Original Article

Cerebral Palsy: Motor Types, Gross Motor Function and Associated Disorders

Farin Soleimani, MD,
Pediatric Neurorehabilitation Research Center,
University of Social Welfare and Rehabilitation Sciences, Tehran, Iran

Roshanak Vameghi, MD, MPH
Pediatric Neurorehabilitation Research Center, Clinical Science Department,
University of Social Welfare and Rehabilitation Sciences, Tehran, Iran

Mehdi Rassafiani*, PhD
Pediatric Neurorehabilitation Research Center, Occupational Therapy Department
University of Social Welfare and Rehabilitation Sciences, Tehran, Iran

Nazila Akbar Fahimi, PhD; Zahra Nobakht, MSc
University of Social Welfare and Rehabilitation Sciences, Tehran, Iran

Objectives: Cerebral palsy (CP) describes a group of disorders in the development of movement and posture in the developing brain. The main aim of this study was to determine the distribution of motor impairment and associated disorders in a population of children with CP.

Method: This study was carried out in 2011 during three months, on 200 CP children. Multiple sources of ascertainment were used, including medical records of patients who access at the major rehabilitation and special educational centers in Tehran and examination by rehabilitation team. Children were grouped according to motor type, topographic pattern according to the Surveillance of Cerebral Palsy in Europe (SCPE) definitions and classifications, Manual Ability Classification System (MACS) and Gross Motor Function Classification System (GMFCS) scales. In this study we evaluate impairments such as seizure disorders, hearing and visual problems, and cognitive issues.

Results: During the study period, 200 CP child (103 males, 97 females) aged 4-12 years were seen, with a mean (SD) age of 7.7(2.4) years. In this study spastic CP was the most common type (80.5%) and more specifically, bilateral CP (62.5%) was more common than unilateral (18%). With respect to the MACS classification, level IV (23%), and to the GMFCS classification also level IV (30.5%) was the most common.

Conclusion: Bilateral spastic CP was the most frequent type that had the worst motor problem, and difficult treatment, so it seems that the health care system should pay more attention to perinatal insults for prevention of CP in our population.

Key words: Cerebral palsy, Associated disorder, Child, MACS/GMFCS/SCPE

Introduction

Cerebral palsy (CP) describes a group of disorders in the development of movement and posture, causing activity limitation which is attributed to non-progressive disturbances that occur in the developing fetal or infant brain. The motor disorders of CP are often accompanied by disturbances of sensation, cognition, communication, perception, and/or behavior, and/or by a seizure disorder (1).

CP is the most common cause of physical disability affecting children in most developed countries, with a prevalence of approximately 2 per 1000 live births (2). Although these clinical syndromes are often not pure, recognition of the dominant motor types and topography has been important for research into causal pathways and possible prevention, correlation with brain imaging, and for establishing a prognosis and setting management goals and strategies. It may also trigger a search for associated problems such as epilepsy, cognitive and communication difficulties, which may significantly impact on the well-being and development of these children (3-4). Traditionally, CP has been classified according to motor type, topographical distribution and functional

*All correspondences to: E-mail: m.rassafiani@yahoo.com

severity (2-3) but as yet there has been no consensus reached on either the descriptors or the definitions of motor type and topographical distribution.
The motor type is usually described as spastic, dyskinetic, ataxic, hypotonic or mixed. Currently in the USA, under the auspices of the National Institutes for Health, a taskforce on childhood motor disorders is working on the important issue of motor type classifications and some helpful guidelines have been published (5-7). The Surveillance of CP in Europe (SCPE) has also gone through a consensus process to develop standard definitions and classifications of topography and motor type. However, although classical presentations are easily recognized, there are many children with mixed or changing motor types that are difficult to define (2-8).
Classifications according to topographical distribution are widely employed. Although hemiplegia, diplegia and quadriplegia are commonly used terms, monoplegia and triplegia sometimes exist as separate entities or may be grouped with hemiplegia and quadriplegia, respectively (2). Not surprisingly, classifications based on motor type and topographical distribution has poor reliability, even when observers are experienced and undergo special training (2-8).
The most useful development in the classification of CP in recent years has been the development of the Gross Motor Function Classification System (GMFCS) (9). The GMFCS is a five-level ordinal grading system based on the assessment of self-initiated movement with emphasis on function during sitting, standing and walking. Unlike the classification of motor type and topography, the GMFCS has been shown to be a valid, reliable, stable and clinically relevant method for the classification and prediction of motor function in children with CP between the ages of 2 and 12 years (9-10).
Of the many types and subtypes of CP, none have a known cure. Usually, medical intervention is limited to the treatment and prevention of complications arising from CP's effects. A 2003 study put the economic cost for people with CP in the US at $921,000 per individual, including lost income (19).
In another study, the incidence in six countries surveyed was 2.12–2.45 per 1,000 live births, (20) indicating a slight rise in recent years. Improvements in neonatology, or the medical specialty which is involved with treatment of neonates, have helped reduce the number of babies who develop cerebral palsy, but the survival of with very low birth weight neonates has increased, and these babies are more likely to have cerebral palsy (21-22).
Perinatal insults are common causes of cerebral palsy in Iranian children. Childhood long–term morbidities and handicaps such as CP are the main factors of years of life lost (YLL) in Iran. According to the WHO report 2006 , in Iran " perinatal factors " cause 10 years of life lost, which is the third most common cause for lost years in the country (after ischemic heart disease and road traffic accidents) (23).
Descriptions of the frequency of CP subtypes in the population may yield clues regarding etiology, and studies of functioning can help clinicians and other service providers develop more coordinated, more holistic care. The determination of the spectrum of functional limitation that characterizes the group of children with CP is essential to enable planning for resource allocation and to facilitate studies relating to etiology, prevention or prognosis (2).
The main aim of this study was to determine the distribution of motor impairment and associated disorders in a population of children with CP with respect to the motor type, topographic distribution, hand abilities and gross motor function according to the SCPE definitions and classifications, manual ability classification system (MACS) and GMFCS.

Materials and Methods

This study was carried out in 2011 during 3 months, on 200 CP children of 4-12 year old. In order to detect demographic characteristics, a questionnaire was completed for each child, including the child, parents, care givers, and child health- medical status, with the aid of parents and the child's records. This questionnaire includes the child and parents' age, sex, job, level of education, siblings, family income, hometown, insurance, duration and the start age of rehabilitation program. In addition, associated problems were collected and information on MACS and GMFCS were obtained by occupational therapists with direct examination and parent reports in any of the children. The questionnaire evaluated for content validity and pilot studies had been carried out.

Definition of CP

CP is an umbrella term covering a group of non-progressive but often changing motor impairment syndromes secondary to lesions or anomalies of the brain, occurring at any time during brain development (24).
Patients with CP may also have other neurodevelopmental impairments that can affect

adaptive functioning, sensory function, learning, communication, and behavior, as well as may cause seizures. Abnormal motor control may be further impaired by features that are associated with CP. Resulting limits in movement and posture cause activity limitation and are often accompanied by disturbances of sensation, deep perception and other sight-based perceptual problems, communication ability, and cognition problems and epilepsy is also found in 1/3 of cases.

Cerebral palsy is divided into four major classifications to describe different movement impairments. These classifications also reflect the areas of the brain that are damaged. The four major classifications are: spastic, ataxic, athethoid/dyskinetic and mixed. Secondary conditions can include seizures, epilepsy, speech and language or other communication disorders, sensory impairments, mental retardation, learning disabilities, urinary or , fecal incontinence and/or behavioral disorders.

Participants

The study was performed on children with CP at different rehabilitation centers in Tehran between January 2011 and April 2011.

Ascertainment of cases was based on a standard definition of CP (25). Multiple sources of ascertainment were used, including records of patients who access a variety of services at the main pediatric rehabilitation and special education centers in Tehran. The rehabilitation centers were in different parts of Tehran including: 3 centers in south, 3 in down town and 2 in north of Tehran (five non-governmental, one public, and two charities) and three schools for children with special needs (1 in south and 2 in west) were sources to identify children with developmental disabilities. The inclusion criteria were having been diagnosed with "CP" by a specialist, being in the age range of 4–12 years, and having accepted participation in the study. Informed consent was obtained from the families after they were informed about the study. All children evaluated by a CP clinician that were 3 senior occupational therapists with an advanced degree, and good clinical experience, and specially trained in the assessment of children with CP. In the absence of excluding conditions such as progressive disorders and neuromuscular diseases, children were confirmed as CP cases.

Instruments

CP subtype was determined on the basis of the classification system developed by the Surveillance of Cerebral Palsy in Europe Collaborative Group (2).

Children were grouped according to motor type, topographic pattern, MACS and GMFCS levels. Motor types were classified as spastic, dyskinetic, mixed, ataxic and hypotonic, as defined in Appendix 1(5-7). Spastic patterns were further classified according to topographical distribution as unilateral involvement (hemiplegic), bilateral involvement (diplegia with the lower limbs more affected than the upper limbs and quadriplegia (with the upper limbs more or equally involved).

The gross motor function of all patients was classified according to the GMFCS for CP by the senior occupational therapists. In this standardized and validated scale, the severity of motor impairment of children with CP is classified by age into five levels. It is based on self-initiated movement, with particular emphasis on sitting and walking. Distinctions between the five levels of motor function are made on functional limitations and the need for assistive devices. Thus, children classified as level I have the most independent motor function, while children at level V have the least (26). The GMFCS levels of the children were determined by the same occupational therapists by means of observation and evaluation of the mobility of the children.

MACS provide a systematic basis to classify how children with CP use their hands when handling objects in daily activities. The MACS is based on self-initiated manual ability, with particular emphasis on handling objects in an individual's personal space (the space immediately close to one's body, as distinct from objects that are not within access). As a general principle, if a child's manual ability fits within a particular level, the child will probably be classified either at or above that level. Children who do not perform the functions of a particular level will almost certainly be classified below that level. Level I includes children with CP with, at most, minor limitations compared to typically developing children, and where the limitations, if any, barely influence their performance of daily life tasks. In the MACS, five levels are described. Distinctions between each pair of levels are also provided to assist in determining the level that most closely resembles a child's manual abilities. The scale is ordinal, with no intent that the distances between levels should be considered equal, or that children with CP are equally distributed across the five levels (27). The MACS levels of the children

were determined by means of observation and parents reports.
The GMFCS and the MACS levels were classified by the same occupational therapist according to the available manuals for the GMFCS and MACS (Appendix 2) (26, 27).

Associated impairments
In many individuals with CP, other impairments interfere with the ability to function in daily life and may at times produce even greater activity limitation than the motor impairments that are the hallmark of CP. In this study we evaluate impairments such as seizure disorders, hearing and visual problems, and cognitive issues. These impairments were classified as present or absent; if present, the extent to which they interfere with the individual's ability to function or participate in desired activities and roles were described. The presence or absence of epilepsy (defined as two or more afebrile, non-neonatal seizures) was recorded.
The estimated cognitive levels (IQ) of the children were determined using a form which was filled in by the families. The form was taken from the impairment form in the SPARCLE project. The learning disability was defined as mild in children with an IQ level of 50 to 70 and severe if the IQ level was less than 50 (28). The details of the form are given in Appendix 3. Characteristics and co-morbidity conditions, such as hearing loss, vision loss, speech disorders, and seizures, were obtained from the parents' reports and medical records.
The collected data was verified and entered into a standard database file and analyzed using the statistical package for social sciences. SPSS 16.0 was used for the statistical analysis.

Results
During the study period, 200 CP children (103 males, 97 females) aged 4-12 years were seen with an overall male: female ratio of 1.06, with a mean (SD) age of 7.7(2.4) years. The demographic characteristics of primary caregivers and children are shown in table 1. Characteristics and co-morbidity conditions, such as hearing loss, vision loss, speech disorders, and seizures are presented in Table 2, and table 3 shows the frequency and percentage of associated disorders of cerebral palsy in this study. The distribution of motor types and topographical distribution within each GMFCS and MACS level and each type are shown in Table 4 & 5.
One hundred- twenty five children (62.5%) with a mean age of 7.6 years were bilateral spastic CP, and 36 (18%) children with a mean age of 7.9 years were unilateral spastic CP, 10 children (5%) with a mean age of 7.6 years were ataxic, and 14 children (7%) with a mean age of 8 years were dyskinetic. About mean age no difference was found among the CP types.
Level IV in MACS classification (23%) and also Level IV in GMFCS classification (30.5%) were the more commons. The remaining cases were distributed rather equally to other levels, near to (19-20%) to the MACS classification and (11-24.5%) to the GMFCS classification per level.

Discussion
In this study spastic CP was the most common (80.5%) and more specifically, bilateral CP (62.5%) was more common than unilateral (18%).The other groups with hypertonia (dyskinetic) accounted for 7% of cases while the remaining motor types (ataxic) represented 5% of the cases. Level IV of Both MACS and GMFCS were more common, 23% and 30.5% respectively.
The information available for providing an adequate classification of the features of CP in any individual will vary over the age span and across geographic regions and settings. The role of aging in changing the clinical phenomenology of CP has been little studied, and the possibility of classification changes over time cannot be completely dismissed. Defining the presence or degree of associated impairments, such as cognitive deficits, is age-dependent, and in infants the type of motor disorder may be hard to explain. Some young children diagnosed as CP may in fact have very slowly progressive disorders that have not yet been clearly identified.
Classification often requires making difficult decisions about where to draw the boundaries within ordinal or quantitative measures. Some degree of arbitrariness is inevitable. Assignment of individuals with the diagnosis of CP to distinct clinical groups is not straightforward and will differ depending on the characteristic(s) chosen as the basis for classification. No one single approach has emerged as definitive; depending on the purpose of the classification, certain characteristics or combinations of characteristics may be more useful than others. For example, in assessing the effectiveness of a new treatment for a specific type of tone abnormality, the nature of the motor disorder and the level of functional motor ability are likely to be paramount,

whereas determining service delivery needs will require the consideration of associated impairments.

No classification system is useful unless it is reliable. It is, therefore, not enough to specify the characteristics to be used in classification; they must be operationally defined so that, in general, competent examiners will classify the same individual in the same way given identical information. However, providing such definitions is beyond the scope of this document. For example, the term spastic diplegia is problematic for classification because its existing definitions are variable and imprecise, and because we lack evidence that the term can be used reliably. Some use the term to describe children with spastic CP whose only motor deficit is in the legs, whereas others include children who have arm involvement of lesser severity than leg involvement. However, determining the relative severity of arm and leg involvement can be challenging because they perform very different functions. By examining CP subtypes, we can gain information that may improve our understanding of possible causes, because certain types of CP may be associated with recognized risk factors. For example, spastic diplegia is reported to occur more often in low birth weight (29). Therefore, examination of changes in the distribution of subtypes may yield clues to contextual factors that may affect the risk of CP.

Similar to previous prevalence reports,(30-34,16) most children in this study had spastic CP (80.5%), with bilateral being more common than unilateral spastic CP. The proportions of children with ataxic CP (5%), and dyskinetic CP (7%) were low, other reports of the proportions of dyskinetic and ataxic CP ranged from 1% to 7% of all cases (33-36).

Few researches have performed relevant studies about the type, associated disorders and functional level of CP in Iran. In one study in a rehabilitation center in Tehran on 112 cases, the frequency of different types of CP were spastic [hemiplegic (36.6%), diplegia (31.3%), quadriplegia (12.5%)], atonic & hypotonic (12.5%), dyskinetic (4.5%), and mixed (1.8%) (39).

In another study on 200 cases the frequency of different types of CP were spastic diplegia (39.5%), mixed (28%), spastic quadriplegia (22%), atonic (4.5%), dyskinetic (4%), and hemiplegic (2%) (40).

Differences in the prevalence of subtypes may result from definition issues or ascertainment methods. Further classifications of the spastic subtype according to limb involvement (i.e., hemiplegia, quadriplegia, diplegia, triplegia, or monoplegia) have raised the issues of reliability. However, other CP investigators also found that the distinction between spastic diplegia and spastic quadriplegia is particularly difficult (37-38). Greater confidence was expressed and more consistent estimates were found when cases of spastic CP were classified as either unilateral or bilateral, as proposed by the Collaboration for Surveillance of CP in Europe, (37) than when the limb involvement method was used.

The widespread adoption of the definition of CP proposed by Bax in 1964 has resulted in the grouping together of large numbers of children with a wide variety of movement disorders, topographical distributions and functional abilities under the 'cerebral palsy umbrella' (3,45). The marked variation in functional abilities of children sharing the common diagnosis of CP has led to repeated efforts to classify children into meaningful clinical syndromes. In terms of motor type and topographical distribution, these efforts have had limited success, and this makes it difficult to make meaningful time and geographical comparisons. (2-3, 8-9) By contrast, the use of the GMFCS now facilitates a reliable means of classification of the severity of the motor disorder. The distribution of children throughout all GMFCS levels confirms the wide range of function and disability in a typical population sample of children with CP. GMFCS level I children are completely independent, they do not use aids, and usually have mild spastic hemiplegia. By contrast, children in GMFCS level V have no independent mobility and often have severe spastic dyskinesia in a quadriplegic distribution. It is of note also, that children with spastic hemiplegia will usually be in levels I and II, and those with quadriplegia will be in levels III, IV and V.

In this study, within the spastic group, differences in motor function among the two topography groups were extremely clear-cut. Compared to children with unilateral distribution, children with bilateral were more severe on the GMFCS and MACS scales. Children with bilateral spastic had the lowest levels of function, being significantly higher on the GMFCS and MACS scales than those with unilateral. In comparison with the total group with spasticity, children with ataxia appeared to have higher levels of function on the GMFCS and MACS scales, but the numbers of children in this group were too small for a conclusive finding. Children classified as having a mixed type of motor disorder were significantly more severe on the GMFCS and

MACS scales than children with ataxia.

The SCPE reported the following incidence of comorbidities in children with CP (the data are from 1980–1990 and included over 4,500 children over age 4 whose CP was acquired during the prenatal or neonatal period): mental disadvantage (IQ < 50): 31%, active seizures: 21%, mental disadvantage (IQ < 50) and unable to walking: 20%, and blindness: 11% (41).

The SCPE noted that the incidence of comorbidities is difficult to measure accurately, particularly across centers. For example, the actual rate of an intellectual impairment may be difficult to determine, as the physical and communicational limitations of people with CP would likely lower their scores on an IQ test if they were not given a correctly modified version.

Speech and language disorders are common in people with cerebral palsy. The incidence of dysarthria is estimated to range from 31% to 88%. Speech problems are associated with poor respiratory control, laryngeal and velopharyngeal dysfunction as well as oral articulation disorders that are due to restricted movement in the oral-facial muscles. In this study speech problems were 47 % which was near to recent study in Iran (41%) (40).

Concurrent seizure with CP in different reports is between 25-33% and in this study was 17%.

This report of population characteristics of children with CP, co-morbid disabilities and evaluation of gross motor and hand functioning by using the GMFCS and MACS at eight rehabilitation centers and two special schools makes an important step forward in expanding our understanding of CP in the Tehran. Future analyses will examine the characteristics of children with CP in other cities in Iran. We need additional research using consistent, population-based methods over time and in more communities to provide a more comprehensive picture of CP among children in the Iran.

The goal of the classifications in the assessment of children with CP is to assist in the communication between clinicians, select homogeneous groups of children for clinical research trials, facilitate the development of rating scales to assess improvement or deterioration with time, and, eventually, to better match each individual patient with specific therapies (49). In our opinion, this paper may provide pediatricians and rehabilitation teams an introduction in how far the classification of CP has come. It may be important to try to make it more relevant to health professionals and expand why the use of the instruments improves the ability to care for children with CP.

Conclusion

In this study the most frequent type of CP was bilateral spastic that had the worst motor status, and difficult treatment, so it seems that the health care system should pay more attention to perinatal insults for prevention of CP in our population.

Significant number of children with CP (59%) had IQ>70 or educable, therefore through early diagnosis and detection of those with normal IQ and use of specialized educational programs (with special attention to their functional disabilities), they can a normal life like others and enjoy themselves.

In conclusion, the term ‘cerebral palsy’, despite all its shortcomings, is worth retaining, although it might be better to use the term ‘cerebral palsies’ to describe a CP phenotype that encompasses the enormous variability in motor type, topography and gross motor function. We think that the best way of classifying children with CP is a combination of motor type, topography and gross motor function, according to the GMFCS and MACS scales.

Acknowledgements

We would like to thank Pediatric Neurorehabilitation Research Center and University of Social Welfare and Rehabilitation Sciences (USWRS) for financial supports and children, parents, care givers, rehabilitation centers and special schools as well for their active participation in this study.

Appendix 1

Definitions of motor types

Spasticity	Hypertonia in which resistance to externally imposed movement increases with increasing speed and varies with direction of movement and/or rises rapidly above a threshold speed.
Dyskinesia	Involuntary, sustained or intermittent muscle contractions causing twisting and repetitive movements, abnormal postures or both.
Mixed motor types	Clinical features of more than one type, usually spastic and dyskinetic.
Ataxia	Abnormal pattern of posture and/or movement with loss of orderly muscle coordination so that movements are performed with abnormal force, rhythm or accuracy.

Hypotonia	Abnormally low tone, in the trunk and limbs that must be distinguished from weakness.

Appendix 2

Summary of the criteria for the GMFCS and MACS

GMFCS	**MACS**
Level I	
Walks without restrictions, limitations in more advanced gross motor skills	Handles objects easily and successfully
Level II	
Walks without restrictions, limitations walking outdoors and in the community	Handles most objects but with somewhat reduced quality and/or speed of achievement
Level III	
Walks with assistive mobility devices, limitations walking outdoors and in community	Handles objects with difficulty, needs help to prepare and/or modify activities
Level IV	
Self mobility with limitations, children are transported or use power mobility outdoors and in the community	Handles a limited selection of easily managed objects in adapted situations
Level V	
Self mobility is severely limited, even with use of assistive technology	Does not handle objects and has very limited ability to perform even simple actions

This table was taken from Carnahan KD, Arner M, Hägglund G (2007) 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 8:50

Appendix 3

Estimated cognitive level of children with CP

For the cognitive level, you can ask the parents some questions and report "*estimated cognitive level*":

Cognitive description/IQ

Has your child had an assessment of IQ in the last year or so?

If yes, what was the result?

.....

1. Do you think your child learns as well as other children of a similar age?.....*Yes/No*
2. Does your child play with and be friends with children of a similar age?.....*Yes/No*

If the answer is Yes to Questions 1 and 2, the IQ is probably >70. If not, consider the following questions:

3. Does you child have severe difficulty with learning in all aspects of development? ..... *Yes/No*
4. Is your child's ability to read and understand ideas like that of a much younger child, such as one more than half of their age? ..... *Yes/No*

If the answer is Yes to Questions 3 and 4, IQ is probably <50.

Otherwise the child probably falls into IQ 50–70, but this should be confirmed by expecting the answer Yes to the questions below:

5. Do you think that your child needs much more help than other children to learn things like reading and understanding ideas?..... *Yes/No*
6. Does your child find it easier to make friends and play with younger children?..... *Yes/No*

Table 1. Demographics of Primary Caregivers and Children Participating in the Study.

Demographics	**Response Categories**		**Frequency (%)**
Gender	Male		103 (48.5)
	Female		97 (51.5)
	Preschool	4-6 Years	55
		6-8Years	41
		8-10 Years	17
		10-12 Years	11

Demographics	Response Categories		Frequency (%)
Child's Education		**Total**	**124 (62)**
	Elementary School	4-6 Years	-
		6-8Years	12
		8-10 Years	34
		10-12 Years	24
		Total	**70 (35)**
	Middle School	4-6 Years	-
		6-8Years	-
		8-10 Years	-
		10-12 Years	6
		Total	**6 (3)**
Type of School	Ordinary School		45 (22.5)
	Special School		57 (28.5)
	Not Going		98 (49)
Living place of family	North		15 (7.5)
	Center		20 (10)
	East		28 (14)
	West		30 (15)
	South		92 (46)
	Margin		13 6.5)
	Missing		2 (1)
Mother's Education	Completed primary School		70 (35)
	Completed high School		84 (42)
	Over diploma & BS		42 (21)
	MS & higher		2 (1)
	Missing		2 (1)
Father's Education	Completed primary School		71 (35.5)
	Completed high School		67 (33.5)
	Over diploma & BS		46 (23)
	MS & higher		13 (6.5)
	Missing		3 (1.5)

Table 2. Characteristics and accompanying co-morbidity conditions of children with cerebral palsy (CP)

Characteristic	Value
Ages (years), median (range)	7 (4–15)
Types of cerebral palsy *N* (%)	
Unilateral Spastic	36 (18)
Bilateral Spastic	125 (62.5)
Ataxic	10 (5)
Dyskinetic	14(7)
Unclassified(mixed)	15(7.5)
Co-morbidity conditions *N* (%)	
Hearing problems	15 (7.5)
Vision problems	80 (40)
Speech disorders	94 (47)
Seizures, epilepsy	34 (17)

Table 3. The frequency and percentage of associated disorders in 200 children with cerebral palsy in Tehran

Associated Disorders			Frequency (N)	Percent (%)
Estimated Cognitive Level	<50		36	18
	70-50		46	23
	>70		118	59
Visual Problems	Having	with functional limitation	40	20
		without functional limitation	40	20
	Not having		114	57
	Not Response		6	3
Hearing Problems	Having	with functional limitation	7	3.5
		without functional limitation	8	4
	Not having		182	91
	Not Response		3	1.5
Speech & Language Disorders	Having	with functional limitation	73	36.5
		without functional limitation	21	10.5
	Not having		95	47.5
	Not Response		11	5.5
Epileptic Disorders	Having	with functional limitation	17	8.5
		without functional limitation	17	8.5
	Not having		157	78.5
	Not Response		9	4.5
Voiding Incontinence	Having	with functional limitation	37	18.5
		without functional limitation	7	3.5
	Not having		145	72.5
	Not Response		11	5.5
Deification Incontinence	Having	with functional limitation	36	18
		without functional limitation	9	4.5
	Not having		143	71.5
	Not Response		12	6

Table 4. Motor types and topographical distribution in 200 children with cerebral palsy in Tehran. For each motor type/topographic pattern, the frequency and percentage are shown within each GMFCS level and each type.

Motor type/topographic pattern		GMFCS					Total *n* (%)
		I	II	III	IV	V	
Hypertonia Spastic							
Unilateral Spastic	In Total/ *n* (%)	12(33.3)	16(44.6)	0(0)	6(16.7)	2(5.6)	36(18)
	In Type(%)	33.3	44.4	0	16.7	5.6	100
Bilateral Spastic	In Total/ *n* (%)	4(3.2)	23(18.4)	25(20)	42(33.6)	31(24.8)	125(62.5)
	In Type(%)	3.2	18.4	20	33.6	24.8	100
Dyskinesia	In Total/ *n* (%)	2(14.3)	2(14.3)	0(0)	6(42.9)	4(28.6)	14(7)
	In Type(%)	14.3	14.3	0	42.9	28.6	100
Unclassified	In Total/ *n* (%)	2(9.1)	3(6.1)	4(12.9)	6(9.8)	0(0)	15(7.5)

Motor type/topographic pattern		GMFCS					Total *n* (%)
		I	II	III	IV	V	
Ataxia	In Type(%)	13.3	20	26.7	40	0	100
	In Total/ *n* (%)	2(9.1)	5(10.2)	2(6.5)	1(1.6)	0(0)	10(5)
	In Type(%)	20	50	20	10	0	100
Total /Level	***n* (%)**	38(19)	38(19)	40(20)	46(23)	38(19)	200 (100)

Table 5. The distribution of motor types and topographical distribution in 200 children with cerebral palsy in Tehran. For each motor type/topographic pattern, the frequency and percentage are shown within each MACS level and each type

Motor type/topographic pattern		MACS					Total *n* (%)
		I	II	III	IV	V	
		Hypertonia Spastic					
Unilateral Spastic	In Total ***n* (%)**	11 (28.9)	7 (18.4)	11 (27.5)	5 (10.9)	2 (5.3)	36 (18)
	In Type(%)	30.6	19.4	30.6	13.9	5.6	100
Bilateral Spastic	In Total *n* (%)	21 (55.3)	21 (55.3)	22 (55)	31(67.4)	30(78.9)	125 (62.5)
	In Type(%)	16.8	16.8	17.6	24.8	24	100
Dyskinesia	In Total *n* (%)	0(0)	3(7.9)	1 (2.5)	5 (10.9)	5 (13.2)	14 (7)
	In Type(%)	0	21.4	7.1	35.7	35.7	100
Unclassified	In Total *n* (%)	2 (5.3)	2(5.3)	5(12.5)	5 (10.9)	1 (2.6)	15 (7.5)
	In Type(%)	13.3	13.3	33.3	33.3	6.7	100
Ataxia	In Total *n* (%)	4 (10.5)	5 (13.2)	1 (2.5)	0 (0)	0 (0)	10 (5)
	In Type(%)	40	50	10	0	0	100
Total	***N* (%)**	38 (19)	38 (19)	40 (20)	46 (23)	38 (19)	200 (100)

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