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Chapter 2

Assessments and Outcome Measures of Cerebral Palsy

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Additional information is available at the end of the chapter

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Abstract

In cerebral palsy (CP), numerous primary problems are observed including muscle tone problems, muscle weakness, insufficient selective motor control, postural control, and balance problems. In the persistence of these problems for a long period, secondary problems including torsional deformities, joint contractures, scoliosis, and hip dysplasia can occur in time, and strategies formed by children to cope with these problems make up the tertiary problems. Hence, the most accurate and brief assessment of all of these problems mentioned above is crucial to determine an effective and precise physiotherapy program. In the assessment of children with CP, it is very important to receive a detailed story consisting of the birth story, to question underlying medical situations and to carry out physical assessment. In clinics, gross motor function, muscle tone, muscle length, muscle strength, and joint range of motion assessments are the most preferred ones.

Keywords: cerebral palsy, assessment, measurement, evaluation, physiotherapy

1. Introduction

Multidimensional assessment in cerebral palsy (CP) is very important for the determination of the fundamental problems of children, to select the most appropriate therapy approaches for these problems and to reveal the changes occurring during time with the therapy. The assessment should provide information on the primary, secondary, and tertiary problems, functional capacity of the children, and the expectations of the children and families. Although various scales and tests prepared for children with CP can be used, observation, photographs, video records, or computer-supported complicated assessment methods can be used as well.

While selecting the outcome measures, psychometric properties should be considered; however, there is no clear information about how the outcome measures will be selected to

reveal the function and health of children ideally [1]. In the selection of the assessment methods, it may be beneficial to consider the dimensions of the International Classification of Functioning, Disability and Health Child and Youth Version (ICF-CY) [2], which is a classification system established by World Health Organization (WHO). When considered in the ICF-CY framework, there are instruments assessing body structures and functions such as problems of muscle tone, muscle strength, and selective motor control; instruments assessing activities and participation such as activities of daily life (ADL) and quality of life; and instruments assessing environmental factors such as impact of the family or the environment. Among these tools, the mostly required ones should be determined for the children. This way, a general opinion can be gathered about the children without much detail. Furthermore, the concerned physicians can examine ultrasound, magnetic resonance (MR), or radiographs as a part of neurologic or orthopedic examination and their results can be combined with the physiotherapy assessments. All of these assessments are crucial not only for establishing a physiotherapy program or to determine the efficiency of the program but also for clarifying the surgical or medical interventions that need to be carried out for the children.

In this chapter, the assessment methods most frequently used by physiotherapists for children with CP are discussed.

2. History and observation

Detailed information should be received from the family or caretakers in all issues related to the children including family history, prenatal, natal and postnatal period, chronologic and corrected age, other accompanying problems, developmental story, adaptive equipment used, therapy approaches applied, medication taken, and educational status of the family [3, 4].

Observational analysis is crucial to determine children's functional skills, spontaneous motions and motion strategies, and the underlying fundamental problems. Thus, it can be decided in which field detailed assessment needs to be carried out. Observational analysis prepared by a specialized physiotherapist completes the standardized tests. During observational analysis, children must be in a setting they can be with their family, and they can feel comfortable and safe. There should be various toys and materials in the setting to reveal the children's capacity and to draw their attention. The assessment room should not be crowded and noisy [3]. Observations provide a general idea to physiotherapists about the general state of the children, quality of movements, capacity and motor strategies developed by the children, protective reactions, and upper and lower extremity functions. Video recordings during observation are rather beneficial as well.

3. Assessment of reflexes and reactions

Observation of reflexes is important to illustrate the severity of the influence in the nervous system, and observation of balance and protective reactions is important to support motor

developmental process. When these assessments are carried out, the corrected age of the children should be considered. It is known that primitive reflexes continue insistently or disappear later than normal or never occur in children with CP [5]. It can be observed that symmetric tonic and asymmetric tonic neck reflexes still continue in adolescent stage in a case diagnosed with dyskinetic-type CP. Insistence of these reflexes can complicate the therapy. It may be necessary to make various adaptations in the treatment program when the primitive reflexes continue in advanced ages. For example, in a case whose asymmetric tonic neck reflexes continues, orientation of the head and extremities in the midline may be the fundamental target of the therapy. At the same time, the assessment of protective reactions is important for determining a treatment program.

4. Assessment of functional level and motor development

Although CP is a nonprogressive central nervous system problem, emerging physical impairment and functional limitations change with the therapy approaches applied to the children during growth and with the effect of the environmental conditions. It is crucial to assess motor development, functional skills, and activity limitations for determining the current state of the children, and there are frequently used test batteries for this purpose. Gross Motor Function Measurement (GMFM) [6] is a standardized measurement instrument frequently used to measure the change in gross motor function. This tool consists of five different dimensions, and all skills of the children during supine/prone position, sitting, crawling, standing up, and walking are assessed in detail. GMFM, with versions consisting of 88 items and 66 items, is accepted worldwide. Items 48 and 50 from GMFM 88 version are shown in **Figures 1** and **2**.

Figure 1. GMFM-88, Item 48.

Figure 2. GMFM-88, Item 50.

Gross Motor Function Classification System [7] is the most frequently used classification system interdisciplinary and intradisciplinary to define motor level in children with CP. This classification system categorizes the functional skills of children during their daily life under five levels. In addition, for assessing functional level and motor development various scales are used as well including *Activities Scale for Kids [8], Child Health Questionnaire [9], Gillette Functional Assessment Questionnaire [10], Functional Mobility Scale [11], Pediatric Evaluation of Disability Inventory [12], Pediatric Outcomes Data Collection Instrument [13], and Functional Independence Measure for Children [14].*

5. Assessment of muscle tone

Spastic type is the most common one among CP types. Therefore, spasticity is the major problem encountered most frequently by pediatric physiotherapists. Spasticity makes the voluntary and selective motor control more difficult, increases energy consumption, and causes the formation of secondary musculoskeletal system problems observed in CP [15]. Various physiotherapy methods can be effective in mild tone problems; however, medical or surgical interventions are needed for severe increase in tone persisting for a long time. In this context, it is crucial to determine the changes occurred in muscle tone.

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The most affected muscles from spasticity in children with CP are gastroc-soleus, hamstrings, rectus femoris, hip adductors and psoas in lower extremities, and shoulder external rotators, elbow, wrist and finger flexors, and forearm pronators in upper extremities [16].

There are various clinical scales, biomechanical assessment tools, and neurophysiologic assessment methods to assess spasticity; however, there is no consensus about the best assessment. The most frequently used clinical scales are *Ashworth/Modified Ashworth (MAS) and Tardieu/Modified Tardieu (MTS)* scales. MTS grades muscle spasticity in three different velocities and goniometric measurements also included for all velocities [17, 18]. According to a study by Numanoğlu et al. [19], the administration of MAS is easier and takes less time than MTS, but MTS gives valuable information about muscle length and dynamic contracture and has better intraobserver reliability [19]. Assessment of knee flexor muscle spasticity with MTS is shown in **Figure 3**.

Figure 3. Assessment of knee flexor spasticity with MTS.

In addition to these, there are scales such as *Spasticity Grading, Modified Composite Spasticity Index, Duncan Ely Test, New York University Tone Scale, and the Hypertonia Assessment Tool* [20–22].

Myotonometer, sensors, Wartenberg Pendulum Test, dynamometer, goniometric measurement, and robot-supported assessment instruments are used as biomechanical assessment tools [21, 23–27]. In the neurophysiologic assessment of spasticity, Hoffman H reflex occurring with low-threshold electric stimulation, tendon reflex occurring with tendon tap, and M-wave generated by high-intensity stimulation of peripheral nerve are used. However, overlapping of the values of healthy muscles with those of spastic muscles decreases the diagnostic value

of these measurements. Furthermore, electromyography methods are also used in spasticity assessment [21, 28–30].

In the long term spasticity; intrinsic structure of the muscles changes and this leads to muscle stiffness. In a study, an increase in the extracellular matrix collagen density of muscle fiber bundle in spastic hamstrings was reported to be the reason for an increased passive stiffness of muscle, and indicated that this situation can develop even before 3 years of age in children with CP [31–33]. From this perspective, it is important to assess not only neural mechanisms of hypertonus but also nonneural mechanism. In recent years, elastography is benefited in the assessment of muscle stiffness in children with CP [34, 35].

In addition to tone increase in children with CP, hypotonia and muscle fluctuations are observed as well. There are tools to assess dystonia such as *the Burke-Fahn-Marsden Rating Scale [36]* and *Unified Dystonia Rating Scale* [37]. There is no tool used routinely by the clinicians to assess hypotonia; it is generally categorized as mild, moderate, and severe.

6. Assessment of muscle strength

One of the primary problems observed in CP is muscle weakness. This situation occurs due to reasons including central nervous system impairment, inactivation, learned nonuse, and inadequate selective motor control. Muscle weakness can be observed in all subtypes of CP, and it is seen that muscular forces of children with CP are less than those of their peers who developed typically. Moreover, children with CP have slower sequential force generation in force application and have influenced motor planning [38, 39].

Many publications show that strength trainings improve functional capacity without causing any problems in children with CP [40, 41]. In this respect, assessment of muscular force is significant.

Muscular force can be assessed as isometric, isotonic, and isokinetic. For muscle strength assessment, the patients should cooperate with the assessor and the target muscle group must contract maximum; however, it could become difficult due to increased co-contractions in agonist-antagonists and due to cognitive limitations [42]. In the assessment of muscular force, manual muscle testing, testing with handheld dynamometer, and isokinetic dynamometer or the measurement of maximum repetition of functional exercises are used frequently [43].

Usage of handheld dynamometers is suggested in the assessment of upper extremity and lower extremity isometric muscular force and grasping in children with CP [43–46]. A systematic review about this issue suggested that Jamar dynamometer can be used to measure grasping force and handheld dynamometer can be used to measure the force of other upper extremity muscles. It is also reported that manual muscle testing can be used to measure the total upper extremity force or hand wrist force in children who have very limited muscular force [47].

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7. Assessment of musculoskeletal system deformities

Children with CP are prone to develop musculoskeletal system deformities. In addition to the major problems generated by central nervous system lesion in CP, secondary problems also exist. The development of musculoskeletal system in children with CP can be affected negatively due to the reasons including muscle weakness, postural problems, and muscle tone problems [50]. Musculoskeletal system should be assessed in detail to detect and to prevent from deformities at an early stage. For this purpose, various measurements should be made such as the measurement of muscular force, range of motion, extremity length, and muscle length.

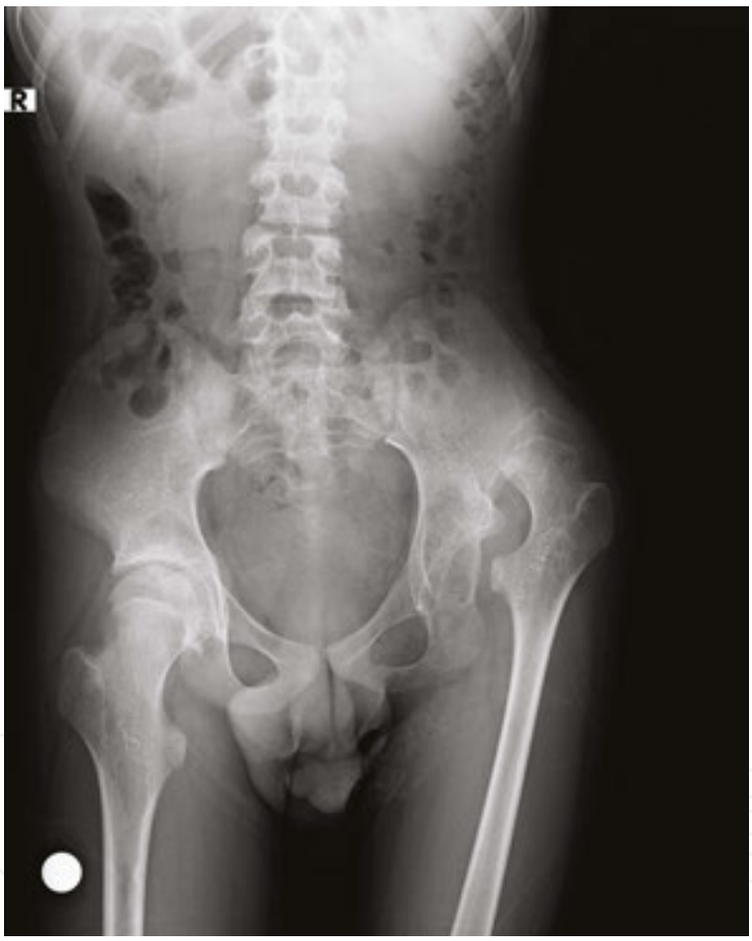

Figure 4. X-ray of a child with quadriparetic CP, age 13, GMFCS Level 5.

Numerous problems concerned with hips can occur in individuals with CP related to aging. Many children with CP are born with a healthy hip; however, scores of problems cause insufficiencies in femur and acetabulum development. These problems are physical inactivity, severe mental retardation, flexion and adduction contractures, pelvic obliquity, sitting in "W" position, excessive tone increase in hip flexor, adductor, and internal rotator muscles, muscular imbalance, and insufficiency in weight bearing [48–50]. Coxavalga, increased femoral ante-

version, and acetabular dysplasia are the major problems of hip. Hip subluxation rate in CP is reported to be 75% [51, 52]. Walking ability is the key point in the development of hip problems. Dynamic compressive forces generated during walking are required for the development of the required depth in acetabulum [53]. Hemiparetic and diparetic children, who could walk independently at the age of 30 months, have the lowest risk for hip dislocation [54]. Hip subluxation was reported to be 11% in ambulatory children and 57% in nonambulatory children [49]. Deterioration of motor level affects hip development directly; it was reported that there was 90% hip displacement in children at GMFCS level V [55]. In **Figure 4**, hip X-ray of a 13-year-old child with quadriparetic CP, who was classified in GMFCS level 5, is shown.

Hip surveillance is important for the determination of hip dislocation. Routine radiographic hip assessment is one of the most significant parts of hip follow-up. It was reported that imaging as a part of orthopedic assessment should be carried out at 12–18 months and should be repeated every 6 months [56]. Reimer's Migration Percentage and acetabular index are assessments suggested for radiologic hip monitoring [54]. Children whose Reimer's Migration Percentage is greater than 33% or whose acetabular index is greater than 30% are at risk and they should be monitored closely [48, 54, 57]. For hip surveillance, the hip abduction range of motion at flexion and extension position, presence of contractures, pelvic obliquity, femoral anteversion angle, and spinal deformities should also be assessed [49].

8. Assessment of physical fitness

Due to physical impairments, individuals with CP have more reduced physical fitness in comparison to their peers who develop typically. Tone disorders, muscle weakness, emotional problems, and unfavorable environmental conditions push individuals with CP to move much less in comparison to their peers during the day and to develop sedentary lifestyle [58]. These risks increase in children who are affected bilaterally or have low GMFCS level. In a study conducted on this matter, it was reported that individuals with CP engage in physical activities 13–53% less in comparison to their peers who developed typically and the time spent sedentarily is twofolds higher than that suggested normally [59]. As the age advances, this situation becomes more serious due to the occurrence of musculoskeletal system deformities and the increase of body weight. Because of the abovementioned reasons, children with CP may face many undesired health conditions such as metabolic dysfunction, cardiovascular illness, and decrease in bone mineral density. There are various measurement methods used to assess physical activity. Maintaining an activity journal may help the assessment. Many surveys such as *Activity Scales for Kids [60], Physical Activity Questionnaire for Adolescents [61], Children's Assessment of Participation and Enjoyment [62], Canada Fitness Survey [63], and the Early Activity Scale for Endurance [64]* are benefited for this purpose [65, 66].

General physical endurance can be assessed by a *6-Min Walk Test* [67, 68]. In addition to the surveys, equipment such as step counters, heart rate meters, and accelerometers can be used or more complicated assessment methods such as The Doubly Labelled Water Technique can be applied [69, 70].

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9. Assessment of gait

Ensuring independent locomotion is one of the basic goals of many physiotherapists and families of children with CP. Children with unilateral CP almost always develop independent locomotion; however, a part of children with bilateral CP walk independently, some of them walk with aids, and some cannot achieve this function during their lifetime. Numerous gait problems such as equinus, crouch gait, jump gait, and scissoring gait are observed in children with CP who can walk independently.

Gait assessment can be used as an outcome measure to determine the reason of the problem in children and to determine the effects of the interventions [71].

Gait assessment in children with CP can be made by observational gait scale-combined video records, time-distance characteristics, and instrumented gait analyses. Instrumented gait analyses made by measuring electromyography activity, three-dimensional joint kinetic, and kinematic values in laboratory setting present an objective assessment of the patients; however, they are not appropriate for routine clinical purposes. These systems require trained personnel, appropriate setting and the evaluation and interpretation of the results lasts for 3–6 h. In this context, observational gait assessment emerges as an important and useful tool for clinicians. Simple gait scales can be used to determine the quantity of the changes in gait pattern, and deviations from normal gait in the stance and swing phases. In these assessments, clinicians record the walking pattern by video and evaluate walking abnormalities in different joints and planes according to the existing scales. Furthermore, there are computer-supported video analysis programs to be used for this purpose. Among the observational gait assessment tools, there are *Gillette Functional Assessment Questionnaire [10], Physician Rating Scale [72], Observational Gait Scale [73], Visual Gait Score, Salford Gait Tool, Edinburgh Visual Gait Scale [74], Observational Gait Analysis, and Visual Gait Assessment Scale* [71, 75]. According to Günel et al., GMFM's gait domain can also be used as a gait assessment [76]. Among these gait scales, *Edinburgh Visual Gait Scale* is suggested because it consists of information in each of the three planes for foot, knee, hip, pelvis, and trunk for both stance and swing phases and have good reliability and concurrent validity. It is reported that any of these scales is not equivalent to instrumented gait analyses [71].

10. Assessment of balance

Muscle tone impairments and abnormal postural control in children with CP affect balance capacity negatively. It is known that static and dynamic balance reactions of children with CP are insufficient when compared with their normally developed peers [77]. *Pediatric Reach Test [78], Pediatric Balance Scale [79], Timed Up and Go Test [80], Pediatric Clinical Test of Sensory Interaction for Balance [81], Heel-to-Toe Stand, Timed One-Leg Stance, and Timed Up and Down Stairs* are frequently used balance assessments in children with CP. Special equipment such as *Wii-Fit* and *Biodex Balance System* can be benefited as well [82–84].

11. Assessment of trunk impairment

Problems concerned with the trunk are observed frequently in children with CP and these problems affect both upper and lower extremity functions negatively. There are different methods for assessment of the trunk impairment. Assessment of postural control at the sitting position can be used to determine the weakness of the trunk muscles. Moreover, the affected trunk control leads to insufficient balance and therefore instruments assessing postural control and balance during sitting can be benefited to assess the trunk impairment [85].

In the literature, there are limited number of instruments providing information about postural control during sitting and most of the measurements are developed for adults [86]. Some of the scales that could be used to assess trunk impairment in children with CP are listed below:

- *Spinal Alignment and Range-of-Motion Measure* assessing spinal alignment and range of motion [87].
- *Segmental Assessment of Trunk Control* assessing static, active, and reactive sitting balance and control level [88].
- *Seated Postural Control Measure* assessing sitting function and alignment [89].
- *Trunk Control Measurement Scale (TCMS)* assessing static and dynamic sitting balance and dynamic reaching [90].
- *Level of Sitting Scale* classifying sitting ability [91].
- *Assessment & Coding of Postural and Behavioral Observations* assessing head control during sitting, grasping, reaching, eating, and drinking activities [92].
- *Sitting Assessment for Children with Neuromotor Dysfunction* assessing static and dynamic postural control during sitting [93].
- *Seated Posture Control Measurement* assessing postural alignment [94].
- *Sitting Assessment Scale* assessing sitting posture and control with video records [95].
- *Chailey Levels of Ability* assessing sitting, reaching, and standing ability [96].
- *Trunk Impairment Scale* assessing static and dynamic sitting balance of trunk coordination [97, 98].

Furthermore, scales such as *Pediatric Balance Scale, Pediatric Reach Test, Modified Posture Assessment Scale, and Gross Motor Function Measurement* provides information about the trunk although they do not assess trunk impairment directly [78, 84, 86, 99].

Among the scales indicated above, Trunk Control Measurement Scale (TCMS) [90] can be preferred because it has good inter-rater reliability, does not require equipment other than simple materials such as a measuring tape and a ruler, does not require researcher training, and can be used easily in clinical setting. Item 8 of TCMS is shown in **Figures 5** and **6** [84, 86, 100].

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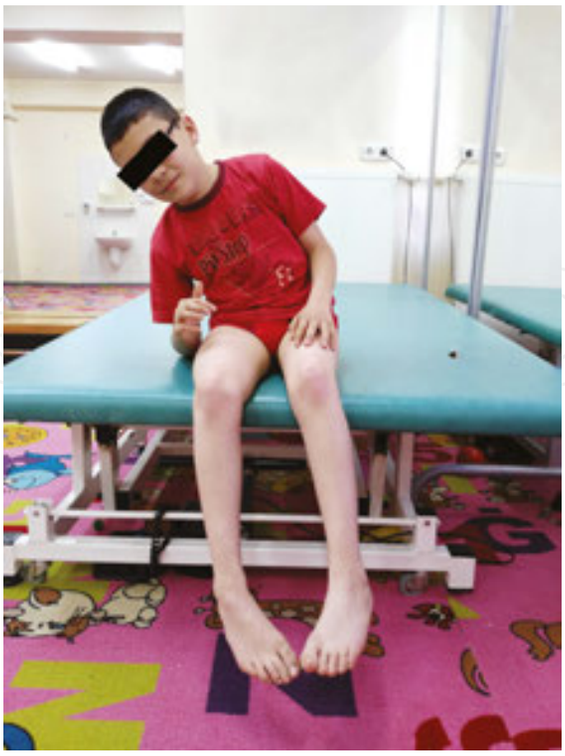

Figure 5. TCMS, Item 8.

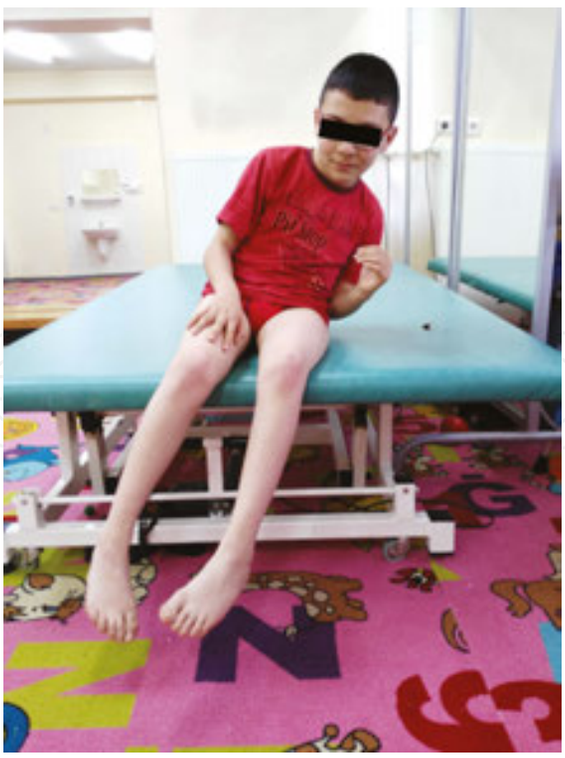

Figure 6. TCMS, Item 8.

12. Assessment of health-related quality of life

Although motor function problems are the major problems in children with CP, with the accompanying sensory, cognitive, and mental problems, activities of daily life and functional independence of the children are influenced as well. Not only children but those of the individuals taking care of them are also affected negatively. It was reported that children with CP experience emotional and behavioral problems fourfolds more than their peers. Quality of life should be self-reported by the person if possible due to its personal nature. However, this may not be possible in children with CP who have severe cognitive impairment; therefore, surveys assessing quality of life need to be answered by family or caretakers [101–103]. Surveys answered by families are used more in children who are under 18 years of age and have difficulty in communication. For children who have no communication problem and can express themselves, child reports should be used. For this purpose, questionnaires such as *Pediatric Outcomes Data Collection Instrument and Child Health Questionnaire [13]* are the most used ones. *Child Health Questionnaire-Parent Form 50 [9], Lifestyle Assessment Questionnaire [104], KIDSCREEN [105], Cerebral Palsy Quality of Life-Child, the Caregiver Priorities and Child Health Index of Life with Disabilities [106], the Pediatric Quality-of-life Inventory CP Module [107], and the DISABKIDS CP Module [108]* that are scored by families are used. According to a systematic review, for children with CP who are at school age, Cerebral Palsy Quality of Life-Child Survey is recommended due to its strongest psychometric properties and clinical utility [3, 101, 109–111].

13. Assessment of activities of daily life

Activities of daily life (ADL) are vital tasks of persons in their school, home, and social environment. According to ICF-CY, these activities are included in the Activity and Participation dimension, including activities such as personal care, nutrition, cleaning, etc. Motor, sensory, perception, cognition, communication, and behavioral problems existing in children with CP can affect ADL performance [112]. Children with CP have difficulty in performing activities of daily life and generally need adaptive equipment or family assistance. Therefore, activities of daily life should be assessed and attempts should be made to develop these activities. According to a systematic review, ADL scales that could be used in children with CP at the age of 5–18 are *ABILHAND-Kids [113], Assessment of Motor and Process Skills [114], Children's Hand-use Experience Questionnaire [115], Klein-Bell Activities of Daily Living [116], Functional Independence Measure for Children [14], Pediatric Evaluation of Disability Inventory [12], School Function Assessment, and Vineland Adaptive Behavior Scales [117]*. Among these scales, *Pediatric Evaluation of Disability Inventory* was reported to be the best assessment instrument for children at an elementary school age because of its psychometric properties and personal ADL items. *Children's Hand-use Experience Questionnaire, Vineland Adaptive Behavior Scale, and Functional Independence Measure for Children* were reported to be appropriate for adolescent age. *Assessment of Motor and Process Skills* scale was reported to be the best scale assessing ADL in adolescent children with CP regardless of age [112].

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14. Assessments of upper extremity

The upper extremity problems are observed in children with unilateral or bilateral CP but these problems can be more important for the children with unilateral involvement because the lower extremity functions are managed in this group more easily.

Motor planning, sensory motor integration, and bimanual coordination problems are observed frequently in the upper extremities *[118]. Manual Ability Classification System (MACS) [119]* classifying the upper extremity function at five levels is used frequently. This system examines the bilateral skills of the extremities during daily life activities. *Assisting Hand Assessment* scale [120] assesses the use of the affected extremity during bilateral activities. Many different scales such as *Melbourne Assessment of Unilateral Upper Limb Function [121], Jebsen Taylor Hand Function Test [122], Zancolli Hand Deformity Classification, Shriners Hospital Upper Extremity Evaluation [123], Upper Extremity Rating Scale, ABILHAND-Kids Questionnaire [113], Bimanual Fine Motor Function, the Quality of Upper Extremity Skills Test [124], and the Canadian Occupational Performance Measure [125]* are used to assess the upper extremity function in children with CP [126]. Two items from *the Quality of Upper Extremity Skills Test* are shown in **Figures 7** and **8**. Also, musculoskeletal evaluation methods, which are mentioned above, can be specified for upper extremities.

Figure 7. An item from *The Quality of Upper Extremity Skills Test*.

A systematic review reported that any of the scales listed above did not reveal all ICF dimensions in detail on their own and different assessment methods should be combined to assess the upper extremity performance and function in children with CP [127].

Figure 8. An item from *The Quality of Upper Extremity Skills Test*.

15. Infant assessment

Today, the number of preterm and low birth weight infants is increasing gradually. These infants can present motor impairment findings ranging from developmental coordination disorder to CP in the later stages of development [128]. It may be necessary to wait until 2–3 years of age to diagnose with CP in many countries. In a study conducted in Denmark, it was reported that although CP diagnosis was made at month 11 on an average, the children were not recorded in CP registry system until 4–6 years old for finalizing that the situation is not progressive [129].

However, prior to diagnosis, various assessments should be carried out and motor development should be monitored in especially risky groups. It is suggested that age-appropriate neuromotor assessments of infants with low birth weight and premature infants are made during the first year of life [130]. These assessments are crucial to ensure the differentiation of the infants with motor dysfunction and typically developing, to predict which infants will have motor influence in the future by considering their current performance and to determine the changes occurring in time [131]. Therapy approaches give the best results at this stage when brain development continues rapidly. In this context, infant neuromotor assessments are made to determine infants with motor impairment and to start the early intervention program promptly.

The commonly used assessment instruments for this purpose were reported as *Alberta Infant Motor Scale (AIMS) [132], Bayley Scale of Infant and Toddler Development [133], Peabody Developmental Motor Scales [134], Denver Developmental Screening Test [135], Prechtl's Assessment of*

General Movements (GMs) [136], Motion Assessment of Infants, Test of Infant Motor Performance (TIMP) [137], Infant Motor Profile [138], and the Neurological Sensory Motor Developmental Assessment (NSMDA) [139] [5, 131].

Among these assessment methods, some of them such as GMs assess spontaneous movements of infants without any handling and some scales assess both spontaneous behavior and motor behavior occurring with minimal handling. Only TIMP and GMs among the abovementioned tests are appropriate to be used before the term stage. In a systematic review, it was reported that GMs have the best predictive validity for CP during the early infancy stage and AIMS and NSMDA are the best scales for motor development prediction in the later months. The authors of this review suggest that more than one scale should be used in infants. They discuss that the utilization of GMS and TIMP in the preterm phase and their use along with AIMS and NDSMA will give best results in terms of predictive, discriminative, and evaluative assessments. Better results can be obtained with the repetition of the assessments in infants in certain intervals [131].

16. Other assessment methods

In addition to all of these assessments discussed above, it may be necessary to assess other accompanying problems as well. Sleep quality in children with CP can be assessed with *Children's Sleep Habits Questionnaire [140]*, global mental functions can be assessed with *Leiter International Performance Scale [141]*, global psychosocial functions with *Self-perception Profile for Children and Self-perception Profile for Adolescents [142]*, attention functions with *Behaviour Rating Inventory of Executive Function [143]*, communication skills with *Preschool Language Scale [144] and Communication Function Classification System [145]*, voluntary motion control with *Selective Control Assessment of the Lower Extremity [146]*, eating and drinking function with *Eating and Drinking Ability Classification System [147]*, and saliva control can be assessed with *Drool Severity Score* [145].

Pain is one of the frequently observed problems in especially advanced ages in children with CP; scores of factors can be discussed causing pain such as contractures, hip dislocation, patella alta, equines deformity, dysphagia, gastroesophageal reflux, gastrointestinal tube feeding, and constipation. Also, pain can develop originating from the used adaptive equipment and orthosis or as a result of physiotherapy, serial casting, and surgical interventions. Whereas information about pain can be assessed simply by asking the children and families or can be assessed with scales such as *Non-Communicating Children's Pain Checklist [148] and Pediatric Pain Profile (PPP)* [149]. For children who have communication problems, parent proxy reports can be used. However, monitoring of findings including spontaneous motions, facial expression, breathing pattern, sweating, or blushing also provides opinion about pain.

Children with CP have numerous motor, sensorial, and behavioral problems as discussed in detail above. Moreover, these problems may give different findings along with growth. Application of protective methods is necessary before the generation of many problems. In this sense, assessments are crucial. The current state of children and changes occurred with

treatments can be observed in detail when the most appropriate assessment is selected from the assessments discussed above by considering ICF dimensions. Thus, both body structure and functions and activity and participation of children with CP can be improved, and inclusion of them in a society as healthier and happier individuals can be assisted.

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