

# Responsiveness of Goal Attainment Scaling in comparison to two standardized measures in outcome evaluation of children with cerebral palsy

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## Abstract

**Objectives:** To assess the responsiveness of Goal Attainment Scaling compared with the Pediatric Evaluation of Disability Inventory (PEDI) and the 66-item Gross Motor Function Measure (GMFM-66) in multidisciplinary rehabilitation practice.

**Design:** Observational study. Pretest–posttest design.

**Subjects/patients:** Twenty-three children with cerebral palsy, aged 2–13 years.

**Methods:** Goal Attainment Scaling, PEDI and GMFM-66 assessments were performed before and after six months of treatment. Physical, occupational and speech therapists constructed and scored 6-point Goal Attainment Scaling scales meeting predetermined criteria, describing the main functional goal per discipline. The contents of the three measures were compared using International Classification of Functioning, Disability and Health child and youth version (ICF-CY) codes. Spearman's rho correlations between Goal Attainment Scaling change scores per discipline and change scores obtained with the PEDI functional skills scales and GMFM-66 were calculated. Complete goal attainment was compared with significant change in terms of the standardized measures.

**Results:** Twenty per cent of the Goal Attainment Scaling items were not covered by items of the PEDI or the GMFM-66. Inconclusive correlations were found between Goal Attainment Scaling and PEDI change scores ( $r$  0.28–0.64). Even after exclusion of the non-corresponding items, correlations were moderate

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( $r$  0.57–0.73). Of 39/64 Goal Attainment Scaling scales scored as complete goal attainment, 16 individual PEDI scores did not show change on the corresponding scale. Low correlation was found between Goal Attainment Scaling change scores and GMFM-66 change scores.

**Conclusion:** Goal Attainment Scaling, PEDI and GMFM-66 were complementary in their ability to measure individual change over time in children with cerebral palsy. Using only the standardized instruments could have caused many individual rehabilitation goals actually attained being missed in the outcome evaluation.

## Keywords

Goal Attainment Scaling, activities of daily living, team, goal setting, child rehabilitation

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## Introduction

Measuring change over time in terms of the activities and participation domains of the International Classification of Functioning, Disability and Health (ICF)<sup>1</sup> is very relevant in contemporary rehabilitation care, and many standardized outcome measures evaluating patients with disabilities have demonstrated reliability and validity for specific populations. In the last decade, however, it has become clear that proving clinically meaningful change with these measures is challenging. This is particularly true for the measurement of individual patients' progress at the activities and participation level in rehabilitation practice.<sup>2</sup>

Responsiveness, defined in the present study as an instrument's ability to detect meaningful change over time in the construct to be measured,<sup>3</sup> may fail for two reasons. First, items in standardized measures may not match individual rehabilitation goals.<sup>4,5</sup> Second, if items do match therapy goals, the outcome may not represent goal attainment. For the purpose of rehabilitation research, the large numbers of items in standardized measures are intended to cover all aspects of functioning and to benefit the measure's sensitivity to change at a group level. When measuring individuals in rehabilitation practice, however, changes may easily be missed if only a few items show change against the large number of unchanged items. Most

populations in rehabilitation are heterogeneous, and goals are often widely distributed across the items of the ICF, resulting in problems interpreting the outcome when using standardized measures alone.<sup>2,6</sup>

Goal Attainment Scaling is used increasingly for individual assessment of progress in rehabilitation. It measures the extent to which individual goals are attained, and can be used for children,<sup>7–10</sup> adults<sup>4,11–13</sup> and the elderly.<sup>14</sup> Its responsiveness in terms of activity and participation items is assumed to be better than that of common standardized functional measures, especially in heterogeneous populations.<sup>4,9,15</sup> The degree to which it overcomes the limitations of the standardized measures will vary for each new field where Goal Attainment Scaling is introduced, depending on the Goal Attainment Scaling method used.<sup>8,9</sup> In regard to its responsiveness, little is known about how Goal Attainment Scaling compares with standardized evaluative measures in paediatric rehabilitation.

The Pediatric Evaluation of Disability Inventory (PEDI) and the Gross Motor Function Measure (GMFM) are examples of commonly used standardized and generic outcome tools in paediatric rehabilitation for children with cerebral palsy. In an intervention study with 55 children with cerebral palsy (age 2–7 years), individual treatment goals of the children receiving physical therapy were analysed to find out how they were reflected in the

PEDI and GMFM instruments.<sup>5</sup> Sixty per cent of the treatment goals proved to be covered by both measures, but 14% of the treatment goals were not covered by either. Treatment goals in occupational and speech therapy and coverage by standardized measures have not yet been studied.

The purpose of the present study was to assess the responsiveness of Goal Attainment Scaling in comparison with that of the reference measures, the Pediatric Evaluation of Disability Inventory and the 66-item Gross Motor Function Measure. Our aim was to measure change over time at the International Classification of Functioning, Disability and Health child and youth version (ICF-CY) activities and participation level in routine multidisciplinary rehabilitation practice for children with cerebral palsy.

## Methods

A convenient sample of children with cerebral palsy from a medium-sized children's unit at a rehabilitation centre were recruited for this study. Children who met the following criteria were included: (a) a confirmed diagnosis of cerebral palsy, (b) aged between 2 and 14 years and (c) expected by their physician to be in multidisciplinary therapy for at least six months. The distribution of severity of cerebral palsy was evaluated by the Dutch language version of the Gross Motor Function Classification System,<sup>16,17</sup> which classifies the motor function of children with cerebral palsy based on their self-initiated movement ([www.netchild.nl](http://www.netchild.nl)), as well as with the Dutch language version of the Manual Ability Classification System,<sup>18</sup> which classifies how children with cerebral palsy use their hands when handling objects in daily activities ([www.macs.nu](http://www.macs.nu)). In both classification systems, level I represents the highest functional ability and level V the lowest level.

After a period of training in the use of Goal Attainment Scaling,<sup>8</sup> eight paediatric physical, eight paediatric occupational and four paediatric speech therapists participated in this study, which had a pretest–posttest design.

Changes were measured using Goal Attainment Scaling, the PEDI and the GMFM-66 for each child over the six-month therapy period in which children received conventional multidisciplinary therapy in a rehabilitation setting. The study was based on the assumption that treatment is beneficial. Each child's therapists constructed Goal Attainment Scaling scales at baseline ( $t=0$ ), and scored the scales after three months ( $t=1$ ) and after six months ( $t=2$ ), resulting in three separate change scores per discipline. The child's occupational therapist administered the PEDI and the child's physical therapist the GMFM-66 at  $t=0$  and at  $t=2$ .

In the present study, an adapted version<sup>8</sup> of the original Goal Attainment Scaling method<sup>19,20</sup> was used. The professionals constructed therapist-specific 6-point Goal Attainment Scaling scales, with the score  $-2$  representing the level equal to start,  $-1$  less progress than expected,  $0$  for the expected level of functioning,  $+1$  and  $+2$  for achievement of more and much more than was expected, respectively, and  $-3$  for deterioration.<sup>8</sup> We analysed raw Goal Attainment Scaling scores instead of applying the commonly used original  $T$ -sum formula.<sup>21</sup>

The participating therapists agreed to adhere to the following criteria<sup>8</sup> for scale development. (a) Goals should be set in consultation with the children and their parents, should be based on their request for help and requirements and should describe the main aim of therapy for each discipline in terms of the activity and participation domains of the ICF child and youth version (ICF-CY). (b) The six levels of the Goal Attainment Scaling scales should be specific, measurable, achievable, realistic/relevant and time-related (SMART). (c) Scales should be constructed ordinally with incremental steps of equal intervals. To ensure ordinality, each Goal Attainment Scaling scale should reflect a single dimension of change. (d) It must be possible to score a scale within 10 minutes, to ensure that it is practicable.

Goal Attainment Scaling scales were constructed and scored by the child's own

therapists, as described in a previous publication.<sup>7</sup> The raters' judgement was based on their professional observations of the child or interviews with parents or teachers rather than testing a child's actual performance,<sup>8</sup> to minimize the influence of children's whims (fatigue, motivation, interaction, behaviour). The intermediate three-month score was used to follow the progress towards goal attainment.

The PEDI<sup>22</sup> uses an interview with parents to measure both capability and performance of functional activities in everyday situations for three domains: Self-Care, Mobility and Social Function. Capability is measured by identifying functional skills that the child has mastered in these three domains. On the functional skills scale, parents indicate whether their child is capable of performing each of 197 tasks in the three domains. The present study used only the three functional skills scale domains of the Dutch version of the PEDI (PEDI-NL).<sup>23</sup>

The GMFM-66<sup>24</sup> is a 66-item version observational instrument, designed and validated to measure change in gross motor function over time in children with cerebral palsy. The present study used a Dutch translation of the GMFM-66. When used together, the GMFM and PEDI provide a comprehensive picture of a child's functional abilities at the ICF activity level.<sup>25</sup> Good reliability, validity and responsiveness have been reported for both the PEDI and GMFM-66.<sup>26,28</sup> The psychometric properties of the Dutch translations are comparable to those of the original instruments.<sup>23,28-31</sup>

We compared the content and ability to measure change over time. First, items used in the Goal Attainment Scaling constructed by the practitioners were compared with the PEDI and the GMFM-66 items, and were identified as match or no match using the ICF-CY code. The main individual goal areas of Goal Attainment Scaling items were coded according to the ICF-CY categories, using the eight ICF linking rules proposed by Cieza *et al.*<sup>32</sup> as recently published by McDougall.<sup>33</sup> Rating was independently performed by the first (DS) and fourth (KG) authors. Discrepancies were

discussed and if more than one code remained applicable, the third author (MK) made the final decision. The PEDI and GMFM-66 items were coded using a method similar to that described in the study by van Engelen *et al.*<sup>5</sup>

Second, to explore the correlations between the outcomes for each discipline, separate Spearman's rho correlations were calculated for the Goal Attainment Scaling change scores of each discipline as well as the change scores of each domain of the PEDI and the GMFM-66 change scores. The influence of construct differences on these correlations was further investigated by calculating spearman's rho values again after excluding pairs of change scores where the Goal Attainment Scaling items did not match the items in the PEDI and GMFM-66.

Third, the ability to detect change over time for the three measures was compared as follows. For Goal Attainment Scaling, minimal clinically meaningful individual improvement was defined as a score equal to or more than zero. For the PEDI and GMFM-66, we approximated the important change score by determining the smallest detectable change score, in accordance with common practice. This method ignores the distinction between smallest detectable change and minimally important change.<sup>6</sup> According to the manuals of the methods,<sup>22,24</sup> the smallest detectable change was defined as a change in which the lower bound of the 95% confidence interval of the  $t=2$  score did not overlap the upper bound of the 95% confidence interval of the  $t=0$  score. The manuals of the measures were used to determine the 95% confidence interval for each score. The degree of individual change in terms of the Goal Attainment Scaling scales and the correlated scales of the PEDI and the GMFM-66 were compared in cross-tabs.

In order to assess the possible consequences of the individual changes found, and to compare our PEDI and GMFM-66 outcomes with existing literature, changes at group level were also considered, as research usually addresses group changes. In order to define acceptable change over time for Goal Attainment Scaling at

group level, a new algorithm was developed using the  $t=1$  score halfway through the therapy period. We defined acceptable change over time at group level as a median score equal to or higher than zero at  $t=2$ , if the median score at  $t=1$  was between the median scores at  $t=0$  (by definition  $-2$ ) and  $t=2$ , and if changes between  $t=0$ ,  $t=1$  and  $t=2$  were statistically significant. Acceptable change over time for the PEDI and GMFM-66 at group level was defined as statistically significant change between  $t=0$  and  $t=2$ , as the minimal clinically meaningful change at group level is also unknown. Changes of all three measures at group level were tested using the Wilcoxon signed ranks test (two-tailed).

## Results

Twenty-three children between the ages of 2 and 13 years participated (mean 7.6, SD 3.1); their Gross Motor Function Classification System and Manual Ability Classification System levels ranged from I to V (Table 1). Eighteen children were treated by three disciplines (i.e. physical therapy, occupational therapy and speech therapy), and five children by two disciplines (i.e. physical therapy and occupational therapy). Sixty-four Goal Attainment Scaling scales ( $18 \times 3 + 5 \times 2$ ) were constructed and scored. Table 1 shows the Goal Attainment Scaling scores, the scale scores on the PEDI and the GMFM-66 scores, at baseline ( $t=0$ ) and after six months ( $t=2$ ), for each child.

Complete agreement between the two authors who linked the Goal Attainment Scaling items to an ICF-code was found for 50/64 Goal Attainment Scaling scales. As regards the other 14 scales, agreement was easily achieved for 8 of them after discussion between the two assessors. There were six Goal Attainment Scaling scales for which two or more codes were found applicable, necessitating a final decision by the third author. Thirteen out of 64 (20%) goals described in the Goal Attainment Scaling scales were not

covered by either the PEDI or the GMFM-66 (Table 2) (Appendix 1 for web publication only).

The Goal Attainment Scaling change scores by the physical therapists and PEDI functional skills scale Mobility were significantly correlated, as were those by the speech therapists and PEDI functional skills scale Social Function (Table 3). Another significant correlation was found between the Goal Attainment Scaling change scores by the occupational therapists and the PEDI functional skills scale Self-Care change scores, after exclusion of the non-matching pairs. Low correlations were found for all other combinations, including the Goal Attainment Scaling change scores by the physical therapists and the GMFM-66 change scores, even after exclusion of the non-matching pairs. Seven goals set by the physical therapists, 11 goals set by the occupational therapists and one goal set by a speech therapist were not covered by the PEDI. After exclusion of the non-corresponding items, a higher but no more than moderate correlation was found (Table 3).

Examination of individual change showed that 9/23, 18/23 and 12/18 Goal Attainment Scaling scores were equal to or higher than zero for the physical, occupational and speech therapists, respectively; 21 children (91%) scored zero or more on at least one of the Goal Attainment Scaling scales and 7 (30%) did so on all Goal Attainment Scaling scales (Table 1). Twenty-one children (91%) improved regarding at least one of the PEDI functional scales, and only 2 (9%) did so for all three scales. Individual change in terms of the GMFM-66 without overlap in the given 95% confidence intervals was found for only one child (Table 1).

The cross-tabulations Tables 4a–c show the comparison of individual change in terms of the correlated measures. For the 39 Goal Attainment Scaling scales scored as 0 or higher, 16 individual PEDI scores on the related scale did not show any change. On the other hand, 3 out of 26 significant changes as assessed by the PEDI scales were not detected by Goal Attainment Scaling.

**Table 1.** Summary of characteristics of the subjects and outcome

Child no.	Age (years)	Gender	GMFCS level	MACS level	GAS score PT t=2	GAS score OT** t=2	GAS score ST** t=2	PEDI FSS*** Self-Care		PEDI FSS*** Mobility		PEDI FSS*** Social Function		GMFM-66***	
								t=0	t=2	t=0	t=2	t=0	t=2	t=0	t=2
1	12	M	IV	IV	-1	1	1	50	56*	40	40	73	76	27	27
2	13	F	V	V	-1	1	ND	50	51	41	44	74	86*	23	26
3	7	F	II	I	-1	2	1	72	78*	65	66	74	79*	67	69
4	13	F	V	V	-1	0	0	32	32	36	38	64	66	28	30
5	5	M	I	III	2	1	0	58	65*	62	68*	69	72	69	74
6	7	M	III	II	-2	0	-1	51	58*	51	46	67	68	53	53
7	9	F	IV	II	-1	1	2	58	79*	67	70	86	86	54	57
8	11	F	III	II	-1	-2	-1	64	65	56	58	67	68	57	58
9	4	M	I	III	-1	2	-1	50	63*	51	68*	62	69*	64	70*
10	7	M	II	I	1	2	0	60	65*	79	83	69	72	76	78
11	6	M	V	V	2	-1	0	22	22	26	33*	55	55	35	35
12	3	M	II	III	-1	-1	1	50	53	61	60	67	69	64	64
13	5	M	III	II	2	1	ND	63	67*	59	66*	79	83	63	66
14	8	M	IV	IV	2	2	2	56	53	28	35*	63	68*	34	36
15	9	F	II	I	2	2	ND	71	71	85	90	74	89*	88	88
16	10	M	III	II	-1	0	ND	66	66	64	64	74	74	59	63
17	6	M	II	II	2	1	-1	57	61*	79	94*	65	64	75	80
18	6	M	I	III	-1	2	-2	72	77*	100	100	78	78	88	88
19	10	F	V	V	1	2	1	48	53*	40	38	68	76*	36	36
20	10	M	IV	II	-1	-1	-2	54	63*	48	42	73	73	29	31
21	2	M	II	III	1	0	2	45	48*	65	66	45	54*	53	55
22	11	F	V	V	-2	-1	1	41	44	39	39	76	83*	25	25
23	5	M	II	I	-1	2	ND	66	75*	66	70*	76	81*	83	83

t=0, baseline; t=2, six months after baseline; m, male; f, female; GMFCS, Gross Motor Function Classification System; MACS, Manual Ability Classification System (level I represents the best functional abilities and level V the most limited ones); GAS, Goal Attainment Scaling; PT, physical therapist; OT, occupational therapist; ST, speech therapist; PEDI-FSS, Pediatric Evaluation of Disability Inventory functional skills scale; GMFM-66, 66-item version of the Gross Motor Function Measure; ND, no data; speech therapy not involved for this child.

\*Indicates significant positive individual change (no overlap of 95% confidence intervals in scores t=0 and t=2).

\*\*Indicates important group change (median GAS score ≥0).

\*\*\*Indicates significant group change (P ≤ 0.05), in this study considered being important change.

**Table 2.** List of International Classification of Functioning, Disability and Health, Child and Youth version (ICF-CY) items used in the 64 Goal Attainment Scaling scales which are not covered in the Dutch Pediatric Evaluation of Disability Inventory (PEDI-NL) and 66-item version of the Gross Motor Function Measure (GMFM-66)

Description of the activity	ICF-CY Classification	Frequency of its use in the GAS scales
Acquiring skills to use writing implements	d1450	1
Using general skills and strategies of the writing process	d1700	1
Discussion with one person	d3550	1
Using writing machines	d3601	1
Grasping	d4401	1
Manipulating	d4402	5
Fine hand use	d440	2
Sports	d9201	1
Total		13

**Table 3.** Spearman's rho correlations between the Goal Attainment Scaling (GAS) change scores and the best corresponding Pediatric Evaluation of Disability Inventory functional skills scales (PEDI-FSS)

$\Delta$ GAS score	Measure	Spearman's rho	P-value	Recalculation after exclusion of the non-corresponding items	P-value
Physical therapists	$\Delta$ PEDI FSS Mobility	0.64 ( $n = 23$ )	<0.01	0.57 ( $n = 18$ )	0.01
Occupational therapists	$\Delta$ PEDI FSS Self-Care	0.28 ( $n = 23$ )	0.20	0.71 ( $n = 12$ )	0.01
Speech therapists	$\Delta$ PEDI FSS Social Function	0.55 ( $n = 18$ )	0.02	0.73 ( $n = 17$ )	<0.01

**Table 4a.** Crosstabs comparing individual change on correlated measures

	$\Delta$ PEDI FSS Mobility CI pre $\neq$ CI post		
	+	-	Totals
GAS score PT $\geq 0$	5	4	9
	1	13	14
Totals	6	17	23

GAS, Goal Attainment Scaling; PEDI, Pediatric Evaluation of Disability Inventory; FSS, functional skills scale; CI, Confidence Interval; PT, Physical therapy

**Table 4b.** Crosstabs comparing individual change on correlated measures

	$\Delta$ PEDI FSS Self-Care CI pre $\neq$ CI post		
	+	-	Totals
GAS score OT $\geq 0$	13	5	18
	1	4	5
Totals	14	9	23

GAS, Goal Attainment Scaling; PEDI, Pediatric Evaluation of Disability Inventory; FSS, functional skills scale; CI, Confidence Interval; OT, Occupational therapy

**Table 4c.** Crosstabs comparing individual change on correlated measures

	$\Delta$ PEDI FSS Social Function CI pre $\neq$ CI post		Totals
	+	-	
GAS score ST $\geq 0$	5	7	12
	-1	5	6
Totals	6	12	18

GAS, Goal Attainment Scaling; PEDI, Pediatric Evaluation of Disability Inventory; FSS, functional skills scale; CI, Confidence Interval; ST, Speech therapy

**Table 5.** Frequency of Goal Attainment Scaling (GAS) scores after three ( $t=1$ ) and six months ( $t=2$ ) and statistical significance of differences at group level between  $t=0$ ,  $t=1$  and  $t=2$ , tested using the Wilcoxon signed ranks test

GAS scores Value	Frequency		
	$t=0$	$t=1$	$t=2$
-3	0	1	0
-2	64	9	5
-1	0	24	20
0	0	16	8
1	0	12	14
2	0	2	17
Totals	64	64	64
Median	-2	-1	0
Wilcoxon $t0-t1$	$Z = -6.4; P \leq 0.01$		
Wilcoxon $t1-t2$	$Z = -2.7; P \leq 0.01$		
Wilcoxon $t0-t2$	$Z = -6.7; P \leq 0.01$		

At group level, the Goal Attainment Scaling scores had a median value of  $-1$  after three months ( $t=1$ ) and a median value of  $0$  after six months ( $t=2$ ), with statistically significant differences between  $t=0$  and  $t=1$  and between  $t=1$  and  $t=2$ , indicating acceptable responsiveness of Goal Attainment Scaling at group level; Table 5 shows the frequencies of scores and  $Z$ -values.

The changes at group level between the baseline scores and scores after six months ( $t=2$ ) on

the PEDI functional skills scale Self-Care, the PEDI functional skills scale Mobility, the PEDI functional skills scale Social Function and the GMFM-66 were all statistically significant ( $Z = -3.62$ ,  $Z = -2.62$ ,  $Z = -3.68$  and  $Z = -3.33$ , respectively, all with  $P \leq 0.01$ ) Examples of GAS scales are given in appendix 2 for web publication only.

## Discussion

When used by a group of trained therapists, Goal Attainment Scaling proved to offer added value in comparison to the PEDI and GMFM-66 instruments, regarding the responsiveness of the instruments. Goal Attainment Scaling detected important changes in activity skills that were not found using the standardized measures alone. This study was unique in that it measured the properties of Goal Attainment Scaling during the pragmatic routine work of a rehabilitation team.

One out of 23 physical therapy goals and 11 out of 23 occupational therapy goals were not covered by at least one of the other measures. The results of our content analysis should be interpreted with some caution, however, as the process of linking items from standardized measures to the ICF codes is still in the pioneering stage. For example, literature shows some discrepancies regarding linkage between the PEDI and the ICF, relating to manipulating (d4402) and grasping (d4401). In the study by Van Engelen *et al.*<sup>5</sup> a single ICF code was chosen for each PEDI item, and manipulating was not linked, while Østensjø *et al.*<sup>34</sup> linked all possible codes to PEDI items and regarded the code for manipulation as one of the options for the PEDI item manipulation of fasteners. In the present study, examples of manipulating were the use of a pair of scissors (child no. 10 in Table 1), the use of a joystick by a child with severe cerebral palsy who uses an electric wheelchair (no. 11) and writing (no. 15), none of which are included in the PEDI. Almost all (17/18) speech therapy goals were covered by the PEDI Social Function domain, which can be explained from the criteria for Goal Attainment Scaling scale



construction, as speech therapy goals relating to activity and participation usually have social communication as their main focus. The use of Goal Attainment Scaling by speech therapists has been shown to be valuable.<sup>8,35</sup> We were unable, however, to find any literature evaluating speech therapy with the PEDI.

The poor correlation between the Goal Attainment Scaling change scores from the occupational therapists and the PEDI functional skills scale Self-Care change scores may have been caused by the non-matching items, as the correlation improved after these items were excluded. Contrary to our expectations, low and non-significant correlation coefficients were found between physical therapists' Goal Attainment Scaling change scores and GMFM-66 change scores. This is probably due to the narrow distribution of the Goal Attainment Scaling data, as a median of  $-1$  was found for the physical therapy scores. Another explanation may be a difference in the construct measured within the ICF-CY activities domain: the GMFM-66 measures a child's capacity for basic gross motor abilities, whereas Goal Attainment Scaling and PEDI measure their performance of activities.

The present study has several limitations that should be considered. How much individual change is sufficient? Recently, Mokkink *et al.*<sup>3</sup> published a consensus paper stating that research on responsiveness should be based on hypotheses testing. However, there is no literature on clinically important changes on which to base hypotheses for our three measures. This is a common problem in rehabilitation medicine.<sup>36</sup>

Underestimation of the responsiveness of the test measure could have been caused by two possible factors. First, for Goal Attainment Scaling, we evaluated responsiveness by setting a cut-off point at 0 (a score of  $<0$  versus a score of  $\geq 0$ ), because in practice professionals are generally only satisfied when goals are fully attained, and this approach is in accordance with practical studies.<sup>37,38</sup> Our decision to treat the range of ordinal data dichotomously, however, threatened the sensitivity to various changes in goal attainment and may have caused

underestimation of the responsiveness of Goal Attainment Scaling. Second, in the manuals of the PEDI and GMFM-66 change is defined using the confidence intervals. We followed this method as it is considered to be common practice. As a result of this, we used the smallest detectable change in order to approximate minimally important change, despite the fact that these are different concepts. In order to prevent overestimating responsiveness of the test measure Goal Attainment Scaling, we prioritized sensitivity using this method at the expense of the specificity of the reference measures. Although the smallest detectable change of at least 4 points on the PEDI scales and 6 on the GMFM-66 could be considered clinically important (Table 1), overestimation of the responsiveness of the reference measures could also be possible.

Another limitation of our study is due to the convenient sample for which responsiveness was studied. In the first place, 11 of the 23 children enrolled were over 7 years of age, whereas the PEDI and GMFM-66 are most sensitive to change for children below this age.<sup>22,31,39</sup> On the other hand, the added value of Goal Attainment Scaling relative to standardized measures could be even more pronounced, as the PEDI and GMFM-66 are increasingly being used for children over 7 years of age in routine rehabilitation practice. Secondly, 14 out of 23 children were classified as Gross Motor Function Classification System level I–III, whereas the GMFM-66 includes basic gross motor skills that were not important therapy goals for these children, who function at a higher level. In spite of these limitations, the strength of a convenient sample is that it reflects true clinical practice and improves the generalizability of findings.

A third limitation of the present study is the relatively small number of children participating. Although the heterogeneity of subjects characterizes common rehabilitation practice, the variable numbers of goals set in the different ICF-CY domains may limit the reproducibility of this study.

Goal Attainment Scaling, PEDI and GMFM were shown to be complementary in their responsiveness at the ICF-CY activity level. Had we used the PEDI alone, we might have missed certain goals that were actually attained, whereas by measuring only complete goal attainment with Goal Attainment Scaling, we might have missed significant change. Goal Attainment Scaling seemed to be more responsive than the PEDI in measuring individual change (Tables 4a–c).

Although change at group level was not our main focus, the possibility of measuring group effects in heterogeneous groups with non-parametric statistics is one of the advantages of Goal Attainment Scaling. We found good responsiveness for both the Goal Attainment Scaling method and the PEDI and GMFM-66 instruments, although the cause of the low responsiveness of the Goal Attainment Scaling constructed by physical therapists remains unknown.

Our findings concur with those of other authors. In the field of paediatric physical therapy, moderate and low correlations have been found between Goal Attainment Scaling and Peabody gross motor and fine motor change scores.<sup>37</sup> In the field of paediatric occupational therapy, differences between Goal Attainment Scaling and the Canadian Occupational Performance Measure (COPM), another individualized measure, have been described recently.<sup>15,40,41</sup> Several studies in the field of adult rehabilitation care in different settings and diagnostic groups have reported Goal Attainment Scaling to be useful for functional outcome measurement.<sup>4,11,13,14,20</sup> Studies in neurorehabilitation comparing Goal Attainment Scaling and the Functional Independent/Assessment Measure (UK FIM + FAM)<sup>4,13</sup> or depression and self-efficacy scales<sup>42</sup> found that over one-third of the goals set by Goal Attainment Scaling were not covered by these standardized measures.

What one measures when using Goal Attainment Scaling, a professional's expectation of a patient's future functioning or the effect of a

period of treatment, remains a challenging question. Goal Attainment Scaling depends on the patient's ability to attain the goals, and on the professional's skills to predict outcome, which requires knowledge and experience.<sup>7,12</sup> The outcome of Goal Attainment Scaling depends on the quality of scale construction, representing a potential source of measurement error that is unique to the idiosyncratic nature of Goal Attainment Scaling. While potential therapist bias poses a threat to validity, it also offers an opportunity to use the professionals' insight in measuring what one intends to measure. Although previous studies have shown that this professional judgement can be used reliably,<sup>4,7,37</sup> therapist bias has to be considered in each new application. Many recent studies on Goal Attainment Scaling have been performed with the intention of increasing its reproducibility and validity, and to standardize the method. Some studies<sup>4,20</sup> have used novel approaches to constructing SMART goals that encourage uniformity in the application of Goal Attainment Scaling.

Finally, in contrast to the standardized measures, a property of Goal Attainment Scaling at group level as well as individual level is that, by definition, the score describes the relevance of the change. Goal Attainment Scaling offers added value when the outcomes on standardized measures and Goal Attainment Scaling match, as it also indicates the relevance of the change measured. This is probably the most important added value offered by Goal Attainment Scaling.

In conclusion, Goal Attainment Scaling as an individual generic measure and the PEDI and GMFM-66 as standardized generic measures are complementary as evaluative outcome tools for children with cerebral palsy. The results show that Goal Attainment Scaling offers added value in terms of content differences and individual change over time. Using only the standardized measures will result in a substantial number of attained goals being missed, even if the relevant ICF items match the items of the standardized measures. Measuring complete goal attainment alone would result in smaller but significant

changes being missed. The value of Goal Attainment Scaling as an evaluative outcome measure, the possibility of measuring group effects in heterogeneous groups, the feasibility and satisfaction of working with Goal Attainment Scaling among patients, families and the teams of professionals, explain its increasing popularity in rehabilitation care. We therefore recommend further development and use of Goal Attainment Scaling in various rehabilitation fields.

### Clinical messages

- Goal Attainment Scaling, the Pediatric Evaluation of Disability Inventory and the 66-item version of the Gross Motor Function Measure are complementary in terms of their responsiveness for children with cerebral palsy.
- Evaluation with standardized measures alone will result in a substantial number of attained rehabilitation goals being missed in children with cerebral palsy.

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