PRM+
JOURNAL OF QUANTITATIVE RESEARCH
IN REHABILITATION MEDICINE

Measuring the change in functional level of children rehabilitants with cerebral palsy: a brief report

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Abstract

Objectives
To compare Gross Motor Function Measure (GMFM), Gross Motor Function Classification System (GMFCS), Functional Independence Measure (FIM®), Manual Ability Classification System (MACS), and Ashworth scale in their ability to discriminate larger and smaller benefits of rehabilitation.

Methods
Retrospective cohort study. The 248 children with cerebral palsy participated in an intensive rehabilitation intervention. Scores were assessed at admission and discharge.

Results
GMFCS and MACS scores did not change. Ashworth scale and FIM improved evenly in almost every individual. There were positive changes in GMFM scores of 233 rehabilitants with median pre/post difference 3.8 (range 0.4 to 29.2) points.

Conclusions
While the Ashworth scale, FIM, GMFCS, and MACS may be valuable tools to assess level of functioning, they were not able to discriminate mild changes observable during a short rehabilitation intervention. Compared to these measures, the GMFM scale demonstrated greater responsiveness identifying such changes.

Keywords:
pediatric rehabilitation; icf; functioning; assessment

INTRODUCTION

Establishing standardised and sensitive scales to assess the success of rehabilitation amongst children with cerebral palsy (CP) is undoubtedly important in order to define realistic rehabilitation goals, measure the effectiveness of interventions, and to demonstrate the need for rehabilitation measures to policy makers. Different scales and frameworks have been suggested for this purpose. Some of them are clinical in nature and describe the severity of symptoms, e.g. Ashworth scale (1). Others focus on the level of functioning, such as the Gross Motor Function Measure (GMFM) and the Gross Motor Function Classification System (GMFCS) (2), the Functional Independence Measure (FIM®) (3), the Edinburgh Visual Gait Analysis Interval Testing (GAIT) (4), Physician Rating Scale (PRS) (5), the Manual Ability Classification System (MACS) (6), the Communication Function Classification System (CFCS) (7), and many others. Some of them, such as the FIM or Ashworth scale, have been developed for use in both adult and pediatric populations while others, such as the GMFM or MACS, were developed specifically for the pediatric population. The scales also differ in the areas of functioning to which they are applied.

Previous studies have suggested that all of the above scales can be good indicators of functional improvement of children with CP during the rehabilitation process (8, 9). Earlier trials have compared some of these scales, found good correlation between them, and suggested that different scales should complement each other (10-13). However, previous research has also suggested that some of these scales may have some limitations depending on the specific area of functioning or the level of severity of impairment (1, 14).

The purpose of this study was to compare the FIM, MACS, GMFM, GMFCS, and Ashworth scales in their ability to discriminate those children with CP who have experienced greater from lesser treatment benefit from rehabilitation intervention.

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Conflicts of interest: none to declare

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METHODS

This was a retrospective cohort study All children with CP who entered a rehabilitation center for a three-week rehabilitation course between January 1stand July 31st, 2015 were included. Each patient received botulinum toxin (Dysport®) injections into appropriately selected muscles as determined by the treating physician, followed by intensive physiotherapy, occupational therapy, speech and language therapy, and psychological support. The Ethics Committee of the Rehabilitation Center approved the study.

Clinical Outcome Measurement Scales

FIM is an 18-item, 7-level ordinal scale, with '1' indicating dependence and '7' indicating independence in functioning. FIM covers both motor and cognitive aspects of functioning with a maximum total score of 128. The minimal clinically significant difference (MCID) has previously been suggested to be approximately 11 points.

MACS describes in five possible levels how 4–18-year old children with CP use their hands to handle objects in daily activities. The levels are based on self-initiated ability and need for assistance or adaptation to perform manual activities.

Table 1. Scores at admission and discharge along with changes.

Scale	At admission			At discharge			Change		
	Median	Range	IQR [a]	Median	Range	IQR	Median	Range	IQR
Ashworth	3	1 to 5	1	2	1 to 5	1	-1	-2 to 0	0
GMFM	50.45	0.3 to 99.1	80.3	54.95	0.8 to 99.6	80.3	3.8	0.4 to 29.2	3.2
FIM	90.5	13 to 124	58.5	92	14 to 126	57	1	0 to 9	1
MACS	3	1 to 5	2	3	1 to 5	2	0	-1 to 0	0
GMFCS	3	1 to 5	3	3	1 to 5	3	0	-1 to 0	0

[a] Interquartile 25%–75% range

GMFM exists in two versions – 66-item and 88-item. The 66-item GMFM was used. Each item has an ordinal 4-level scale: 0 = 'does not initiate'; 1 – 'initiates'; 2 – 'partially completes'; and 3 – 'completes'. The total score is given in percentage; therefore, the maximum total is 100%. The minimal clinically significant difference (MCID) has previously been suggested to be approximately between 1.2 and 5.3 points.

GMFCS level is a rating of severity of motor functional impairment with five possible choices: level I – 'walks without limitations'; level II – 'walks with limitations'; level III – 'walks using a hand-held mobility device'; level IV – 'self-mobility with limitations; may use powered mobility'; and level V – 'transported in a manual wheelchair'.

Ashworth scale is a 6-level scale that describes the severity of spasticity: 0 – 'No increase in muscle tone'; 1 – 'Slight increase in muscle tone'; 1+ – 'Slight increase in muscle tone, manifested by a catch, followed by minimal resistance throughout the remainder (less than half) of the range of motion'; 2 – 'More marked increase in muscle tone through most of the ROM, but affected part(s) easily moved'; 3 – 'Considerable increase in muscle tone, passive movement difficult'; and 4 – 'Affected part(s) rigid in flexion or extension'.

Statistical analysis

The descriptive statistics with normal distribution were presented as means, standard deviations, percent, and ranges when appropriate. The statistics with abnormal distribution were presented as medians, 25–75% interquartile range (IQR), percent, and ranges when appropriate. All analyses were performed using Stata/IC Statistical Software: Release 14. College Station (StataCorp LP, TX, USA).

RESULTS

Of the 248 children, 232 (94%) had CP as a primary diagnosis for referral for rehabilitation. Their median age at admission was 75 (range 20 to 154, IQR 59) months. Of them, 61% were males and 39 females. During the rehabilitation course, all 248 patients received injections of botulinum toxin (Dysport®) with a median dosage per rehabilitant of 270 (40 to 880) UI and a median dosage/weight of 17.0 (1.9 to 46.8) UI/kg.

Table 1 shows the scores of evaluated scales at admission and discharge. GMFCS and MACS scores did not change except in one case each. The Ashworth scale improved by one level in almost every rehabilitant (93%, 223 out of 240). FIM showed a slight improvement in most patients with a median change of 1 (range 0 to 9, IQR 1). There were positive changes in GMFM scores of 233 patients with a median pre/post difference of 3.8 (range 0.4 to 29.2, IQR 3.2) points.

DISCUSSION

Hence, in this descriptive study of 248 children with CP who underwent a three-week intensive rehabilitation program, the GMFM scale was the only out of five scales that could be used to discriminate those who benefitted from the rehabilitation. GMFCS and MACS did not show any change, while the Ashworth scale as well as FIM improved almost evenly in virtually every patient. This study describes the experience of a single rehabilitation center and therefore no definitive inferences regarding the entire field of CP rehabilitation can be made. The possible differences between groups based on the severity, age, the form of CP, and main clinical syndromes have not been analysed. Our results are in line with previous studies which have shown the discriminatory ability of the GMFM (9). The absence of observable changes in functioning measured by GMFCS and MACS is not surprising, as even intensive rehabilitation intervention can hardly be expected to change significantly such rough five–level scores in

children with a heavy chronic disorder in three weeks. The low discriminatory ability of FIM was unexpected, as a well-structured 18-item test could be anticipated to describe more precisely the change in the level of functioning than it did in our sample. This result contrasts with a previous report (8) and raises the question as to whether it would suffice to obtain Ashworth scale, FIM, GMFCS, and MACS scores only once during the rehabilitation intervention in our patient population in order to use scarce resources more efficiently.

We can speculate that one of the main reasons why GMFM performed better than FIM in this study is the fact that FIM evaluates dependency. In relation to the International Classification of Functioning, Disability and Health (ICF), FIM employs only one dimension of participation, i.e. capacity, that describes the functioning without assistance. This leaves another part of functioning, i.e. performance (functioning in some real-life situations with all available assistance) outside the scope of FIM. As aforementioned about GMFCS and MACS, it is difficult to expect that the need for assistance changes significantly during such a short period as three weeks. On the contrary, ICF-based GMFM employs the entire spectrum of the concept of functioning and this may explain why it performed so well in this study. Further studies in different patient samples could help to validate our results.

CONCLUSIONS

While Ashworth scale, FIM, GMFCS, and MACS might be valuable tools to assess the level of functioning, they seemed to be too rough to describe mild changes observable during a short rehabilitation intervention. In comparison, the GMFM scale appears more sensitive in defining such changes.

REFERENCES

1. Damiano DL, Quinlivan JM, Owen BF, Payne P, Nelson KC, Abel MF. What does the Ashworth scale really measure and are instrumented measures more valid and precise? Dev Med Child Neurol. 2002;44(2):112-8.

2. McMaster University. Homepage of Motor Growth Measures Canada2015 (Available from: http://motorgrowth.canchild.ca/en/.

3. Uniform Data Set For Medical Rehabilitation. Guide for the use of the uniform data set for medical rehabilitation, Version 5.0. Buffalo, NY: State University of New York at Buffalo Research Foundation; 1996.

4. Read HS, Hazlewood ME, Hillman SJ, Prescott RJ, Robb JE. Edinburgh visual gait score for use in cerebral palsy. J Pediatr Orthop. 2003;23(3):296-301.

5. Maathuis KG, van der Schans CP, van Iperen A, Rietman HS, Geertzen JH. Gait in children with cerebral palsy: observer reliability of Physician Rating Scale and Edinburgh Visual Gait Analysis Interval Testing scale. J Pediatr Orthop. 2005;25(3):268-72.

6. Eliasson AC, Krumlinde-Sundholm L, Rosblad B, Beckung E, Arner M, Ohrvall AM, et al. The Manual Ability Classification System (MACS) for children with cerebral palsy: scale development and evidence of validity and reliability. Dev Med Child Neurol. 2006;48(7):549-54.

7. Cockerill H. Developing the Communication Function Classification System for individuals with cerebral palsy. Dev Med Child Neurol. 2011;53(8):675.

8. Amatya B, Khan F. Rehabilitation for cerebral palsy: Analysis of the Australian rehabilitation outcome dataset. J Neurosci Rural Pract. 2011;2(1):43-9.

9. Colovic H, Dimitrijevic L, Stankovic I, Nikolic D, Radovic-Janosevic D, Zivanovic D. The effects of botulinum toxin type A on improvement and dynamic spastic equinus correction in children with cerebral palsy - preliminary results. Arch Med Sci. 2014;10(5):979-84.

10. Compagnone E, Maniglio J, Camposeo S, Vespino T, Losito L, De Rinaldis M, et al. Functional classifications for cerebral palsy: correlations between the gross motor function classification system (GMFCS), the manual ability classification system (MACS) and the communication function classification system (CFCS). Res Dev Disabil. 2014;35(11):2651-7.

11. Robinson LW, Clement N, Fullarton M, Richardson A, Herman J, Henderson G, et al. The relationship between the Edinburgh Visual Gait Score, the Gait Profile Score and GMFCS levels I-III. Gait Posture. 2015;41(2):741-3.

12. Carnahan KD, Arner M, Hagglund G. Association between gross motor function (GMFCS) and manual ability (MACS) in children with cerebral palsy. A population-based study of 359 children. BMC Musculoskelet Disord. 2007;8:50.

13. van Meeteren J, Nieuwenhuijsen C, de Grund A, Stam HJ, Roebroeck ME, Transition Research Group South West N. Using the manual ability classification system in young adults with cerebral palsy and normal intelligence. Disabil Rehabil. 2010;32(23):1885-93.

14. van Eck M, Dallmeijer AJ, van Lith IS, Voorman JM, Becher J. Manual ability and its relationship with daily activities in adolescents with cerebral palsy. J Rehabil Med. 2010;42(5):493-8.