

Discussion

Given the complex and variable nature of the movement disorders in children with cerebral palsy, we believe that consensus among a diverse group of experts is an essential step in the development of a valid classification system and subsequent use of the system in clinical practice and research. The results of the nominal group process and Delphi survey consensus methods provide evidence of the validity of the content of the Gross Motor Function Classification System. The international group of experts were unanimous in their agreement that there is a need for a classification system for children with cerebral palsy that is based on the construct of disability and functional limitation. Although the experts initially expressed some differences of opinion regarding the description for each level, the distinction between each level, and the age of children who could be classified reliably, consensus agreement was achieved for all 29 statements after two rounds of the Delphi survey.

The overall level of chance-corrected agreement ($\kappa=0.75$) supports the interrater reliability of the classification system when used to classify the gross motor function of children 2 to 12 years of age. Our goal was to develop a classification system that is quick and easy to use. Therefore, to examine reliability the therapists received no special training and were not required to perform any assessment procedures. Rather, each child's gross motor function was independently classified by two therapists who were familiar with the child's current

motor abilities. The results suggest that gross motor function can be classified accurately by occupational therapists and physical therapists who have knowledge of a child's current motor abilities.

Written comments by therapists who participated in the reliability phase of the study suggest that interrater reliability would have been higher had the therapists received formal orientation or training in the use of the classification system. Many of the questions that were raised could easily have been addressed in a single training session. These include concerns about classifying a child's motor function at a particular level if either quality of movement was poor or the therapist believed the child's function would eventually be classified at a higher level. Although the written instructions state that gross motor function should be classified based on the child's usual performance in home, school, and community settings, some therapists expressed uncertainty about whether to classify on the basis of what the child can do at their best versus what the child ordinarily does. One therapist provided a written description of a child's motor abilities that clearly represented Level V yet classified the child's motor function as Level IV. Comments by other therapists also suggested that there was some reluctance to classify a child in the most severe category.

We have attempted to address all these concerns in the Introduction and User Instructions guide that is distributed with the Classification System. Nevertheless, to avoid errors attributable to incorrect interpretation of the guidelines, we recommend that users establish interrater reliability before using the classification system for research. We also recommend that professionals who work together classify the gross motor function of several children from their caseloads independently and discuss the results before using the classification system in clinical practice.

Although the consensus of the experts was that the classification system can be used to classify accurately the gross motor function of children between 1 and 2 years of age, comments made by some of the experts suggested that this may be difficult. Interrater reliability, therefore, was examined separately for children under the age of 2 years. The overall level of chance-corrected agreement ($\kappa=0.55$) supports the contention that the distinctions among the five levels are not as

Table III: Chance-corrected interrater agreement (κ) for each level of classification, by age of patients

Level	Younger age group (<2 y)		Older age group (2-12 y)	
	P	κ	P	κ
I	0.216	0.841	0.188	0.590
II	0.270	0.589	0.138	0.473
III	0.189	0.471	0.163	0.908
IV	0.203	0.415	0.288	0.817
V	0.122	0.122	0.225	0.857

P is the proportion of the total number of classifications made in each level.

Table IV: Category association statistics for each level of classification, by age of patients

Level chosen by any observer	Probability that second observer will choose same level				
	I	II	III	IV	V
<i>Younger age group (<2 y)</i>					
I	0.88	0.13	0.00	0.00	0.00
II	0.10	0.70	0.15	0.05	0.00
III	0.00	0.21	0.57	0.14	0.07
IV	0.00	0.07	0.13	0.53	0.27
V	0.00	0.00	0.11	0.44	0.44
<i>Older age group (2-12 y)</i>					
I	0.67	0.33	0.00	0.00	0.00
II	0.45	0.55	0.00	0.00	0.00
III	0.00	0.00	0.92	0.08	0.00
IV	0.00	0.00	0.04	0.87	0.09
V	0.00	0.00	0.00	0.11	0.89

pronounced for children under 2 years of age. Despite the experts' concerns that the distinction between Levels I and II and between Levels III and IV would be difficult, the therapists who participated in the reliability phase of the study had the most disagreements between Levels IV and V. Until the reliability and validity of the classification system are examined further, caution should be exercised when classifying the gross motor function of children under 2 years of age.

Level I represents the continuum of children with neuro-motor impairments whose functional limitations are less than what is often associated with cerebral palsy, and children who have traditionally been diagnosed as having 'minimal brain dysfunction' or 'cerebral palsy of minimal severity'. The construct for Level I is consistent with the findings of Coolman and associates (1985), who reported that some children born preterm demonstrate a pattern of persistent neuromotor abnormalities that are not as severe as those associated with cerebral palsy. We anticipated that the distinction between Levels I and II would be the most difficult when classifying the motor function of children under 2 years of age, as differences in mobility are not pronounced. For the therapists who participated in the reliability phase of the study, however, disagreements between Levels I and II were more frequent when classifying the motor function of children 2 to 12 years of age. This suggests that the therapists had difficulty deciding whether a child had functional limitations in the ability to walk outdoors and climb stairs and whether a child can perform gross motor skills such as running and jumping.

The therapists and pediatricians who participated in the nominal group process and Delphi survey consensus methods indicated that a classification system for children with cerebral palsy has applications for clinical practice, research, teaching, and administration. Participants in the nominal group process suggested that a classification system would help professionals to present information on a child's current functional abilities and assist families and professionals in planning for a child's needs, including the recommended use of assistive technology. Participants also indicated that a classification system would be helpful in considering whether a child would benefit from specific treatments, including surgical interventions, and in providing consistency in terminology in the dissemination of the results of treatment outcome research. Recommended administrative applications of a classification system included the ability to distribute the case-loads and to determine the resources needed for particular case-loads.

An interesting philosophical issue has been raised concerning the use of numerical designations for the five levels of the classification system, rather than verbal descriptors such as 'mild', 'moderate', and 'severe'. We concluded that on balance the use of numbers to distinguish levels carried less implied value than for example the terms just mentioned. We assume that clinicians counseling parents about a child's functional classification, in this or any other system, will always spend time interpreting the meaning of each level, whether it be a number or a descriptive term. Furthermore, it might be argued that words like 'severe' potentially carry far more emotional impact than a numerical designation, offered with an explanation of the prognostic and clinical implications for that child.

Further research is aimed at examining the validity and applications of the Gross Motor Function Classification

System. The system is being used as the major stratification variable in a prospective longitudinal study of the development of gross motor function in children with cerebral palsy, designed to create motor growth curves of the motor progress of a randomly selected cohort of children across Ontario. We are also undertaking a masked retrospective chart review of adolescents with cerebral palsy, followed prospectively from infancy, to assess how well children track in the same classification level, and at what age their classification is predictive of motor function status at age 12. Work is under way to assess the validity of a brief structured interview with a parent, using algorithms that appear on pilot testing to have utility as a simple means of classifying children's gross motor function. If the system proves as useful as we believe it to be, clinicians may for the first time have objective data to address the two major questions asked by every parent of a child with cerebral palsy: 'How bad is it?' and 'What is the outlook for my child?'

Appendix A:

PANEL MEMBERS FOR THE DELPHI SURVEY

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Appendix B:

GROSS MOTOR FUNCTION CLASSIFICATION SYSTEM

Introduction and User Instructions

The Gross Motor Function Classification System for Cerebral Palsy is based on self-initiated movement with particular emphasis on sitting (truncal control) and walking. When defining on a 5 level Classification System, our primary criterion was that the distinctions in motor function between levels must be clinically meaningful. Distinctions between levels of motor function are based on functional limitations, the need for assistive technology including mobility devices (such as walkers, crutches, and canes) and wheeled mobility, and to a much lesser extent quality of movement. Level I includes children with neuromotor impairments whose functional limitations are less than what is typically associated with cerebral palsy and children who have traditionally been diagnosed as having "minimal brain dysfunction" or "cerebral palsy of minimal severity". The distinctions between Levels I and II, therefore, are not as pronounced as the distinctions between the other Levels, particularly for infants less than 2 years of age.

The focus is on determining what level best represents the child's present abilities and limitations in motor function. Emphasis is on the child's usual performance in home, school, and community settings. It is therefore important to classify on ordinary performance (not best capacity), and not to include judgements about prognosis. Remember the purpose is to classify a child's present gross motor function, not to judge quality of movement or potential for improvement!

The descriptions of the 5 levels are broad and are not intended to describe the function of individual children. For example, an infant with hemiplegia who is unable to crawl on hands and knees but otherwise fits the description of Level I, would be classified in Level I. The scale is ordinal, with no intent that the distance between levels be considered equal or that children with cerebral palsy are equally distributed among the 5 levels. A summary of the distinctions between each pair of levels is provided to assist in determining the level that most closely resembles a child's current gross motor function.

The title for each level represents the highest level of mobility that a child will achieve between 6-12 years of age. We recognize that classification of motor function is dependent on age, especially during infancy and early childhood. For each level, therefore, separate descriptions are provided for children in several age bands. The functional abilities and limita-

tions for each age interval are intended to serve as guidelines, are not comprehensive, and are not norms. Children below age 2 should be considered at their correct age.

An effort has been made to emphasize children's function rather than their limitations. Thus as a general principle, the gross motor function of children who are able to perform the functions described in any particular level will probably be classified at or above that level; in contrast, the gross motor function of children who cannot perform the functions of a particular level will likely be classified below that level.

Gross Motor Function Classification System

LEVEL I - Walks without restrictions; limitations in more advanced gross motor skills.

Before 2nd birthday: Infants move in and out of sitting and floor sit with both hands free to manipulate objects. Infants crawl on hands and knees, pull to stand and take steps holding onto furniture. Infants walk between 18 months and 2 years of age without the need for any assistive mobility device.

From age 2 to 4th birthday: Children floor sit with both hands free to manipulate objects. Movements in and out of floor sitting and standing are performed without adult assistance. Children walk as the preferred method of mobility without the need for any assistive mobility device.

From age 4 to 6th birthday: Children get into and out of, and sit in, a chair without the need for hand support. Children move from the floor and from chair sitting to standing without the need for objects for support. Children walk indoors and outdoors, and climb stairs. Emerging ability to run and jump.

From age 6 to 12: Children walk indoors and outdoors, and climb stairs without limitations. Children perform gross motor skills including running and jumping but speed, balance, and coordination are reduced.

LEVEL II - Walks without assistive devices; limitations walking outdoors and in the community.

Before 2nd birthday: Infants maintain floor sitting but may need to use their hands for support to maintain balance. Infants creep on their stomach or crawl on hands and knees. Infants may pull to stand and take steps holding onto furniture.

From age 2 to 4th birthday: Children floor sit but may have difficulty with balance when both hands are free to manipulate objects. Movements in and out of sitting are performed without adult assistance. Children pull to stand on a stable surface. Children crawl on hands and knees with a reciprocal pattern, cruise holding onto furniture and walk using an assistive mobility device as preferred methods of mobility.

From age 4 to 6th birthday: Children sit in a chair with both hands free to manipulate objects. Children move from the floor to standing and from chair sitting to standing but often require a stable surface to push or pull up on with their arms. Children walk without the need for any assistive mobility device indoors and for short distances on level surfaces outdoors. Children climb stairs holding onto a railing but are unable to run or jump.

From age 6 to 12: Children walk indoors and outdoors, and climb stairs holding onto a railing but experience limitations walking on uneven surfaces and inclines, and walking in crowds or confined spaces. Children have at best only minimal ability to perform gross motor skills such as running and jumping.

Distinctions between Levels I and II:

Compared with children in Level I, children in Level II have limitations in the ease of performing movement transitions; walking outdoors and in the community; the need for assistive mobility devices when beginning to walk; quality of movement; and the ability to perform gross motor skills such as running and jumping.

LEVEL III – Walks with assistive mobility devices; limitations walking outdoors and in the community.

Before 2nd birthday: Infants maintain floor sitting when the low back is supported. Infants roll and creep forward on their stomachs.

From age 2 to 4th birthday: Children maintain floor sitting often by 'W-sitting' (sitting between flexed and internally rotated hips and knees) and may require adult assistance to assume sitting. Children creep on their stomach or crawl on hands and knees (often without reciprocal leg movements) as their primary methods of self-mobility. Children may pull to stand on a stable surface and cruise short distances. Children may walk short distances indoors using an assistive mobility device and adult assistance for steering and turning.

From age 4 to 6th birthday: Children sit on a regular chair but may require pelvic or trunk support to maximize hand function. Children move in and out of chair sitting using a stable surface to push on or pull up with their arms. Children walk with an assistive mobility device on level surfaces and climb stairs with assistance from an adult. Children frequently are transported when travelling for long distances or outdoors on uneven terrain.

From age 6 to 12: Children walk indoors or outdoors on a level surface with an assistive mobility device. Children may climb stairs holding onto a railing. Depending on upper limb function, children propel a wheelchair manually or are transported when travelling for long distances or outdoors on uneven terrain.

Distinctions between Levels II and III:

Differences are seen in the degree of achievement of functional mobility. Children in Level III need assistive mobility devices and frequently orthoses to walk, while children in Level II do not require assistive mobility devices after age 4.

LEVEL IV – Self-mobility with limitations; children are transported or use power mobility outdoors and in the community.

Before 2nd birthday: Infants have head control but trunk support is required for floor sitting. Infants can roll to supine and may roll to prone.

From age 2 to 4th birthday: Children floor sit when placed, but are unable to maintain alignment and balance without use of their hands for support. Children frequently require adaptive equipment for sitting and standing. Self-mobility for short distances (within a room) is achieved through rolling, creeping on stomach, or crawling on hands and knees without reciprocal leg movement.

From age 4 to 6th birthday: Children sit on a chair but need adaptive seating for trunk control and to maximize hand function. Children move in and out of chair sitting with assistance from an adult or a stable surface to push or pull up on with their arms. Children may at best walk short distances with a walker and adult supervision but have difficulty turning and

maintaining balance on uneven surfaces. Children are transported in the community. Children may achieve self-mobility using a power wheelchair.

From age 6 to 12: Children may maintain levels of function achieved before age 6 or rely more on wheeled mobility at home, school, and in the community. Children may achieve self-mobility using a power wheelchair.

Distinctions Between Levels III and IV:

Differences in sitting ability and mobility exist, even allowing for extensive use of assistive technology. Children in Level III sit independently, have independent floor mobility, and walk with assistive mobility devices. Children in Level IV function in sitting (usually supported) but independent mobility is very limited. Children in Level IV are more likely to be transported or use power mobility.

LEVEL V – Self-mobility is severely limited even with the use of assistive technology.

Before 2nd birthday: Physical impairments limit voluntary control of movement. Infants are unable to maintain antigravity head and trunk postures in prone and sitting. Infants require adult assistance to roll.

From age 2 to 12: Physical impairments restrict voluntary control of movement and the ability to maintain antigravity head and trunk postures. All areas of motor function are limited. Functional limitations in sitting and standing are not fully compensated for through the use of adaptive equipment and assistive technology. At Level V, children have no means of independent mobility and are transported. Some children achieve self-mobility using a power wheelchair with extensive adaptations.

Distinctions Between Levels IV and V:

Children in Level V lack independence even in basic antigravity postural control. Self-mobility is achieved only if the child can learn how to operate an electrically powered wheelchair.

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