in this study[10,11].

Two physical therapists were trained in the administration of the FMS. Inter-rater consistency was evaluated prior to data collection, with kappa reliability index of 0.70 for home and of 0.90 for the school and community settings. Studies demonstrated that the FMS was both reliable and valid for reporting mobility methods of children to different distances, with inter-rater reliability coefficients varying from 0.86 to 0.92 and validity index, from 0.71 to 0.76[7,12].

Socioeconomic level of the families was documented based on a structured interview using a questionnaire called *Brazilian Economics Classification Criteria, developed by the Associação Brasileira de Empresas de Pesquisa*[13]. This questionnaire includes information about years of education of the family's leader, household appliances, number of domestic servants, among others. Each item receives a specific score; and the scores are summed to yield a total score, which is converted into economical categories that vary from A

(very high) to E (very low). In this study, families' economic classes were combined into two groups: High socioeconomic level Group, which included classes A and B, and Low socioeconomic level Group, composed of classes C, D, and E.

Data analysis

A sample size of at least 95 participants was calculated as being required, based on α=0.05, power of 0.85, and considering an effect size w=0.40 for the variable FMS[14].

Descriptive data were reported on children's mobility methods and devices in each environment within the same GMFCS level, according to high and low socioeconomic group levels.

Nonparametric Friedman test was selected to test differences across the independent variables (home, school, and community) on the dependent variable (usual mobility method, based on the FMS scores), for each GMFCS level. When the Friedman test was significant ($p<0.05$), Wilcoxon signed ranks tests were conducted to determine bivariate differences across settings.

Mann-Whitney's test was applied to compare mobility between children from high and low socioeconomic levels.

RESULTS

Characteristics of participants

One hundred and fourteen children treated in rehabilitation centers or private clinics in Brazil composed the initial sample of the study. One child was excluded because a parent refused to answer the socioeconomic questionnaire. Final sample included parents of 113, who gave written consent for their children to participate. Information about children's age, gender, GMFCS and family's socioeconomic level are summarized in Table 1.

Mobility methods and devices used

Among all children classified as level II (n=34), only one (n=1, 3%) used crutches at school and in the community. The remaining ones from this GMFCS level (n=33, 97%) did not use any specific mobility devices. Children at level III (n=24) used either a walker (n=7, 29%), manual wheelchair (n=5, 21%), combination of manual wheelchair and walker (n=5, 21%), crutches (n=1, 4%), sticks (n=1, 4%), or a combination of manual wheelchair, walker and crutches (n=1, 4%). In this classification level, 4 (17%) children used crawling as the main mobility strategy or were carried by an adult. Children from level IV (n=55) used a manual wheelchair (n=43, 78%), a combination of manual and battery-powered wheelchair (n=1, 2%), a combination of manual wheelchair and walker (n=3, 6%) or a walker (n=3, 5%). In this classification level, 5 (9%) children used crawling as the main mobility strategy or were carried by an adult.

Difference in mobility across settings

Level II

Table 2 presents mobility methods across settings. There was a significant difference across the settings, i.e., home, school, and community (p=0.001). Post hoc analyses revealed differences between home and community (p=0.001). At home, children in level II reported walking independently on level surfaces (n=23, 68%), walking independently on all surfaces (n=8, 23%) or using sticks or holding on furniture/walls for support (n=3, 9%). In the community, a higher proportion of children who used sticks or walked holding on walls for support was observed (n=11, 32%).

Level III

There was a significant difference across settings, i.e., home, school, and community (p=0.001). Post hoc tests revealed differences between home and school (p=0.002), and home and community (p=0.002). At home, level III children reported that they crawled for mobility (n=8, 34%), used sticks or held on furniture/walls during gait (7, 29%), used wheelchair (n=2, 8%), walker (n=2, 8%) and crutches (n=1, 4%), walked independently on level surfaces (n=1, 4%), did not complete the distance required or was carried by an adult (n=3, 13%). At school and community, it was documented that there was a higher proportion of wheelchair (n=8, 34%) and walker (n=7, 29%)

Table 1. Descriptive characteristics of participants (n=113).

Characteristics	Total (n=113)	High socioeconomic level Group (n=49)	Low socioeconomic level Group (n=64)
Age (year), mean (SD)	8 years and 2 months (3 years and 4 months)	9 years and 1 month (3 years and 8 months)	7 years and 5 months (2 years and 9 months)
Age (range)	4 to 17 years-old	4 to 17 years-old	4 to 15 years-old
Gender			
Male (%)	69 (61)	28 (57)	41 (64)
Female (%)	44 (39)	21 (43)	23 (36)
GMFCS level II (%)	34 (30)	17 (34)	17 (27)
GMFCS level III (%)	24 (21)	11(23)	13 (20)
GMFCS level IV (%)	55 (49)	21 (43)	34 (53)

GMFCS: Gross Motor Function Classification System; SD: standard deviation.

Table 2. Frequency (%) of Functional Mobility Scale (FMS) scores performed across settings.

FMS scores	GMFCS level II† (n=34)			GMFCS level III†† (n=24)			GMFCS level IV†† (n=55)		
	Home	School	Community	Home	School	Community	Home	School	Community
1	0 (0%)	0 (0%)	0 (0%)	2 (8%)	8 (34%)	8 (34%)	19 (34%)	43 (78%)	39 (70%)
2	0 (0%)	0 (0%)	0 (0%)	2 (8%)	7 (29%)	6 (25%)	3 (6%)	2 (4%)	2 (4%)
3	0 (0%)	1 (3%)	1 (3%)	1 (4%)	2 (8%)	2 (8%)	0 (0%)	0 (0%)	0 (0%)
4	3 (9%)	6 (17%)	11 (32%)	7 (29%)	2 (8%)	3 (13%)	2 (4%)	2 (4%)	2 (4%)
5	23 (68%)	24 (71%)	16 (47%)	1 (4%)	1 (4%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
6	8 (23%)	3 (9%)	4 (12%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
C	0 (0%)	0 (0%)	0 (0%)	8 (34%)	1 (4%)	0 (0%)	19 (34%)	1 (2%)	0 (0%)
N	0 (0%)	0 (0%)	2 (6%)	3 (13%)	3 (13%)	5 (20%)	12 (22%)	7 (12%)	12 (22%)

†group difference was found between home and community; ††group differences were found across home and school and home and community; GMFCS: Gross Motor Function Classification System; FMS scores: 1, wheelchair; 2, walker; 3, crutches; 4, sticks or holds on walls, furniture, fences, for support; 5, independent on level surfaces; 6, independent on all surfaces; C: crawling; N: does not complete the distance.

use, and a lower frequency of holding onto walls for support (n=2, 8%) or crawling for mobility (n=1, 4% at school; n=0, 0% at community), when compared with the home environment.

Level IV

Results showed significant differences across settings, i.e., home, school, and community (p=0.001). Post hoc analysis revealed differences between home and school (p=0.001) and home and community (p=0.001). At home, children from level IV reported crawling for mobility (n=19, 34%), or used a wheelchair (n=19, 34%), a walker (n=3, 6%), sticks or held onto furniture or walls during ambulation (n=2, 4%), did not complete the distance required or was carried by an adult (n=12, 22%). Children reported a higher frequency of wheelchair use at school (n=43, 78%) and in the community (n=39, 70%), and less frequent of crawling for mobility at school (n=1, 2%) and in the community (n=0, 0%), when compared with the home environment.

Difference in children's mobility across socioeconomic levels

High and low socioeconomic level groups had a similar baseline on the variables age (F=9.68; t=1.98; p=0.06), gender (x^2=2.10; p=0.164), and GMFCS (x^2=1.27; p=0.530). A significant difference in mobility between children from the high and low socioeconomic groups was observed only at home (p=0.031). Descriptive information indicated that at home, children from high socioeconomic levels (n=49) used a wheelchair more frequently (n=12, 25%) and crawled less frequently for mobility (n=7, 14%), compared to those from the low socioeconomic group, which reported lower frequency of wheelchair use (n=10, 16%) and higher frequency of crawling (n=20, 31%). The remaining FMS mobility categories presented similar frequencies between groups (Table 3).

DISCUSSION

This study provides evidence that mobility of children and adolescents with CP is influenced by different environmental settings and by the family's socioeconomic status. Differences in mobility methods of children classified as GMFCS level II were found at home and in community settings. For children classified as levels III and IV, differences were found between home and community settings and between home and school. No differences were found in mobility methods used for school and community settings' requirements.

A specific profile of mobility methods was found for children and adolescents at each GMFCS level. At level II, a higher percentage of children and adolescents (97%) walked independently across the contexts of home, school, and community. Specifically, a higher proportion of participants from this sample walked independently at home and held onto walls, fences or shop fronts at community (classified as rating 4). At GMFCS levels III and IV, the preferred mobility method used by children and adolescents at home was crawling (level III and IV) or using a wheelchair (level IV). However, in the school and community, these same children more frequently used a wheelchair (GMFCS IV) and wheelchair or walker (GMFCS III) for mobility.

At home, the mobility profile from the present sample was similar to that observed in previous investigations[3,6]. However, these results did not show any differences in mobility across school and community, whereas the literature reports differences between these settings[3,6]. Considering the similarities between age and GMFCS characteristics of this sample and samples from other studies, the lack of difference observed in this study reflects children's use of the same mobility methods at school and in the community, which is different from the method used at home.

Graham et al. evaluated 310 children with CP (mean age of 11 years-old) using the FMS[2]. The study included 114 children with spastic hemiplegia, 124 with spastic diplegia, and 72 with spastic quadriplegia. The authors did not report about participants' level of GMFCS. According to their results, 3.2% of the diplegic and 31.9% of the quadriplegic children used crutches for mobility at home, 16.1% of the diplegic and 6.9% of the quadriplegic ones used it at school and 16.9% of the diplegic and 2.7% of the quadriplegic ones used this strategy in the community. Such evidence is distinct

Table 3. Frequency (%) of Functional Mobility Scale (FMS) scores performed across socioeconomic levels.

FMS scores	High socioeconomic levels† (n=49)			Low socioeconomic levels† (n=64)		
	Home	School	Community	Home	School	Community
1	12 (25%)	18 (38%)	18 (38%)	10 (16%)	33 (52%)	29 (45%)
2	3 (6%)	5 (10%)	4 (8%)	2 (3%)	4 (6%)	4 (6%)
3	1 (2%)	3 (6%)	3 (6%)	0 (0%)	0 (0%)	0 (0%)
4	5 (10%)	2 (4%)	5 (10%)	7 (11%)	8 (12%)	11 (17%)
5	12 (25%)	13 (26%)	10 (20%)	11 (17%)	12 (19%)	6 (10%)
6	3 (6%)	1 (2%)	1 (2%)	5 (8%)	2 (3%)	3 (5%)
C	7 (14%)	0 (0%)	0 (0%)	20 (31%)	2 (3%)	0 (0%)
N	6 (12%)	7 (14%)	8 (16%)	9 (14%)	3 (5%)	11 (17%)

†group difference was found at home; FMS scores: 1, wheelchair; 2, walker; 3, crutches; 4, sticks or holds on walls, furniture, fences, for support; 5, independent on level surfaces; 6, independent on all surfaces; C: crawling; N: does not complete the distance.

from descriptive information from the present sample, since none of the 58 quadriplegic children assessed in this study used crutches at home or school and only 1.7% of them used crutches in the community. Considering the 43 diplegic children from our sample, only 2.3% utilized crutches at home, 6.9% at school and 4.6% in the community. Compared to the characteristics reported by Graham et al., the participants from this sample did not use as much crutches across the different environments. Furthermore, Tieman et al.[6] reported the use of two types of wheelchairs, manual and battery-powered, by the same participant, in different settings, in 2% of GMFCS II, 10% of GMFCS III and 37% of children from GMFCS IV. In contrast, only one participant from our sample reported using two types of wheelchairs. These variations in the use of mobility devices between our sample and other studies might reflect the resources available to Brazilian children and adolescents with CP, where a limited number of sticks and crutches are available for children, and the cost of powered wheelchairs limits its acquisition for most families.

Socioeconomic level appears to have an impact on mobility specifically within home. According to our findings, children from families of higher socioeconomic level used a wheelchair more often, compared with those from a low socioeconomic level, who typically relied on floor mobility. This finding suggests differences in home accessibility. It is likely that children and adolescents from families of lower socioeconomic status experience greater challenges in architectural modification, restricting the use of wheelchairs for mobility at home, as opposed to the ones from families of higher socioeconomic status, for whom accessibility modifications may be available.

This study described the mobility method most frequently used by the participants in each setting, as determined by three-distance parameters. A limitation of the present study refers to the conceptual lack of clarity regarding the main concept measured by the instrument. In fact, administration of the FMS may combine several types of information including typical mobility of the child in each setting (i.e., home, school, community), typical method of mobility used by a child specific to distances of 5, 50 and 500 m, and/or typical mobility strategy used by the child to transpose the distances in the respective settings. In order to overcome this limitation, the data collection procedure focused on a specific aspect, which was asking about the typical mobility strategy used by the child at home, school, and in his/her community. Such procedure was standardized for all children in the sample. Studies that use the FMS scale need to clarify the framework in which the instrument was administered. In addition, information provided by the present study may not be generalizable, as the results represent mobility devices used by children with CP in Brazil. Future studies need to consider additional contextual factors, which may impact on the functional mobility of children with CP including, for example, information on task demands, variations in surfaces and terrains, family support, and social expectations.

Current practice in rehabilitation focuses on enabling functional activity and participation for individuals with CP, as well as with other clinical conditions. Independent locomotion is important to achieve such outcomes. Information about the mobility methods used in different settings may help guiding decision-making and family counseling, supporting effective recommendations from pediatric specialists regarding the use of mobility devices across relevant environments.

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