Functional performance assessment of children with cerebral palsy according to motor impairment levels

Avaliação do desempenho funcional de crianças com paralisia cerebral de acordo com níveis de comprometimento motor

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Abstract

Background: Several studies have evaluated motor function among children with cerebral palsy (CP), but little is known about how mobility impairment, self-care and social function interrelate with their functional skills and caregiver assistance. Objectives: To identify functional differences among children with CP at different levels of motor dysfunction, and to investigate the relationship between these differences and the domains of mobility, self-care and social function in functional skills and caregiver assistance. Methods: An analytical cross-sectional study was conducted among 70 children and their families. The children were aged 4 to 7.5 years and received care at the Children’s Rehabilitation Center. The instruments used were the Pediatric Evaluation Disability Inventory (PEDI) and the Gross Motor Function Classification System (GMFCS). Data analysis was performed by means of ANOVA and Pearson’s correlation. Results: The results showed significant functional variability among the children with CP at different levels of motor dysfunction severity. This variation was observed in the domains of mobility, self-care and social function. The results also showed a strong correlation between mobility and self-care and between mobility and social function. Conclusions: In view of the variability shown by the children, it was necessary to apply PEDI and GMFCS, which appears to increase the understanding of how gross motor function relates to activities of daily living. This correlation demonstrates the extent to which mobility is a determinant for evaluating functional performance and guiding therapeutic practice to develop children’s potentials and instruct caregivers in stimulation. Key words: cerebral palsy; functional skills; mobility; performance assessment.

Resumo

Contextualização: Diversos estudos têm avaliado a função motora de crianças com Paralisia Cerebral (PC), entretanto pouco se sabe sobre as inter-relações entre comprometimentos da mobilidade, autocuidado e função social relacionadas às habilidades funcionais da criança e à assistência do cuidador. Objetivos: Identificar diferenças funcionais de crianças com PC em diferentes níveis de disfunção motora e correlacioná-las com os domínios mobilidade, autocuidado e função social na habilidade funcional e na assistência do cuidador. Métodos: Realizou-se uma pesquisa analítica de corte transversal com 70 crianças/famílias, com idades de 4 a 7,5 anos, atendidas no Centro de Reabilitação Infantil, por meio do Pediatric Evaluation Disability Inventory (PEDI) e do Gross Motor Function Classification System (GMFCS). A análise dos dados foi realizada por meio da ANOVA e teste de correlação de Pearson. Resultados: Os resultados indicaram importante variabilidade funcional das crianças com PC em diferentes níveis de severidade da disfunção motora. Essa variação foi observada nos domínios mobilidade, autocuidado e função social. Os resultados apresentaram, também, forte correlação entre os domínios mobilidade e autocuidado e mobilidade e função social. Conclusões: Diante da variabilidade apresentada pelas crianças, percebe-se a necessidade de aplicação do PEDI e GMFCS, o que parece aumentar o entendimento sobre a relação entre funções motoras grossas e atividades da vida diária. Essa correlação demonstra o quanto a mobilidade é determinante para avaliar o desempenho funcional e orientar a prática terapêutica no sentido de desenvolver as potencialidades das crianças, bem como orientar o cuidador na estimulação. Palavras-chave: paralisia cerebral; habilidades funcionais; mobilidade; avaliação do desempenho.

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Introduction

It is well known that, among children with cerebral palsy (CP), the main disorder is motor impairment, which causes several changes due to the encephalopathy with subsequent modifications in body biomechanics. Additionally, children can suffer from cognitive, sensitive, visual and hearing impairments which, combined with motor changes and task or environmental restrictions, reflect on their functional performance in different ways. The heterogeneity of the health conditions of children with CP does not allow a classification of motor impairment levels, and it is also a challenge for multi-professional rehabilitation teams to use measures based on children's functional performance. This occurs because several studies present the functional scenario of the severity levels of CP in daily activities but do not describe the impact of the isolated disorder or the disability during the performance of these tasks.

In the literature, some studies have proposed that the combination of the Pediatric Evaluation of Disability Inventory (PEDI) and the Gross Motor Function Classification System (GMFCS) could improve the classification of these children in terms of functionality. Thus, the GMFCS would help to classify motor impairment into severity levels according to the limitations and to the need for assistive technology while the PEDI would assess children's functional capacity, skills and performance. This would allow the early detection of disorders at higher levels of impairment.

In this context, it has been suggested that the combination of PEDI and GMFCS would be a way to assess the impact of motor disability on the performance of functional activities, associating the children's functional differences and their characteristics in the mobility, self-care and social function domains. These domains provide information about important aspects of the children's functionality so that therapeutic actions can be planned according to their actual level of impairment and stimuli can be given to reach their full potential. Thus, the goals of the present study were to identify the functional differences between CP children with different levels of motor impairment and to investigate the relationship between these differences with the mobility, self-care and social function domains, in functional skills and in caregiver assistance.

Methods

This was an observational and descriptive study that included 70 children/families aged 4 to 7.5 years. The study included all children of that age group with a medical diagnosis of CP assisted at the Children’s Rehabilitation Center in Natal, Rio Grande do Norte, Brazil. The sample selection was non-randomized and based on the evaluation of the children's medical charts at the previously cited center. Those who did not have a confirmed diagnosis of CP were submitted to a medical evaluation before they were enrolled in the study. Children with progressive brain injuries were excluded from the study. All types of CP were included and there was no sample loss. This study was approved by the Research Ethics Committee of the Health Sciences Center of Universidade Federal do Rio Grande do Norte (protocol 016/04). The guardians signed an informed consent form allowing the children's participation.

Procedures

Initially, two physical therapists were trained to administer the PEDI and GMFCS protocols. The interrater reliability test for the PEDI, based on the assessment of 30 children, showed levels of intra-class correlation (ICC) higher than 0.90 for all assessed categories. All children were evaluated by the GMFCS, then by the PEDI.

Assessment tools

The GMFCS proposed by Palisano et al. was used to assess the severity of a child's neuromotor impairment. Based on this instrument, children were grouped according to the following levels of severity: levels I and II refer to those children with lower functional impairment and that are able to walk without restrictions; level III refer to those children that need help; level IV/V includes the children that use assistive technology to ambulate.

To assess functional performance, we used the PEDI translated, adapted and validated by Mancini to suit Brazilian sociocultural characteristics. This instrument evaluates the child's functional skills through a structured interview administered by the caregiver. It is composed of 197 items, subdivided into three domains: mobility (59 items, involving tub transfers, toilet transfers, indoor and outdoor locomotion, and climbing stairs); self-care (73 items involving eating, dressing, grooming); and social function (65 items related to communication with comprehension and expression, problem-solving, interactions with peers and adults and safety awareness). Each item scores 0 for “unable” to perform the activities or 1 for “capable”. The PEDI also evaluates the caregiver assistance, showing the child’s level of independence through eight self-care tasks, seven mobility tasks and five social function tasks.

The amount of necessary assistance is evaluated through a five-point scale, where 5 indicates the child’s independence; 4, need of supervision; 3, minimal assistance; 2, moderate assistance; 1, total caregiver assistance. In the first part of the test,
three overall net scores are given on the performance in the self-care, mobility and social function areas. The comparison between the functional areas or domains is quite limited because each scale has a different number of items. Thus, to make this comparison possible, the net scores obtained in the PEDI were added and then converted to continuous scores according to the children’s levels of disability (0-100).

Statistical analysis

The data was analyzed with the software Statistical Package for the Social Science (SPSS 15.0). The significance level was set at <5% for all statistical tests. After verification of normal distribution through the Kolmogorov-Smirnov test, analysis of variance (ANOVA) was used with Bonferroni’s post hoc test to identify the existence of significant differences between the severity levels of the gross motor function and functional skills and caregiver assistance. Pearson’s correlation test was applied to analyze the performance in the three domains (mobility, self-care and social function) at each level of motor function.

Results

The characteristics of the evaluated children are shown in Table 1. Of the 70 children, 46 (65.7%) were classified at levels IV/V of the GMFCS. The different levels showed associated vision, speech and language problems, mental disorders and random, heterogeneous seizures. These disorders were mainly evidenced at levels IV/V.

The descriptive analysis of functional abilities: mobility, self-care and social function showed the variability of the children. As seen in Table 2, the medians of these functional skills according to severity of motor function ranged from 14.24 to 59.91, and some scores of the most severely impaired children are above the mean for their group. An example can be observed in level III of the mobility item, where scores of 48.11 were found when the limits in the children from level II ranged from 38.28 to 52.76, and those from level I, from 40.41 to 63.81 (Table 2).

The ANOVA results showed that, within functional skills, there are significant differences between the mobility (p=0.0001), self-care (p=0.0001) and social function (p=0.0001) domains (Figure 1). When analyzing mobility, the Bonferroni test showed that the children from levels IV/V had a significantly poorer functional performance than those from levels I (p=0.0001), II (p=0.0001) and III (p=0.0001), while the children from level I were significantly better than those from level IV/V (p=0.02). There were no significant differences between levels I and II, III and IV. In the activities related to self-care, the children from level IV/V had significantly lower differences compared to those from level I (p=0.0001), II (p=0.001) and III (p=0.0001). There were no significant differences between the children from level I, II and III. Regarding social function, the children with level IV/V motor impairment were significantly more impaired than those from the other groups, with significant differences between the means from levels IV/V and I (p=0.0001), II (p=0.017) and III (p=0.002). There was no significant difference between levels I, II and III, concerning social function.

Table 1. Sample characterization with respect to age, sex, type of CP, socioeconomic level and the presence of comorbidities.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Groups</th>
<th>Level I n (%)</th>
<th>Level II n (%)</th>
<th>Level III n (%)</th>
<th>Levels IV/V n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>4</td>
<td>7 (29.2)</td>
<td>-</td>
<td>3 (12.5)</td>
<td>14 (58.3)</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>2 (15.4)</td>
<td>-</td>
<td>2 (15.4)</td>
<td>9 (69.2)</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>3 (13.0)</td>
<td>2 (8.7)</td>
<td>1 (4.3)</td>
<td>17 (73.9)</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>2 (20.0)</td>
<td>2 (20.0)</td>
<td>-</td>
<td>6 (60.0)</td>
</tr>
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<td>2 (4.8)</td>
<td>3 (7.1)</td>
<td>26 (61.9)</td>
</tr>
<tr>
<td></td>
<td>Female</td>
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<td>2 (7.1)</td>
<td>3 (10.7)</td>
<td>20 (71.4)</td>
</tr>
<tr>
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<td>-</td>
</tr>
<tr>
<td></td>
<td>Diplegia</td>
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<td>-</td>
<td>4 (30.8)</td>
<td>5 (38.5)</td>
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<td>-</td>
<td>-</td>
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<td>-</td>
<td>-</td>
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<td>14 (45.2)</td>
<td>4 (12.9)</td>
<td>4 (12.9)</td>
<td>9 (29.0)</td>
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<tr>
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<td>-</td>
<td>-</td>
<td>2 (5.1)</td>
<td>37 (94.9)</td>
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<td>-</td>
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</table>

CP=cerebral palsy.
The ANOVA results for caregiver assistance also showed significant differences between mobility (p=0.0001), self-care (p=0.0001) and social function (p=0.0001). The results of the Bonferroni test for mobility, self-care and social function showed similar results to those shown above (Figure 1). Regarding the results of the functional skills assessment, Pearson’s test found a correlation between the mobility and self-care in levels I (r=0.716; p=0.004) and IV/V (r=0.561; p=0.001); between mobility and social function in level I (r=0.836; p=0.001) and IV/V (r=0.468; p=0.001); and between self-care and social function in level I (r=0.694; p=0.006) and IV/V (r=0.775; p=0.001). The same correlations between the three domains were found for caregiver assistance.

There were also correlations between functional skills and caregiver assistance in the mobility, self-care and social function domains. There were correlations for mobility at levels I and IV/V (I: r=0.927; p=0.001; and IV/V: r=0.540; p=0.001) and for self-care at level I and IV/V (I: r=0.899; p=0.0001; II: r=0.996; p=0.004; and IV/V: r=0.753; p=0.001). Social function had a strong correlation in all levels (I: r=0.938; p=0.0001; II: r=0.982; p=0.018; III: r=0.997; p=0.001; and IV/V: r=0.879; p=0.001).

**Discussion**

The results of the present study indicated a functional variability of the CP children, i.e. a significant variation in functionality within the different levels of motor impairment severity in the mobility, self-care and social function domains (Table 2). The Bonferroni tests showed a greater difference between the means of levels I and IV/V, indicating that the children of level IV/V had greater motor severity and functional impairment, therefore greater dependence on the caregiver. The variability is clearly shown by the fact that some children presented functionality above the group mean. i.e. when evaluated with the PEDL they showed similar functionality to the groups with mild impairment, according to the GMFCS classification. These findings corroborate those of Ostenjo, Calberg and Vollestad and Allegretti, Mancini and Schwartzman, who also indicated functional variability of CP children in the three domains.

Considering motor function severity, 65.7% of the subjects were classified in levels IV/V (Figure 1), a fact that demonstrates a higher prevalence of children with a poorer functional performance in all domains when both functional skills and caregiver assistance were assessed. This fact is consistent, as motor function is directly related to the functional skills and caregiver assistance items. Thus, children with more severe motor impairment showed less independence in functional skills and, consequently, more dependence on caregiver assistance. It was also observed that the greater mobility impairments seen in the children of level IV/V are related to poorer performances in self-care and social function. Mobility also seems to influence the performance of self-care tasks, so that the children classified as level I are very independent in these tasks while those classified as level IV/V are very dependent on the caregiver. In this context, it is worth noting that this is restricted

<table>
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<tr>
<th>Functional skill</th>
<th>Level I (n=14)</th>
<th>Level II (n=4)</th>
<th>Level III (n=6)</th>
<th>Levels IV/V (n=46)</th>
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<td>SD</td>
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<td>Mean</td>
<td>Mean</td>
</tr>
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<td>63.73</td>
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<td>Median</td>
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<td>59.68</td>
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<td>Mean</td>
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<td>54.50</td>
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<td>SD</td>
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<td>20.17</td>
<td>18.16</td>
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<td></td>
<td>Median</td>
<td>62.00</td>
<td>51.78</td>
<td>60.71</td>
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</table>

The results of the present study indicated a functional variability of the CP children, i.e. a significant variation in functionality within the different levels of motor impairment severity.
to the comparison between the previously mentioned groups. When level I is compared to level II and III, there is no significant difference and, although they have greater motor impairment, functionality is preserved. This fact can be explained by the presence of small changes between these levels, not directly implying total dependence on caregiver assistance\textsuperscript{13,17}.

It must be taken into account that, the child’s socioeconomical status may interfere in their classification, as there are children who do not move because they do not have the financial means to afford a wheelchair or other modalities of assistive technology\textsuperscript{11,13,19}. In the present study, 26 of the 46 children who were unable to walk did not have a wheelchair, a

Figure 1. Analysis of the differences between severity levels of gross motor function and the functional skill and caregiver assistance domains.
Functional performance assessment of children with cerebral palsy

fact that limits locomotion in their own environment, and 37 of
the 46 children did not attend school. This fact may aggravate
their current social status, as social function may be related
to environmental restrictions and to language and mental
comorbidities.

When the performance of the children of level I was com-
pared to that of moderate levels II and III in all domains, both
in functional skills and caregiver assistance, no significant dif-
ference was found (Figure 1). Therefore, it must be noted that,
although neuromotor impairment influences the functional
performance of the children classified in the extreme catego-
ries, caregivers may directly influence the performance of the
moderate children. When the caregiver did not stimulate the
child to use his/her abilities in social function and self-care,
they became more dependent than the mildly impaired chil-
dren, regardless of their similar behavior. Thus, the caregiver
acts as an environmental factor of negative effect, limiting the
child’s potential, and it is crucial that the caregiver’s assistance
be limited to those situations where it is indispensable.

It was also observed that there is a strong correlation
between mobility and self-care, and mobility and social func-
tion, for both, functional skills and caregiver assistance. This
indicates that children in level I with better mobility skills also
need some help from caregivers in self-care and in social func-
tion. The opposite was observed in the children of level IV/V,
i.e. poorer mobility skills were associated with less ability in
self-care and social function, requiring more caregiver assist-
ance. These results show the negative impact of severe motor
impairment in the performance of the daily activities and in
the children’s functional independence. According to Mancini
et al., intrinsic and extrinsic aspects limit children’s functional
possibilities, hampering their performance of everyday activi-
ties. The more dependent the children are on caregiver assist-
ance for the execution of routine tasks, the fewer the chances
to interact with their environment. For these children, most of
the task restrictions are negative, further preventing their mo-
tor development.

The analysis of the results by level showed correlations
between functional skills and caregiver assistance for mobil-
ity in levels I and IV/V, for self-care in levels I, II and IV/V and,
for social function, in all the levels (Figure 1). Similar results
were found in the study by Ostenjo, Calberg and Vollestad,
who found statistically significant differences for social func-
tion in levels III, IV, V. Their study, however, found only this
type of correlation, not considering the correlation between
the domains when comparing functional skills and caregiver
assistance, so it is not possible to determine the relationship
between mobility and functional independence. In the present
study, the close relationship was found between mobility
and functional independence. This relationship is important
because it demonstrates that higher levels of mobility and
the presence of fewer associated disorders allow greater
functional independence. It is also important to highlight
that, although mobility is intrinsically linked to functional
independence and that this independence is one of the main
objectives of physical therapy intervention, the influence of
comorbidities associated with CP cannot be underestimated.
This emphasizes the need for an interdisciplinary approach
that considers all aspects of development and reaches better
therapy results.

Although the children of levels I, II and III had significantly
greater functionality than those of level IV/V and although
there was no significant difference between the three levels,
the children of level III showed a peculiarity in the self-care
domain: they were more disabled in “walking” than the chil-
dren of level I, but not in self-care. This result is contrary to
that of Wassenberg-Severijnen et al., who found better indi-
ces in mobility than in self-care and social function. This fact
may be explained by two reasons: the first is that the self-care
item from PEDI is more related to manual skills and the sec-
ond involves the characteristics of the children of level III in
this sample group. Most of the children evaluated in this study
were diplegic, i.e. more functional in self-care for manual skills,
while those of level II were mostly hemiplegic, more functional
in walking. However, Allegretti, Mancini and Schwartzman
emphasize that, although musculoskeletal impairment in chil-
dren with diplegic CP is more evident in lower limb function,
certain upper limb functional activities can also be impaired.
Thus, it become crucial to evaluate and classify the children in
a standardized manner in order to improve the communica-
tion among professionals and to organize the information and
evidence available in the literature about a particular disease
or pathological process. This information may help the profes-
sionals involved in these children’s rehabilitation process, indi-
cating the type of activities that must be evaluated and included
in the therapeutic approach. To avoid underestimating the
children’s capacity, it is important to carefully observe the vari-
ations in functionality in order to conduct a proper investiga-
tion of the functional potential of each individual.

Thus, the results of the present study showed the variability
and heterogeneity of the functionality of CP children within
the different levels of motor function severity in the mobility,
self-care and social function domains. A strong correlation was
also found between the mobility and self-care domains and be-
tween mobility and social function, both regarding functional
skills and caregiver assistance. Considering this, there is some
proximity in the functional daily activities in spite of the differ-
ences in levels of gross motor function.

This correlation demonstrates how the domains are inter-
connected and interfere in the child’s development, showing

the negative impact of the severe motor impairment on the performance of daily activities and on children's functional independence. This reinforces the need to consider the variability from these patients and their peculiariest in clinical practice.

Given this variability, there is a clear need to use the PEDI and GMFCS assessment protocols, which demonstrate the importance of mobility in the evaluation of children's functional performance. This fact improves the understanding of the relationship between gross motor function and activities of daily living through a better classification of motor impairment and of the impact on functional activities. With this information, it is possible to guide therapists in planning the most efficient intervention for patients to develop their potential, as well as to instruct caregivers to stimulate the children according to their characteristics, thus improving functional skills and quality of life.

References


